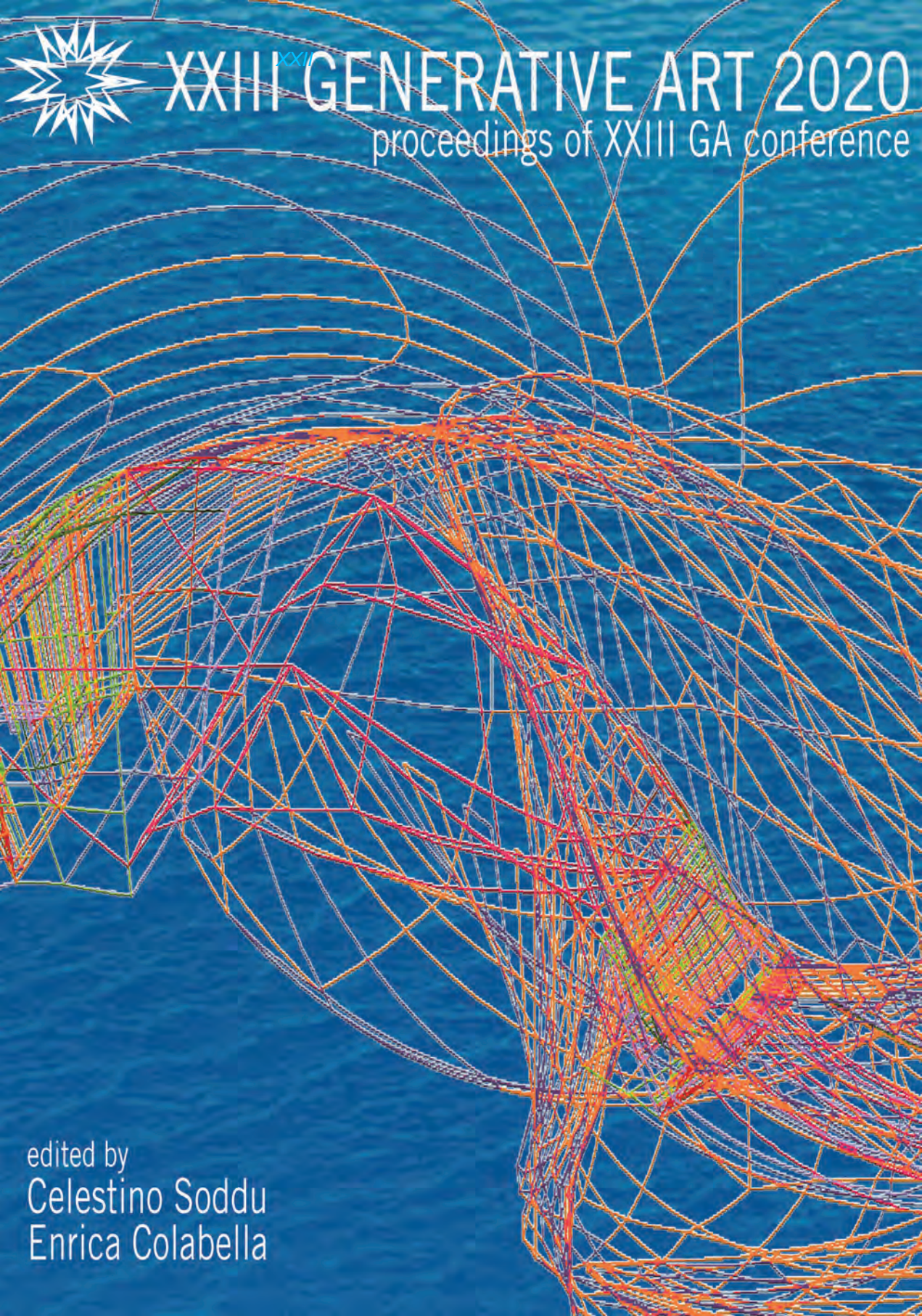

XXIII GENERATIVE ART 2020
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Celestino Soddu
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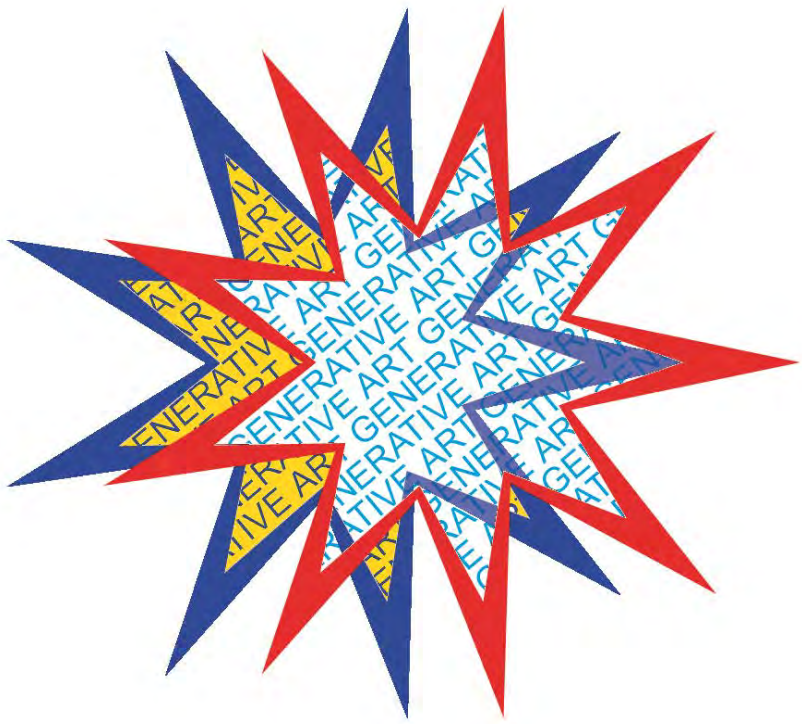
The book contains the papers, installations, posters, artworks and live performances presented at XXIII Generative Art virtual conference in Milan, Italy.

In the cover an anamorphic 360 degree perspective of a generated event and in the section titles, frescos by Piero della Francesca.

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Edited by Celestino Soddu and Enrica Colabella

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OPENING XXIII GENERATIVE ART CONFERENCE

"Rarely have philosophy and science been able to say less about our condition than they do today. This dry desert of rationality is called nihilism. It is our tragedy"
Jean-Luc Marion,

In this particular moment, with everything that is changing in our lives because of the pandemic, there is a need for a "great reset" that is interpreted in very different ways according to different points of view.
What these hypotheses of renewal have in any case in common is the need to rediscover individual vision and dignity.
After thirty years of nihilism, following only an objective logic of problem-solving, we moved towards the use of artificial intelligence in Art, Design, Music, and Architecture.
Now, the need to rediscover and re-evaluate the individual with different points of view is growing. It is opposing indiscriminate globalization that has generated a flattening of the cultural and personal values of a humanistic vision.
Generative Art, and its close relationship with science, has allowed us to develop the identity for rediscovering a new poetic vision of our time.
The Renaissance tradition, and particularly Piero della Francesca, repurpose to us, through the logical evaluation of the subjective point of view, the access to the complexity in Art, rediscovering Wonder, and Invention.
Creativity in generating events presupposes a poetic logic built through original algorithms, therefore identifiable and recognizable. On the other hand, now a lot of especially young people work with the last innovative technologies by making excessive use of commercial programs and random as a generator of "new" forms. In this way, the goal of achieving the recognition of the events generated as a representation of a specific subjective point of view is missing.
In these 23 years of meetings on Generative Art we have always preferred the possibility of communicating various approaches and different ways of conceiving creativity through the use of digital tools, and not only. This for an opening to a vision of Art more humanistic too and not only technological. The constant of the proposals presented has always been the experimentation on the concept of generation, and this common approach has allowed us to open very fruitful discussions on our common field of interest, Generative Art.
Technologies are rediscovered not as autonomous tools to be adapted to, but as tools at the service of man to be used for the invention.
In these last times, a new generative iter inside the numerous available technologies and the possibility to interact in different ways with them, has led to accelerating the subjective specificity of each proposal. This had detached us more and more from the indiscriminate use of pre-packaged programs where creativity was confined and globalized.
The current moment has also widened the fields of interest, more and more attentive to the green shift that is looming as indispensable and that can provide, too, a key of interpreting the possible identities and specificities to be safeguarded, as nature teaches us. Nature becomes again the main aim of our discovering processes for the quality of our life. This is a natural dress that directs our actions, our creativity towards the uniqueness of each one

for designing Art as the science of invention.
Generative Art enhances these potentialities by building a common ground of response to new emerging needs.

Celestino Soddu and Enrica Colabella
Chairs of Generative Art annual conferences since 1998

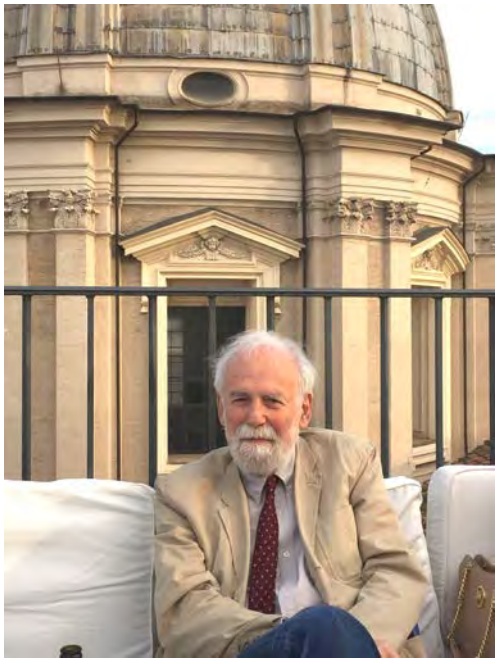




PAPERS

GENERATIVE DESIGN, a possibility to teach design by improving students' creativity and their subjective vision

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Celestino Soddu

PREMISE
Teaching to design is a discipline that is still at the center of a very heated debate. The main references are still based on Vitruvius and Bauhaus.
Since the mid 80's, in the wake of the work done to develop the generative software ARGENIA created to manage generations of urban, architectural, and industrial design events, I realized that I had identified also a logical approach to design events. These works always are different but recognizable for belonging to a subjective idea. But what I consider highly innovative and surprising is the fact that, together with Enrica Colabella, I used this generative approach in design teaching by developing a new discipline, which we have called Generative Design. This approach has achieved some of the primary objectives of teaching design, regardless of the practical tools, computer or not, that everyone can use.
The results have been extremely positive. This has been confirmed too by the students themselves, once they entered the world of work. They thank us too for the contribution we have given them in the ability to manage design processes and in improving, in progress, the quality of their design work making it more and more in tune with their identity as architects and designers.

ABSTRACT
The specificity of the generative software that I developed is to have organized the design path starting from the subjectivity of the idea and vision.
The basic reference of this approach to design is Piero della Francesca. Although he was Leonardo da Vinci's main reference for mathematics and geometry,

Piero has only recently been re-evaluated thanks to the books by Eugenio Battisti. The discovery of a geometrical logic that Piero developed and systematized to represent the world in perspective, radically changes the approach taken until that moment in the logical design processes. These were, and still are today, largely based on the collection and analysis of objective data and their cataloging, following what was systematized by Vitruvius in his ten books on architecture.
The passage from "objective" representations to perspective highlights the potentiality of the *point of view,* of subjective vision. ***Perspective is an open door to complexity***.
The subjectivity of the point of view can also represent infinity, unlike non-perspective representations, like axonometric drawing, which is limited even if more easily measurable and analyzable.
Based on these possibilities, the generative software ARGENIA is a progressive tale of subjective discovery in design. The algorithms written for this software tell, through the progression of explicit logics, the non-linear dynamic system of a subjective path that starts from the representation of the idea to the realization of a project. The fields of interest are architectural, the urban, scale of the object, or evolution of art as Picasso and Bacon.
Today, unfortunately, most of the theories on design are still only related to the Vitruvian structure of objective cataloging and are not able to logically support the design path that is based on the dynamics of non-linear systems and the unpredictability of the architect's subjective uniqueness.
This is reflected in the didactics of the project. The traditional approach has difficulties to interact with the students on the specifics of their logical process, it can only support their work with the analytical acquisition of typological and formal data from past experiences.
The past is not only data but can also be interpreted by the designer. This interpretation can follow the specific logic of research and design discovery.
The great teaching of the ability to interpret the past comes from Francesco Borromini, the greatest Baroque architect. He interpreted the classical canons not as forms but as a starting point for possible transformations. To work on transformations and not on forms is to follow the natural logical process of design.
Transforming is like working with algorithms that are the logical structure of the transformations themselves. This means not only abandoning shapes as a specific terrain of creativity but moving into the field of transformations. Not only that, but it also means abandoning the objective logic of typologies to adopt the creative potential of topology.
In this field, Palladio has given us great teaching. He used, in an explicit way, topological paradigms and not typological ones.
With the use of topological paradigms, he explicitly built a reference system for the development of the project that defines the construction of a suitable engine for the development of the project as a complex non-linear system. Rudolf Wittkower has systematized the structure of these Palladian topological paradigms that have contributed to the quality, uniqueness, and complexity of his architecture.

Instead, the use of typological references, as it was developed in the last century, has contributed to pushing the architectures to lose the ability to communicate an idea. This is the structure that supports the symbolic function of the relationships between events, such as the relationship between the outside and the inside, between the public and the private as it had been dominant since the Greek temples. In these ancient architectures, the topological paradigm defined the progressive discovery from outside to inside. It structured the relationships with the progressive passage from the sun of the outside, to the sun/shadow of the columns until the darkness of the sacred cell.
Many of the buildings built in the last century, but also some recent architecture, have lost this "sacredness". The functionality, so dear to an objective vision of the design approach, has also been diminished, losing the ability to identify the relationship between man and space, the logic underlying spatial sequences that facilitated not only practical use but also the existence of a symbolic functionality.

THE BIRTH OF GENERATIVE DESIGN AS A POSSIBLE DESIGN DISCIPLINE

At the end of the 1980s, once my generative software ARGENIA was not only operationally effective but had also developed through successive layers of complexity, I realized that its structure was an accurate and exhaustive account of the design process that stems from a subjective vision of the city, architecture and design objects. The design of this software had followed the path of the development of a project, telling explicitly, through dedicated algorithms, all the progressive steps that lead from a first sketch to the final project.
This progressive story of how the design logic is developed linked to an idea, to a subjective point of view, was transferable also to the teaching approach to design by expanding and making explicit and communicable the logical steps of the design path.
At this point, with Enrica Colabella who taught, like me, at the Politecnico di Milano, we wrote a book, "Il progetto ambientale di morfogenesi" *(English version: GENERATIVE ART & DESIGN Theory, Methodology, and Projects Celestino Soddu, Enrica Colabella. Free downloadable at https://www.artscience-ebookshop.com/GenerativeArtDesign.htm),* essentially dedicated to design students and their teachers. It retraced, theoretically and operationally, the path developed in generative software but also expanded it to make it didactically effective and such to pursuing the goals of teaching design.
This completely revolutionized what was the teaching of design, mainly based on re-proposing the "workshop", the "studio" of the architect where the teaching was not aimed at the construction of a possible cultural and design identity of each student designer, but it was based on his ability to repeat what the architect-professor did, his ideas. Moreover, these design courses were developed essentially on the acquisition of "Vitruvian" data such as the distributive characters of buildings, the morphological and typological structure of architecture, and the history of architecture. This was taught as the objective acquisition of categories of data and not associated with a logical interpretative path of growth

of the subjective identity of the student-designer.
We applied this approach not only in the teaching of design in our courses but also in the master theses, more than a hundred, that we followed together as tutors since the 1990s years. (www.generativism.com). The discussion of these theses allowed us to present and discuss this redefinition of the approach to design with colleagues from the master degree committees of the Faculty of Architecture of the Politecnico di Milano.
The path developed in generative software, with its algorithms that tell the logic of the construction of a project, had become an opportunity for a theoretical and practical redefinition of the discipline of design, both in the field of architecture and the city and industrial design. This disciplinary redefinition is based on the logic underlying the creative process. In other words, this approach structures the awareness of the progression of logic and a complex and non-linear dynamic system as it is, and should be the progressive procedure of design invention.
The basis of this approach is the interpretation, therefore the subjective evaluation of one's references and the creative choice to operate not in the direction of "discovering" new forms but to identify the logic of progressive transformation of forms by linking these dynamics to one's architectural vision. Not only that, the explicit expression of the designer's creativity, following Poincaré's definition of creativity, is proposed in the subjective identification of new relationships between events (topology) and not in the "discovery" of new forms.
We have called this disciplinary approach "Generative Design" and we founded the Generative Design Lab at Politecnico di Milano University. This "new" discipline has been included in the study program of the Faculty of Architecture, Engineering / Architecture, and Design of the Politecnico di Milano. It has also been exported to some universities abroad.

TEACHING THE DESIGN
The disciplinary hypothesis on which we have operated is based on the definition of certain purposes of design teaching:
1. To support the construction, in every designer, of his own design identity and make it operational and recognizable in the operational practice of the project.
2. To teach designers to read, interpret, and use operationally their cultural background and to build their imagery by interpreting the past to support specific design acts.
3. To build and structure, in progress, the quality of one's design in a conscious way, such that it can be increased and not lost in the progressive project opportunities.

Nodal elements of the discipline of generative design and its educational path are:
1. Identification of the characters of the identity in the progress of each student designer;
2. The inter-changeability of forms as a verification of the design idea and its potentiality and complexity. Abandoning formalization, as a search for "new" forms, the student designer is oriented to define the project as a progressive transformation, as a definition of logic applies to any previous form and is identified through the possible achievement of a character. All this logically retraces what happens in the design process;

3. Face the white sheet, the initial moment of the design by re-proposing the project sketches through the use of catalysts and progressive transformations of the same in topological paradigms, the basis of creativity in the project.
4. Develop the project by progressively applying the logics of transformation subjectively defined as able to characterize the project itself. The logics of transformation is adopted as responding to the characteristics of subjective identity and applied to specific design acts of progressive transformations, such as transformation to define how it ends, how it bends, how it divides, etc.
5. The results of the design process as possible variations. The structure of variations follows the logic of identifying the idea through its multiple formalizations, implemented through the inter-changeability of forms, performed through possible and interchangeable progressive paths of transformation.

IDENTIFICATION OF THE CHARACTERS OF THE SUBJECTIVE IDENTITY

The initial moment of the training course of this “new” design discipline is the identification, by each student, of his or her subjectivity as a designer. It is, definitely, the most difficult moment, not so much for the complexity of this first step but for the difficulty of the student to answer subjectively to the didactic requests. The student is accustomed, especially in this period of supremacy of tools and technology over subjective logical thinking, to respond objectively to requests. He finds himself perplexed to have to abandon a linear path for a non-linear interpretative path.

Once overcome these perplexities in the field of subjectivity, the student can make the best use of his creativity and design skills.
Enrica Colabella proposed to ask each student to identify his or her own possible identity as a designer through three adjectives, which may be in contrast with each other, but which can capture the complex and still hidden character of each student's design vision. This first step defines the goal to be achieved and makes possible a student-teacher interaction to activate a logical path in this sense.

FROM FORMING TO TRANSFORMING

The next step was to link these adjectives, these characteristics of each designer's vision to processes of formal transformation. Operationally, the student designer is asked to experiment with possible transformations of events, first simple and then more complex, so that the results of these transformations lead to an increase in the character indicated.
The transformation logics identified as possible transformation processes are not structured concerning specific previous forms but are proposed as adaptive to any previous form. Transformations, in fact, unlike shapes, define a process, an increase in complexity, and not a static structure, even if defined parametrically. This leads the designer to build, in progress, specific subjective logic of transformation that become the tools that can be used in many different occasions of design, a sort of collection of logical tools related to their design vision.
The project opportunities to which the transformations refer are common to the various design themes and can be

identified as acts that lead to an increase in complexity. Each design occasion involves an increase in complexity managed by a transformation process. The creation and evaluation of this process become relevant to the increase of one of the adjectives chosen as representing the student's vision.
All this is aimed at building one's own identity as a designer, and the tools of transformation that make it recognizable.
This first operational step is not directly related to a specific project but contributes to the construction of a growing background of operational tools that can be used in subsequent projects too.

THE INITIAL MOMENT OF THE DESIGN PATH, FROM THE CATALYST TO THE TOPOLOGICAL PARADIGM

When we have to face a specific design theme the first logical operation comes from how to "dirty" the white sheet. Every single project is born from a sketch and is progressively transformed until it becomes an executive project.
This phase, so important for every single project, is performed in Generative Design through the use of catalysts linked to the interpretation of student's cultural references. These references are not only related to architecture or design objects but also extend to literature, poetry, music, everything that can be interpreted as a system of relationships between events.
The choice of catalysts therefore became, through subjective interpretation, the choice of a system of relationships between events that opens to the possible construction of a topological paradigm capable of triggering and controlling the design process.
Referring to Poincaré creativity is connecting existing events in different and surprising ways. In other words, creativity is made explicit by identifying a topological structure that reflects one's idea.
To implement this initial phase of the project, the student designer identifies his reference and interprets it as a system of relationships between the parties. As Poincaré states, the quality of this creative act can only be evaluated in terms of beauty, and therefore it is strongly connected to subjectivity.
Once interpreted as a system of relationships, and having associated to each component event and to each relationship between the parties one of the adjectives chosen as able to reflect own vision, the designer is faced with a topological paradigm that can be used as an engine for the development of the project. The paradigm needs extensions and increases in complexity to adhere to the theme of the project, but this does not affect the organic structure that has been identified as the carrier of the idea.
As often happens in every project path, often the paradigm adopted initially proves insufficient to manage the progressive development of complexity.
At this point, referring to Renè Thom, the non-linear dynamic system presents a discontinuity, which we could call catastrophe. The designer will have to make a paradigm "jump", identifying a new more complex one, capable of defining an advanced organicity of the project. This new paradigm will have to include all the work already developed (the progressive sequences of the transformation of the events and their

achievement of the adjectives sought) and open new fields of development.

THE DEVELOPMENT OF THE PROJECT THROUGH POSSIBLE PARALLEL PATHS OF PROGRESSIVE TRANSFORMATIONS

The transition from the topological paradigm, essentially non-formalized, to the first formalized changes. The progressive transformations achieve the "final" results implemented through the systematic use of previously identified transformation logics. Each event of the paradigm will grow in complexity through the subsequent transformations. These manage, in this way, the progressive increase of functionality associated with the progressive increase of the characters responding to the subjective vision of the designer.

THE RESULT AS POSSIBLE PARALLEL VARIATIONS

This logical path towards complexity, and therefore towards the possibility of responding to project requests is not linear and univocal. The transformation logics (algorithms or identified paths of transformation) can be used in series and parallel, in a different order, and with mutual contamination. This creates different formal scenarios even if they all respond to the same design vision.
In other words, the inter-changeability of possible forms is accepted, maintaining the peculiarity of the design response to the designer's vision. On the contrary, the production of parallel scenarios, different but recognizable in the idea, defines the possibility to verify the quality of the idea itself.

An idea is not communicable through only one result. The last is only one of the possible representations of the idea.
The idea can be communicated only through a series of almost infinite variations. Each variation is a possible facet, all together represent the idea in its potentiality.

THE GENERATIVE DESIGN MANUAL

To support the design work of the students, to whom we have always asked to develop in succession different design themes for verifying the quality of the defined transformation logics, we have written a small manual of Generative Design, clarifying and structuring ten subsequent steps of the design path.
http://www.generativism.com/tiki-index.php?page=GDDM

GDDM
Generative Design Digital Manual

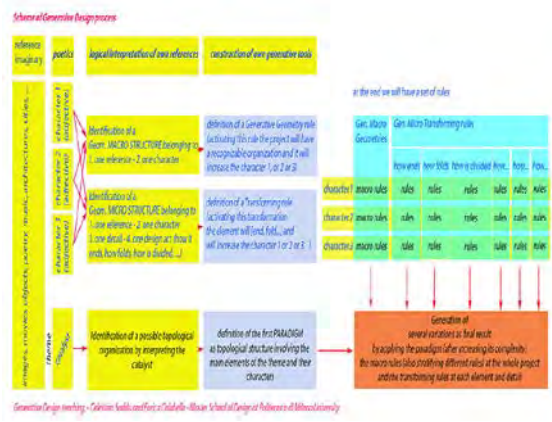
Celestino Soddu and Enrica Colabella

This Digital Manual is built for the first time for supporting the managing, step by step, of the Generative Design process. Following the schedule of lessons, we will be published in the journal GASATHJ for more widespread use in Generative Design teaching activities.
It will be implemented during the teaching process with different materials: examples, theoretical and practical references, dedicated papers, lesson movies, etc. used in each lesson and in each teaching exercise.

Why generative Design?

The main aims of a Generative Design process are to identify a possible vision and to construct our performing way for developing ideas in design. There is not a question to find out unexpected and fascinating forms, but to find the possibility to communicate at the best our design ideas. Operatively, Generative Design helps us to construct and develop an idea following a scientific

process and not by representing it with only a singular result, with a "solution" as a simplification of the complex possibilities in act. Generative Design is how we can plan a transforming process, by following a poetic logic able to bring us from first sketches to several possible variations as final results. All together these variations can communicate our subjective idea, our peculiar vision as designers, open to a possible identifying style.



1st step: identification and definition of aims as design characters.

We cannot run progressive paths if we haven't clear aims. These aims are not only practical aims, configured only for identifying functions. The main generative aim is to reach possible results able to represent our subjective vision for gaining complexity.

For this, a good tool is to define some characters of our performing aims as characters that we love to rediscover in our design results. Operatively we can identify these characters with three adjectives.

Number three is very useful for easily controlling them in our first steps. Only one is too much axiomatic, two are many times in opposition or alternatives and more than three are too much for controlling them in our first operative procedure. One example: smart, baroque, exciting. Our chosen adjectives might be also in their significance, in contrast, one each other. They stay together in a performing way for defining a not linear system, open to complexity

2nd step: constructing own reference imaginary world

Imaginary references: as just said, interesting examples of design, of objects, of music pieces, of poetry, of architecture, of cities, of movies, of faces, of animals, and so on.

When we chose a reference, soon after the choice we must associate to the reference one (or more) of the characters that we identified. That is: we must have a clear design vision able to drive us when considering them.

Our 3 adjectives identify deeply our first peculiar points of view as attractors of the real world. The character expressed with our 3 adjectives is a very good key for interpreting the world of images, poems, music, movies, drawings, postcards, etc. that we choose for subjectively discovering in them our defined characters.

In this way, we are performing a selected imaginary world as a representation of our references for gaining the world of our incoming generative design results.

So we start by performing aims as characters of an imaginary world of references.

This is a selection made for association in resonance between attribution/word (character) and images, sounds, word, etc (reference world).

A double moment in a discontinuous process.

Suggestion: collect several references for each character, paying attention to each reference difference from all others, covering a particular aspect of our impressions. The process is in discovering the character significance of our attributions.

The reason why we identify several references for each adjective is in the plurality of possible poetic logic for each adjective/attribution. By performing this associative process, we are collecting in our mind a plurality aspect of the same significance. So we become able to focus on a plural useful formalization of the same adjective for performing our generative process.

With this process, we are delineating in deep our aims.

Two ways to approach these references:

1 - Considering the whole reference or

2 - Considering only a part of it.

Whole reference / macro level: we consider the global geometry, the whole structure, and organization, performing a complex system that we can focus on by interpreting our reference.

1st example: looking at Milano we could consider its peculiar global geometry as a system able to connect everything in subsequent circles and, at the same time with transversal straight lines belonging to different main locations. This is not

only a peculiar static form, this is a "Generative Geometry", able to perform a great open number of connections, all belonging in a congruous way to our generative Milano system.
2nd example: looking at the Bach fugues, we could consider the structure of a global system created by subsequent repetitions, following well-identified rules, where each repetition is a variation of the same theme. This structure of an organization is well identified as a "Generative Geometry" too.
Details - Fragments of the references / micro level: Operatively we identify one (or more) peculiar detail(s) of our reference as a particular discovered aspect of our characters at micro-scale, by itself, or in its connections.

For doing that, we must identify the role of each detail. If it belongs to "how" this event ends, "how" it folds itself, "how" it is divided into several parts, and so on, by performing geometric rules of connections. In practice, we can associate each reference to:
a) one of the characters that we identified,
b) a particular aspect that belongs to a particular "design act" that we can interpret as performed in the design process that constructed these results,
c) a peculiar "Generative Geometry" able to represent our interpretation of the geometric structure of our reference in a reasonable way.
1st example: we choose a reference to the Chrysler Tower in NY. The detail is the cup of the tower. The "design act" is " how it ends". The adjective is "exciting. Now we made a logical interpretation of this detail and we "discover" that the tower ends by repeating the final geometry (in this case an arc) several times progressively reducing the dimension and putting the reduced arc over the previous one. This logic performs all the sides of the tower. Following this peculiar (and subjective) approach we can identify a possible rule able to perform the "how to end" aspect, as a rule, applicable to other and different occasions. We can do that also if the "arc" is configured as a different geometric event or also if the event is not geometric but a word, a note, a decoration, and so on. This rule is similar to a fractal geometry, where each event is repeated reducing it in a scalar way and generating it in a definite process until it will be so little at minimum scale, but always following the same geometric logic, as in nature. This rule is a rule of Generative Geometry. We can associate this rule to our character (exciting) and a peculiar "design act": how ending one of the events of our projects (ending a communication, a dress, an architecture, a pen, and so on).
We haven't found a form but a rule able to manage possible progressive transformations fitting a peculiar character defined as our aim.
It's clear that; the logical interpretation, expressed as a poetic logic is a subjective and plausible hypothesis related to a possible design path and it is not the objective reconstruction of the real design process, that can happens also following other rules. Each design result of good quality is performed in a complex way, where the possibility of discovering hidden rules is always open. Our site of interest is our logical interpretation because we are looking for the possibility to construct our design process related to our design vision. Performing these expressions of poetic logic we are learning how we can gain the complexity of our time, starting from our singular vision. These "design acts" are the results of decision moments that we normally perform during our design activity: how to end an object, a communication, a piece of music, a dress, how to divide it into two or several parts, how to fold it or to change the tonality, or to move from one material to another, how to make a skin, how to open a hole, and so on. Each one can identify these possible "design acts" following their own identity as a designer. It involved the micro-scale too of our reference with the same logic of Generative Geometry.

3rd step. Constructing our Generative Tools.
We are constructing our Generative Tools when we identify the "Generative Geometry" discovered by the geometric logics (rules, geometric progressive transformations, and exceptions) that we like to read in our references. These Generative Tools can involve the whole project process.
We can call them "Logics of Transformation" as our logical hypothesis of a progressive transformation (folding, dividing, and so on) able to perform a possible form characterized by one of our adjectives.
"Generative Geometries" and "Logics of transformation" are like operative algorithms applicable to the generative design process. We can write real algorithms too if we can represent with algorithms each transforming process. In any case by drawings or by algorithms, they are our generative design tools that we can use in all our design activities.

4th step. Choosing (or accepting) a design occasion.
The step of starting with a new design project is a very important moment.

In our teaching experience, each student can identify the theme of his/her design experiment. This decision is not important because it belongs to an activity that is not proper for designers, but proper for clients. After this occasion, soon we will have the theme to develop. We are working as a designer.
The only thing that we must follow when we choose the design theme is that we need to find out in the theme a possible complex structure with many unexpressed questions to answer. This because each designer needs to effort questions: each question can generate a design answer. More are the occasions where we have to gain an answer with our design act more the quality of results can increase in complexity.

5th step. Identifying a catalyst for interpreting it as a possible topological structure
Design is a transforming process with a progressive increase in complexity. The first act of a design process is not a transformation because there is not anything existing. So we need to make complex our empty sheet.

We can do that using a sketch that we will consider as a catalyst or using an image as a catalyst. How can we choose or make an appropriate catalyst?
It must not represent a "formal" idea, because forms are interchangeable and they cannot be identified in this too early moment. They might gain only a simplified solution of our generative process, as an easy result. This becomes very dangerous, stopping our process. In this way is very hard to find out another solution.

Better, the catalyst could be a reference for the organic structure of our project; it could help us to identify a first topological structure. So we will use this catalyst for transforming it into a paradigm, able to make a first identification of the parts of our project and their relations. No forms must be identified because if a form will early emerge, it will be too dangerous for the progressive design process. This early choice can kill the creative process.
example: Our theme is a poster. If we like organic structures, we can use, as a catalyst, an image of an animal, i.e. an elephant. This is only a catalyst and, after using it for starting our project, we have to forget it. We don't use the elephant as a form! Our logical interpretation of this catalyst could be: there are 4 parts in my poster, like the legs of the elephant but there is a free event (like the proboscis) focused on the "last news" that we intend to communicate with the poster. I can define that the four parts are "baroque", the free event is "smart". A final event, where I will communicate a peculiar detail, will be "exciting" and will be at the end of my poster, it will be little like the code of the elephant. Now I will forget the elephant and I will have the first "topological" structure of my project: the organization paradigm.

6th step. Toward the paradigm
In a few steps, it is possible to organize our moving from a catalyst to the paradigm. Firstly, we must make a logical interpretation of our catalyst, identifying some events (that we interpret as belonging to some parts of the project as a performing connection) and their direct or indirect relationships.
Secondly, we can associate with the entire object and to each event and each relationship a peculiar character, choosing it from the three characters that we previously identified.

Representing together events, their characters, and their relationships we will have the first paradigm of an organization that we can directly use for going ahead in our design process.

This is only a "first" paradigm because the object that we are going to design needs an increase of complexity that we can obtain repeating the same process (catalyst and characterized paradigm) for each event inside the first paradigm. And so on.

7th step. Performing first formalization at the macro and micro scale.

Looking at the just defined paradigm, we can make a logical interpretation of this structure and we can apply to this topological structure a geometrical structure. Practically we will apply to this paradigm one of the "Generative Geometries" that we identified in one of our references belonging to the characters. We will apply it at the macro scale, involving the entire project. If we like to apply more than one character, we can apply more Generative Geometries. This work starts in transforming the previous structure, so we can apply these geometries one after the other, transforming the previous transformation.

Looking at each event, we will identify the "design acts" necessary to perform the event itself, their functions, and characters. Following that, we will apply the "transforming rules" that we identified through our logical interpretation of our references at a micro-scale.

In the end, we will have the first formalization of our

project. More we can gain a sequence of variations applying different "Generative Geometries" to the whole project and different "Logics of Transformations" to each event.

8th step. Increasing Complexity

Looking at our project, we will need to develop it toward the complexity, in a way that the results will satisfy the complex needs of our times. We can do that by increasing the complexity of the paradigm by developing new paradigms for each event and subsequent formalization of these new events.

9th step. Changing the paradigm

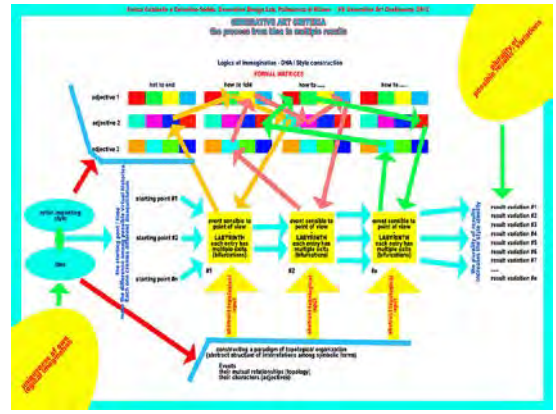
However, it's possible that the adopted paradigm doesn't work well: it is not able to manage the increasing complexity, the increasing functions, and requests of the project. For this reason, we can change the paradigm, but we are not losing our already made work.

Being a topological structure, it is possible to run in changing the paradigm, not transforming it, but jumping from a paradigm to a new one (starting from the catalyst and so on).

The interesting matter is that we don't lose our previous work. Each event can be generated again using the same transforming rules and the same characters that we used in the previous paradigm

10th step. Final results

The final result is not unique. Each possible result is one of the representations of our idea, but cannot fully represent our idea, never our vision. It's necessary to generate a set of variations, each one different but all together representing the same idea.
The variations are like different individuals of the same species. Different olive trees, with completely different forms but all recognizable as olive threes. Altogether, they communicate the character of the species, as our variations will communicate the uniqueness of our design vision.



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REFERENCES

papers:

Generative Art Geometry.Logical interpretations for Generative Algorithm
https://generativeart.com/GA2014papers/Celestino_Soddu_Generative_Geometry_2014.pdf

Logics of ImaginationGenerative Art performs a Style as Executable Proces
https://generativeart.com/GA2012/celestino.pdf

Generative Baroque Algorithms
https://generativeart.com/GA2011/celestino.pdf

Generative Design. A swimmer in a natural sea frame
https://generativeart.com/on/cic/papersGA2006/21.htm

Perspective,aVisionaryProcess:TheMain GenerativeRoadforCrossingDimensions

https://www.soddu.it/papers/NNJ_v12n1_Soddu_pp33-46.pdf

Poetic Logic
https://www.generativeart.com/ga2015_WEB/poetic-logic_colabella.pdf

books:

GENERATIVE ART & DESIGN Theory, Methodology and Projects

https://artscience-ebookshop.com/ebooks_free/GenerativeArtDesignTheory_2.pdf

DIGITAL CIVILIZATION WHERE TREES MOVE
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GENERATIVE ART - FUTURING PAST
https://artscience-ebookshop.com/libroGA_FPr.htm

Generative City Design Aleatority and Urban Species
https://artscience-ebookshop.com/ebooks_free/AleatoryCities.pdf

L'immagine non Euclidea (The not Euclidean image, Italian language)
https://artscience-ebookshop.com/immaginenoneuclidea_book.htm

websites:

https://www.generativism.com/tiki-index.php

https://www.generativedesign.com

https://www.gasathj.com

Computer based generative art and my series Structure 193, Chrysé tomé, XT3, Te-XT rumor, Te-XT rumor automat and System 25XT3

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Abstract

I have been concerned with computer generative art (CGA) since the late 1970s (a time, incidentally, when any explicit definition or theory of this approach were still absent). My first CGA series was titled *Structure 193.* In it, a constant number (193) of identical elements generated a structure growing from a central point, ultimately yielding a form determined by the random variation of four visually distinct types of connections between the individual elements.

From 2012 I engaged in developing an algorithm which was intended to generate elaborately structured compositions on a square-shaped surface, including circles, lines, oblongs or squares, uniquely in proportions of the golden ratio. In 2015 I proceeded to minimalize this structure, scaling it down to a network made up of three horizontal and three vertical lines observing the golden ratio, with a superposition of squares and circles, in nontransparent white and black (*XT3*). This opened up the possibility of generating an immensely rich repertoire of black-and-white square-shaped symbols, which I subjected to selection and subsequently treated in the same way as letters in a natural language text, i.e., classifying them along the lines of different frequency of the various symbols and rate of probability of their mutual positioning (*Te-XT rumor*).

The following programme (*Te-XT rumor automat*) involved the linking of the individual elements along lines determined by their neighbourhood in both directions (division of square-shaped format). Its follow up (*System 25XT3*) consisted in the random pick of a central element to

which the programme added further elements starting from the centre, observing corresponding proportional divisions. The composition thus grew in a manner determined alternatively by newly specified elements and division axes. The originnal black-and-white palette was transformed to the combinations of white-grey-black, or white and three shades of grey.

An outstanding issue confronting computer generative art is the question of a point at which a programme of this type can be regarded as a manifestation of artificial intelligence. While an expert system which makes decisions in “search space” – i.e., one which picks correct answers – is standardly classified as intelligent, it is also true that in the creative domain intelligence is widely held to start only at the level of seeking out potential new formulations of questions.

1. Structure 193

During my final year of studies at Charles University´s Faculty of Arts, I began to ponder the possibility of exploring the correlation between the variability of form and the rationally, statistically defined rules of its origin. I then found the use of a computer quite natural, surely also due to the fact that my teacher at that time was Zdeněk Sýkora, a pioneer in the field of using computers in art [1]. I was then in the process of writing, under his tutorial guidance, my master´s thesis, *Real Motion as a Medium of Art*. Its subject reflected my interest in kinetic art and the actual dynamics present in visual aratwork.

Between 1979 and 1985 I made a computer generative series (at a time when this approach was still waiting for a precise definition and theoretical framework) [2], [3]. The series is named *Structure 193*, with an explanatory subtitle, *Study of a Finite Plane Structure.* In it, a constant number (193) of identical elements generated a structure growing from a central point, ultimately yielding a form determined by the random variation of four visually distinct types of connections between the individual elements. The process of connecting was statistically determined. One of its outputs was a set of 30 silkscreen prints, four paper reliefs, and one three-dimensional object (see Fig. 1). After its completion, I published information about this series in 1988, in the journal *Constructivist forum* [4].



Fig. 1: Two silkscreen prints *from series Structure 193, 1985 (A-CON-5 a NUCL-A-0) and a paper space relief (NEGCND-1).*

2. Series Golden ratio and Chrysé tomé

From 2012 I engaged in developing an algorithm which was intended to generate elaborately structured compositions on a square-shaped surface, including circles, lines, oblongs or squares, uniquely in proportions of the golden ratio [5], [6].

2.1 Composition of Random Circles with Radiuses in a Golden Ratio Arrangement

In its initial stages, the programme´s scope was limited to randomly filling the pictorial surface with circles whose radiuses were derived from the format of the whole composition, and which were in mutual correspondence with the golden ratio (see Fig. 2).

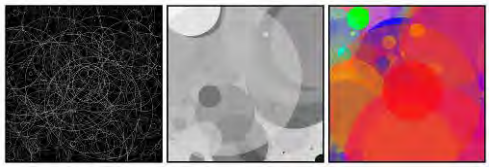


Fig. 2: Three output variants of the initial programme: ZR-022b-0348, 2012; ZR-05-1193, 2012; ZR-066-1783, 2012.

The multiplying complexity of overlapping circles brings to the fore the rudiments of a uniform structural order, induced by the radiuses´ correlated gradual incrementation. The seminal lapidary set of merely either positive or negative circles on black or white background was subsequently enhanced by transparent values of grey surfaces, or by surfaces made up of randomly picked, again transparently overlapping colour hues.

2.2 Composition of Random Circles Located within Golden Ratio Intervals

My next aim was to organize the continuously generated circles, or more specifically, their centres, on the pictorial surface, also in mutual correspondence with the golden ratio intervals. These compositional alternatives were tested out in black-and-white line drawings as well as in corresponding surface variants using various degrees of grey as well as in different colour hues which were manifest both in the colour of a circle´s surface, and in the colour of its contour line (see Fig. 3).

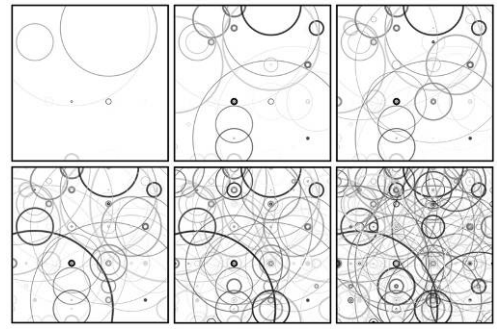


Fig. 3: Record of the development of one variant of a programme which was already set on mapping the placement of circle centres in mutual correspondence with the golden ratio. The last stage corresponds to the print GR/wb/lin_1209, 2012.

While this exclusive focus on the geometrical shape of the circle inevitably led to an optical condensation of the pictorial surface, the method of progressive overlapping of various colours and different degrees of transparency resulted in a continual transformation which in its turn made

possible the regulation of the number of circles added at each individual step, and thereby also increase in the rate of change of the density of elements across the composition as a whole (see Fig. 4).

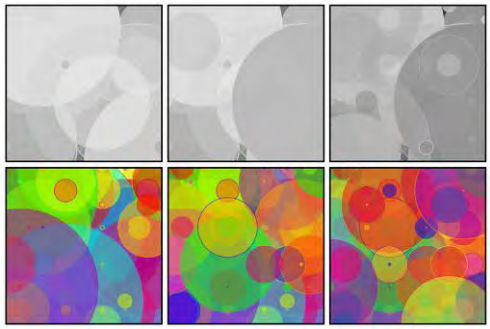


Fig. 4: Record of the development of two variants of a programme mapping the placement of circle centres in mutual correspondence with the golden ratio. The first variant features a black-and-white scale (top series, the last stage corresponds to the print GR/wb/pl_1209, 2012), the second variant is multicoloured (bottom series, the last stage corresponds to the print GR/coVpl_1209, 2012).

2.3 Compositional Grid Generated along the Lines of the Golden Ratio

The further development of these programmes took as the starting point a rectangular grid, once again derived by division of the format according to the golden ratio. The division itself may be initiated at each step by either a “small” or a “large” section, which is left up to random choice, in a process consisting alternatively of either seven steps (see Fig. 5), or 15 steps. Such division of pictorial format by its progressive golden-ratio division yields different variants of an ideal grid which may then be employed as the seminal structure for the further placement of visually active elements.

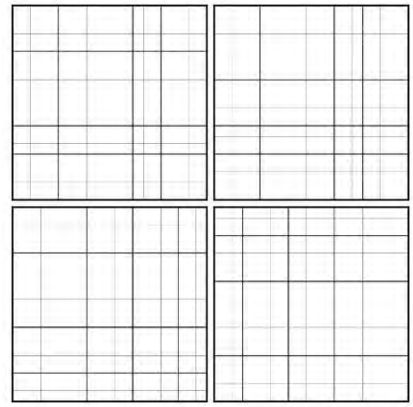


Fig. 5: Four random results of the division of a square into eight sections, horizontally and vertically, according to the golden section.

By visually active elements are understood here colour surfaces which either fill in the individual rectangles (see Fig. 6), or, in a later variant, proceed to locate within the grid´s newly generated squares circles that subsequently alternate, randomly once again, with square-shaped surfaces.

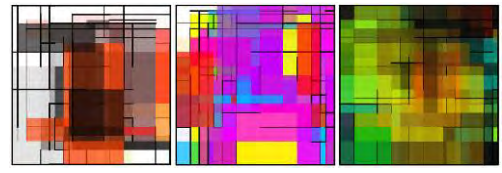


Fig. 6: Three colour compositions in a grid divided in 15 steps. XT_Ch15_L&R-CC-C0046, 2014; XT_Ch15_line_rect_CC05-00176, and Ch15_L&R-CC-E8067, 2014.

In naming this series I chose to use the Greek letters *chi* (X) and *tau* (*T*).

Materialized variants of these concepts included, apart from digital prints on paper or canvas, also reliefs in wood, glass or plastic (see Fig. 7).



Fig. 7: Four space compositions from series XT_Ch7: XT_Ch7_LCR-04, 2015; XT_Ch7_CPR-C001, 2015; XT_Ch7_CPR-A0005, 2015 a XT_Ch7_AGR-A0001, 2015, each 50 × 50 cm.

2.4 Golden Ratio Composition of Circles and Squares

The last programme is designed to detect, in a grid defined by golden ratios, squares within which it randomly inscribes circles or fills them with colour. The resulting colour choice is stratified at infinitely variable values (for examples, see Fig. 8).

3. Colour Space as a Source of Colour Relationships

More than a few of my compositions employ colour to achieve various types of emotional effect. A major modern-age tradition of scholarly reflection on colour was initiated by Johann Wolfgang von Goethe. His work, *Zur Farbenlehre (Entwurt einer Farbenlehre)*, of 1810, sparked off the systematic study of human experience with the psychological effect of colours. However undeniable it may be, this effect for many reasons defies a truly objective description. This is due not only to the subjective nature of individual experience, but above all to the fact that what we deal with here is an area of considerable structural complexity. In the traditional analytical approach, the whole of a living system is dissected into partial elements which may be easier to describe and control, though only at the price of loss of their actual functionality. While Goethe´s study did point at the relevance of individual colours in terms of emotional impact, its ultimate oversimplification inevitably leads to either downright false or at least inconclusive, scarcely verifiable findings. During the 19th and 20th centuries, the study of both physical and physiological properties produced a plethora of new discoveries which accelerated experimentation in art, and eventually also became instrumental in broadening the horizon of the art-loving public. A most sophisticated contribution was rendered to this process by the avant-garde Bauhaus art school. There in particular, two key figures, Johannes Itten [7] and Josef Albers [8], made crucial inroads into the study of empirical properties of colour as a complex phenomenon which made it mandatory to regard colour as a contextually bound quality contingent on hue, lightness, saturation, and transparency.

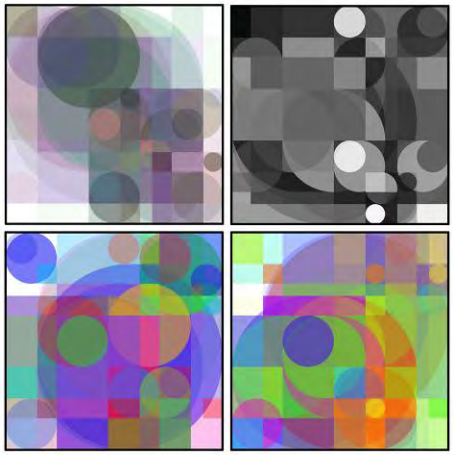


Fig. 8: Four compositions in a grid divided by seven ratios, filled in with circles and squares. Top row: XT_Ch7_C&C-G0262, 2014. XT_Ch7_C&C-H0157, 2014; Bottom row: XT_Ch7_C&C-H0036, 2014; XT_ Ch7_C&C-H0038, 2014.

An empirical description of colour can be achieved by various approaches, each of which invariably aims at bracketing its respective chromatic scale within a standard system. The essential prerequisite is always the choice of criteria. The development of the definition of colour in computer-generated imagery in particular has entailed a fairly exact classification involving various models of colour systems which have been mostly centered around three characteristics, and are consequently qualifiable as colour space models. Subjective perception of colour assigns to an observed colour quality the proper colour value (hue) which corresponds to the overall dominant wavelength, apart from which it determines, with respect to the chromatic situation at large and the relation to the light level of the environment, its saturation (where a decrease in saturation translates into an increasingly refracted colour effect), and its lightness which signals a reduction of distinct wavelength definition to a dark, monochrome state. This particular colour model is designated HSB, an acronym made up of the initial letters of the English expressions for the above-listed criteria: namely, Hue, Saturation, Brightness. The corresponding colour space thus offers a pattern involving a relatively unlimited palette which is readily controllable by three scales.

In programming specific compositions, I took the HSB model as my point of departure. Nonetheless, in each individual case, while sticking to the principle of randomness in choosing a newly included colour, the actual choice was subjected to a similarly random process imposing on it certain subsequent limitations. These limitations, enforced at markedly longer intervals, concerned the occurrence of a colour in certain sections of the HSB colour space. For illustration, one can envision an interposed threedimensional object which would once again be describable in terms of the magnitude of the scale pertinent to HSB parameters. In other words, for a definite amount of time during the choosing stage, the complete HSB colour space was limited to a single section which reduced the attainability of colours in accord with its own hue, lightness or saturation. Subsequently then, the choice was limited to colours of similar hues but variable lightness, or else ones of similar lightness and variable hues, and so on. A possible sequence of colour choices is indicated in the sequence of colours by lines, in Fig. 9.

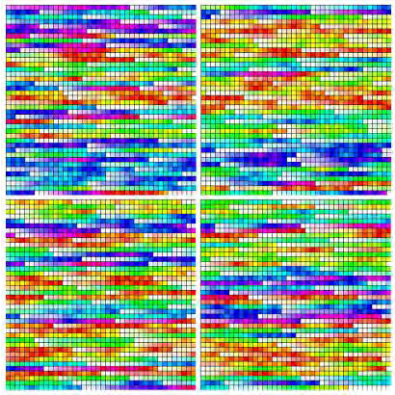


Fig. 9: Four different colour sequences of 1,600 successive randomly chosen hues in an arrangement respecting variable sections of partial limitations.

4. XT3 and the project Te-XT rumor

In 2015 I began to apply a simple rule for the generation of new compositional elements which would be subsequently further interconnectable. Their primary compositional network was obtained by a reduction to three horizontal and three vertical lines according to the golden ratio principle. The network is subsequently filled in, through a process of random superposition, by appropriate squares and circles in nontransparent white and black colours (hence the title *XT3*). This can eventually produce a comparatively very extensive repertoire of black-and-white square-shaped symbols (see Fig. 10).

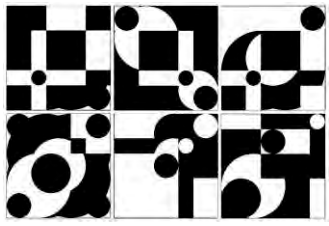


Fig. 10: Six elements of XT3 series, 2015.

During the initial stage of the project *Te-XT RUMOR*, I picked 324 elements out of a much larger set of basic symbols. I presented this selection in the form of a digital print on paper entitled *Signum generator 324* (see Fig. 12).



Fig. 11: Signum generator 324, 2015, 75 × 74 cm, digital print on paper, passe-partout, glass.

Out of the complete set of elements two smaller subsets were then extracted, each consisting of 13 elements. The criteria for their selection included a degree of morphological similarity, visual compactness, and potential to command interest. Further on, these selections were used in producing structures of 11 × 11 elements, governed by the organizing principle of the probability of the occurrence of specific elements, in a process somewhat reminiscent of the probability patterns observed in the arrangement of letters in natural languages (hence the title, *Te-XT rumor*). The ratios of occurrence of the various symbols were once again set in consonance with the golden ratio, so the resulting digital prints on canvas, *Te-XT rumor R1* (2015), and *Te-XT*

rumor B4 (2015) actually demonstrated at all levels subordination to this rule. The set B was subsequently also used in generating along the same lines a larger format (120 × 120 cm), albeit made up of a reduced number of 5 × 5 elements: *Te-XT rumor B GR* (see Fig. 12).

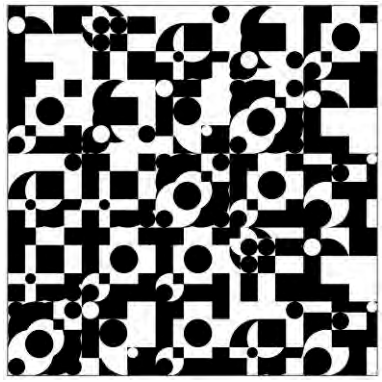


Fig. 12: Te-XT-rumor-B-GR, 2015, 120 × 120 cm, digital print, canvas.

The series was accompanied by this artist statement:

"The primary repertoire of symbols is comprised of forms created on a square background divided in accord with the golden ratio invariably into 16 fields made up of black and white squares and circles. Of the generated 324 symbols which manifest a mutual "genetic" correspondence, share a common constructive order, and at the same time are mutually distinct, two sets of 13 symbols each were selected. Priority was given to symbols which are characterized by a fairly transparent and distinctive structure (see *Signum generator 324*).

Each set of 13 symbols, which are close in nature to ´letters´, may serve for the structuring of a message whose syntactic rules contain the definition of the frequency of individual symbols, approximating the values of their co-occurrence, again in compliance with the golden ratio. The purpose of the resulting message is thus to supply information about the potential beauty of the complexity and symmetry of the structure (*Te-XT*) itself".



Fig. 13. TeXT rumor variable, 2015, 25 pieces, acrylic, canvas, 55 × 55 cm, number of elements and assembled whole variable; assembled whole 500 × 280 cm.

The last part of the series consists of 25 black-and-white paintings in acrylic on canvas (55 x 55 cm), which may figure as parts of variable arrangements in which

they are freely linked with one another (see Fig. 13).

5. The series Te-XT rumor automat and System 25XT3

The following programme (*Te-XT rumor automat*) involved the linking of the individual elements along lines determined by their neighbourhood in both directions (division of square-shaped format – see Fig. 14).

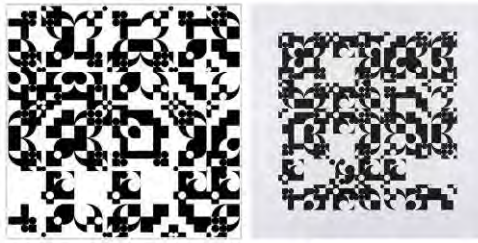


Fig. 14: TeXT rumor automat 16-10-6, 2016, 120 × 120 cm, digital print, canvas; TeXT automat 7 16-12-12, 2016, silkscreen, paper, 700 × 700 mm

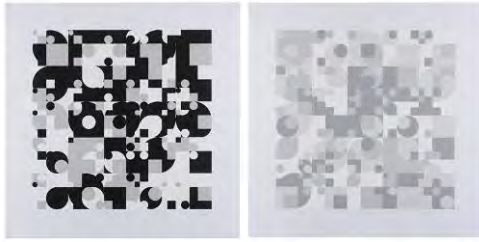


Fig. 15. System 25XT3 17-03-18, 2017, silkscreen, paper, 700 × 700 mm; System 25XT3 17-04-27, 2017, silkscreen, paper, 700 × 700 mm

Its follow up (*System 25XT3*) consisted in the random pick of a central element to which the programme added further elements starting from the centre, observing corresponding proportional divisions. The composition thus grew in a manner determined alternatively by newly specified elements and division axes. The original black-and-white palette was transformed to the combinations of white-grey-black, or white and three shades of grey see Fig. 15).

6. System 25XTS – variable magnetic collages

As I intended to retain in the artefact´s final version the possibility of transformation, another variant of the process came to include a composition made up of separate elements planted on a magnetic support (see Fig. 16).



Fig. 16: Variable magnetic collages: System 25XT3 BW 17-07-10, 2017 a System 25XT3 COL 17-07-20, 2017, variable collage, digital print, paper, magnetic elements, 70 × 70 cm;

7. System 25XT3 based on genetic algorithm

The alignment of a random choice of colours distributed among 25 component parts of System 25XT3 in pursuit of preferred colour combinations of the various colour neighbourhoods is the task to be dealt with by the genetic algorithm.

The generated extensive basic population of structures with 25 random elements is evaluated by a fitness function which is calculated for each structure by adding up the values assigned to the individual

elements classified according to colour relations within them and the correlation between their bases. The positive number 1 is assigned to the superimposition of smaller squares or circles above larger ones in those cases where the colours are mutually adjacent or complementary within the colour wheel. Similar evaluation mode applies to colour neighbourhoods between the elements´ bases.

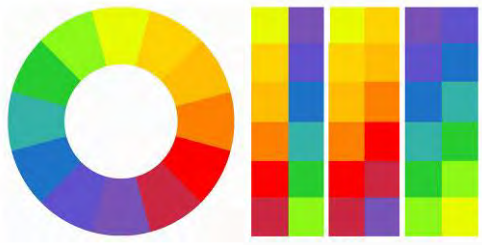


Fig. 17. Colour wheel used by GA and three paired columns of preferred colour combinations

Random combinations of more favourably evaluated parts of structures are instrumental in the production of new structures in ensuing generations. Repeated fitness function evaluation enhances the visual impact of compositions in subsequent generations.

An outstanding issue confronting computer generative art is the question of a point at which a programme of this type can be regarded as a manifestation of artificial intelligence. While an expert system which makes decisions in “search space” – i.e., one which picks correct answers – is standardly classified as intelligent, it is also true that in the creative domain intelligence is widely held to start only at the level of seeking out potential new formulations of questions.

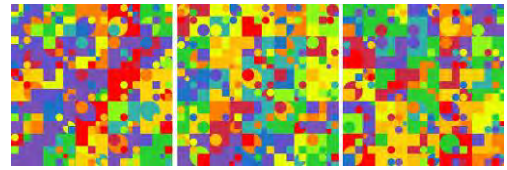


Fig. 18: Results of new generations.

8. References

[1] Sýkora, Z. – Blažek, J.: Computer-Aided Multi-Element Geometrical Abstract Paintings, *Leonardo*, Vol 3, No. 4. Oct., 1970, pp. 409-413

[2] Boden, M. A. – Edmonds, E. A.: What is Generative Art? in BODEN, M. A., *Creativity and Art, Three roads to surprise,* Oxford: Oxford University Press 2010.

[3] Galanter, P.: Generative Art Theory, in PAUL, Ch. (ed.), *A Companion to Digital Art*, Chichester: John Wiley & Sons, Inc. 2016, pp. 146-180.

[4] Svoboda, A.: Structure 193, *Constructivist forum,* Vol. 5, No. 7, 1988, pp. 15-21

[5] Livio, M.: *The Golden Ratio: The Story of Phi, the Extraordinary Number of Nature*, New York: Random House, 2003

[6] Ghyka, M. C.: *Le Nombre d´Or,* Paris: Gallimard 1976

[7] Itten, J. & BIRREN, F (ed.): *The Elements of Color*, Hoboken: John Wiley & Sons 1970

[8] Albers, J. *Interaction of Color*, New Haven & London: Yale University Press 1975

[9] Poli, R. – Langdom W. B. McPhee, N. F.: *A field Guide to Genetic Programming*, Published via http://lulu.com and freely available at http://www.gp-field-guide.org.uk, 2008.

Lost Rituals: Generating Text Using Behavioral Data Objects

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ABSTRACT

Many systems have been created for the purpose of generating interesting, novel, entertaining, or insightful text. However, a common shortcoming of these systems is that they do not often include internal structural context about the objects and concepts being described by the generated text, and therefore produce spontaneous gibberish or nonsense, or even simple grammatical errors. This undermines the illusion that the text was generated by a thinking individual and exposes the fact that the output was produced by an algorithm rather than a mind. We describe the system implemented to drive the "Lost Rituals" application, which attempts to address these shortcomings using a complex framework of modeled objects. We describe the implementation of narrator backstory and voice selection as a method for deepening user perception of experiential validity and realism. We explain the technique of using the association of state, behavior, and modification capabilities of represented objects to the generated text as a path to improving descriptive coherence and avoiding or minimizing the loss of suspended disbelief. Examples of generated output are provided, along with discussion for areas of future improvement and exploration.

1 Introduction

Conceptually, the most common forms of artistic outputs from procedural generation systems can be broadly categorized into visual art, musical art, interactive experiences (such as games), architecture, and language-based art such as literature. This final type can be seen through many lenses, with varying levels of conceptual coherence and the presence or absence of traditional narrative structure. When narrative structure is present, maintaining coherence throughout the narrative is an especially difficult challenge. Consider, for example, that at the time of this writing, there has never been a convincingly human-competitive novel-length narrative text story produced by a procedural system.

The NaNoGenMo project, for example, has, since 2013, encouraged participants to write program code that generates a 50,000-word novel[1], and many entries have been created since the project's inception[2], but none of these has ever been a complete human-competitive narrative. The majority of these novels are created through what are often

creative and clever structural tricks, none of which depend on narrative plot advancement throughout.

We have endeavored to develop a possible route to achieving the goal of long-form generative text with a coherent and unified narrative. “Behavioral data objects” are programming structures that combine state-related data and evaluation logic with the generation of specific textual segments that can be used to describe the data, changes in its state, and any associated actions that might be appropriate to the generation goal. It is our position that this strategy has some unique advantages over the most common existing strategies.

2 Common Existing Strategies

There are three primary strategies that appear dominant in the world of procedural text generation: context-free transformation grammars, Markov chains, and neural or deep learning techniques. While each of these approaches can sometimes produce impressive results, each has a tendency to produce output that is revealed to be essentially gibberish upon close reading. The reasons for this vary based upon the system being used.

2.1 Context-Free Transformation Grammars

Context-free transformation grammars rely on a repeating loop of replacements, where symbols are replaced with other symbols, typically drawn from a collection of available options[3]. A very popular system based on this approach is Compton’s *Tracery*[4], which has been ported to many programming languages. Context-free grammars suffer from exactly what their name implies: they do not contain context. This makes the production of coherent narrative events especially difficult. Short, standalone snippets of text can be generated easily, and are generally syntactically correct, but the transmission of state and meaning from artifact to artifact is often lost. *Tracery* attempts to overcome this challenge, at least in part, via the use of *ad hoc* variables, allowing already-selected replacement symbols to be consistently re-used in later text. However, what this solution lacks is transmission of state and metadata, since the generated symbol is stored and represented only in its textual form. There is no underlying justification for the selection of any given symbol, and therefore no such data to be conveyed to later pieces of the generation process to maintain context.

2.1.1 Example Output

The following are some examples of generated text using a context-free transformation grammar.[5]

An owl is almost always wistful, unless it is a grey one.

A duck is often indignant, unless it is a purple one.

A unicorn is rarely wistful, unless it is a green one.

An eagle is sometimes vexed, unless it is a grey one.

2.2 Markov Chains

Markov chains are state machines whose state transitions are controlled by stochastic probabilities.[6] In the realm of text generation, a Markov chain is typically configured such that a given state produces a specific word or character as output, and then transitions

to another state, whose output is appended onto the text, continuing until some termination state is achieved. The construction of the chain's configuration can be done either manually or (more commonly) through training on a corpus of existing text. The probabilities of transitioning from any state to any subsequent state are modeled upon the probabilities detected in the corpus. When training has been completed, the chain can be used to very quickly produce text output that resembles the corpus in the sense that it will reflect approximately the same state transition probabilities. While this approach is able to mirror the "feel" of the input corpus, the transition from state to state generally does not convey any contextual information, since each state is arrived at purely through a probability based on the starting state. Even if such contextual information were transmitted across states, it would be nearly impossible to use the contextual information in a meaningful way, since the training of the chain cannot reasonably take context information into consideration when analyzing probabilities. The end result of this is that Markov chains tend to produce output text that meanders through linguistic non-sequiturs, following the most superficial transitional structures of the corpus, but completely failing to replicate the relationship to any underlying information being described. It is, put simply, just a bunch of words strung together.

2.2.1 Example Output

The following are some examples of generated text using a Markov chain.[7]

'I am a master armorer , lords of Westeros , sawing out each bay and peninsula until the'

'Jon Snow is with the Hound in the woods . He won't do it . " Please don't'

'Where are the chains , and the Knight of Flowers to treat with you , Imp . ""'

'He thought that would be good or bad for their escape . If they can truly give us'

'I thought that she was like to remember a young crow he'd met briefly years before . "'

2.3 Neural and Deep Learning Techniques

The use of neural-network driven, or more precisely "deep learning," techniques is one of the more promising and modern approaches being used for generative text production at the time of writing, and there has been a fair amount of success at producing high-quality results using these techniques[8]. The use of deep learning allows for the generative system to be trained against a truly massive corpus of example texts, and to identify complex and multi-faceted structures within the corpus that can be used when generating output. However, while the generated text is certainly able to produce what appears at first glance to be very convincing language, deeper reading will often reveal that the text is actually meaningless, often self-contradictory, and incoherent. As with the previous strategies, the underlying reason for this shortcoming is that while the structure and appearance of the language is being learned, the meaning behind it is not. The generator is producing output without any actual conceptual thread holding it together. It is, at the bottom, simply producing a very opaque simulacrum of a coherent linguistic structure, complex enough to not reveal itself immediately, but breaking down entirely upon careful reading.

2.3.1 Example Output

The following text was generated using a deep-learning engine.[9]

QUEENE:

I had thought thou hadst a Roman; for the oracle,

Thus by All bids the man against the word,

Which are so weak of care, by old care done;

Your children were in your holy love,

And the precipitation through the bleeding throne.

BISHOP OF ELY:

Marry, and will, my lord, to weep in such a one were prettiest;

Yet now I was adopted heir

Of the world's lamentable day,

To watch the next way with his father with his face?

3 *Lost Rituals* Application Description

As a vehicle for the implementation of our generation strategy, we created an application called *Lost Rituals*. The application presents an interactive experience through which the user is introduced to a narrator, and then reads along through a book of fictional rituals in a fantastic world. The rituals are generated as the user turns the pages of the book.

There are two primary forms of text generation used in *Lost Rituals*: generation of the narrator's backstory, and generation of individual rituals.

In order for the generated rituals to be coherent from beginning to end, the generator required the ability to manage contextual state. This prevents the generation of nonsensical, impossible, or implausible actions as part of the generated rituals, and allows for a deeper connection between individual elements.

3.1 Platform Details

Lost Rituals is implemented in the programming language Swift 5.3. It runs on the iOS platform, specifically intended for iPhone devices.

All speech output generation is accomplished through the use of iOS's built-in text-to-speech capabilities. The voices available for selection are dependent upon the voices that have been installed by the user on their device, or the default set if no additional ones have been manually installed.

The application is bundled with a variant that is specialized for use over the Messages instant messaging system included on iOS. This variant allows two human participants to take turns building up a ritual step-by-step as an interactive activity, unlike the primary application mode in which an entire ritual is generated at once.

3.2 Narrator Generation

When the user begins to use the application, he or she is first presented with an introduction by a fictional narrator. Along with the textual introduction, the narrator introduces himself or herself using text-to-speech audio output. The voice of the narrator is

selected as part of the generation process, and thus is related to the "character" of the narrator. The user can choose to generate a new narrator as many times as necessary to allow the selection of an acceptable voice for the reading of the rituals. Once a narrator is selected, the user simply presses a button to begin, and the first ritual is generated, presented visually, and read aloud.

The generation of the narrator's introduction is one of the simpler elements of the application, but it immediately reveals a crucial aspect of the value of using behavioral objects: the gender of the narrator is contextual data. The narrator is introduced by name, and the name is gender-associated. The voices provided by the built-in text-to-speech framework in iOS are also gender-associated. By maintaining the gender as a piece of metadata when the narrator's name is selected, it is simple to select a voice that matches the gender. This is a rather uncommon feature in generative text systems, since most of them do not exist in the context of a complete, standalone runtime application that uses a selectable voice to read the output. In the case of *Lost Rituals*, this feature helps bring the user's perception more "into the world" of fantasy, and deepens immersion.

Beyond voice selection, maintaining the underlying data of the narrator's identity allows more descriptive elements to be added, such as "Sir" versus "Lady" as a name prefix to indicate nobility.

In practice, the generation process for the narrator's introduction is the following:

1. Create an instance of a NarratorIntroduction data structure
2. Creation of the NarratorIntroduction causes creation of an instance of a Narrator class object
3. Creation of the Narrator class object creates a singleton instance, populated with gender, name, institution, and other data
4. The NarratorIntroduction data structure interrogates the Narrator object instance for relevant information, and incorporates it into generated output text

3.2.1 Code Representation

The following is a truncated version of the code representation of the narrator.

```
class Narrator {
  let speechSynthesizer =
AVSpeechSynthesizer()
  let gender: Gender
  let title: String?
  let institution: Institution?
  let givenName:
CommonPersonGivenName
  let surname: CommonPersonSurname
  let voice:
AVSpeechSynthesisVoice?

  private init() {
    gender = Bool.random() ? .male
: .female

    switch Int.random(in: 0...2) {
      case 0:
        institution = School()
      case 1:
        institution = Institute()
      default:
        institution = Church()
  }
```

This is only a small portion of the code used in the initialization of the Narrator, but serves to illustrate the richness that is available through such an approach; the Narrator exists as a collection of defined facts and attributes rather than simply as a name. These facts and attributes can

be related to one another using any programming logic desired, and can be passed along during the generation process as part of a rich context definition.

3.2.2 Example Output

The following are example outputs from the narrator introduction process in *Lost Rituals*.

Pleased to meet you! I am Dr. Malaya Mahoney, from Nymoxorr University of Parapsychology.

The University recently acquired this grimoire via an anonymous donation. It was immediately obvious that it contained the details of the most noteworthy rituals from all corners of the world. I have brought it for you to peruse.

Are you ready to start?

—-

I'm Acolyte Miracle Crosby, from the Sacred Orthodoxy of Undying Devotion. Hello!

To better understand the heathen mind, the Orthodoxy has built a library of the details of the most noteworthy ceremonies from around the world, logging the discoveries in this aged tome, called the Tome of Zemu. I am pleased to present it to you.

Shall we explore?

3.3 Ritual Generation

The process of ritual generation in *Lost Rituals* is built upon the same behavioral object strategy as used in the narrator introduction generation. The rituals contain many more data elements than the introduction, however, and therefore are constructed using a much larger number of branching behaviors and conditional data structures.

In the Swift programming language, any data structure can publish its own textual representation on demand. This “description” facility is leveraged very heavily by *Lost Rituals* to produce text output.

Each concept to be represented in the text is placed through the instantiation of the highest-level concept, such as “Ritual”. The process of instantiating this data object, contained within the initialization method of each object, not only establishes state information for the data object itself, but also evaluates various stochastic conditions and uses the results of that evaluation to instantiate smaller concepts that fall within the larger one. For example, a “Ritual” has a “RitualIntroduction” and a “Procedure”. The initialization of the Ritual itself is not completed in memory until all of the contained dependency concepts have themselves been fully initialized, and their own contained concepts initialized, and so on. Functionally, this means that an entire tree of established facts is created in memory before any text is generated.

A novel aspect of this strategy is that by utilizing a hierarchical instantiation pattern, a reference-based Context object can be passed along to any contained object to guide and participate in its instantiation, and perhaps even have additional information added to it. This is a powerful approach for allowing context to travel between artifacts, and opens an avenue to address some of the shortcomings of the approaches described earlier.

Additionally, scoped parameters can be provided alongside the common contextual information, based on specific demands and requirements of the

contained data object. For example, the “DomesticAnimal” structure allows the specification of whether or not adjectives will be associated with it. This allows code to make use of the concept of either “a pig” or “a well-fed pig”. The animal object is responsible for understanding its own attributes (such as, in this example, that the pig is well-fed) but it is not necessary to generate additional facts in cases where they are known to be irrelevant, especially since the ultimate depth of the additional fact tree cannot be known by the containing data object.

The following simplified code snippet illustrates how the instantiation process works, specifically for a “Bottle” object possibly used in a ritual.

```
struct Bottle: OfferableThing, UsableThing
{

  let name: String
  let article: String
  let adjective: String?
  let material: Material
  let methodOfOffering: String
  let methodOfUse: String

  init(singular: Bool = true) {
    adjective =
Bottle.adjectives.keys.map({ $0
}).randomElement()!

    if singular {
      name = "bottle"
      article =
Bottle.adjectives[adjective!]!
    } else {
      name = "bottles"
      article = ""
    }

    material = Crystal()

    var methodOfUse: String

    if Bool.random(probability: 75) {
      let filled =
Bowl.filledWords.randomElement()!
      let contents: String

      switch Int.random(in: 0...100) {
        case 0...33 :
          contents =
Bowl.nonFoodContents.randomElement()!
        case 34...66:
          contents = Ingredient().name
        default:
          let beverage = Beverage()
          if let adjective =
beverage.adjective {
            contents = "\(adjective)
\(beverage.name)"
          } else {
            contents = beverage.name
          }
      }

      methodOfUse = "\(filled) with
\(contents)"

      switch Int.random(in: 0...100) {
        case 0...25:
          let verb = singular ? "is" :
"are"
          methodOfUse += ", which \(verb)
then
\(Ingredient.offeringActions.randomElement(
)!)
\(Ingredient.offeringLocations.randomElemen
t()!)"
        case 26...50:
          methodOfUse += ", then
\(Bottle.putSomewhereSpecial.randomElement(
)!)"
        default:
          break
        }

      } else {
        methodOfUse = "filled with
\(Bottle.specialItems.randomElement()!)"

        if Bool.random() {
          if Bool.random() {
            methodOfUse += ", sealed"
          }
        methodOfUse += ", then
\(Bottle.putSomewhereSpecial.randomElement(
)!)"

        } else {
          if Bool.random() {
            methodOfUse += " and sealed"
          }
        }
      }

      self.methodOfUse = methodOfUse

      methodOfOffering =
material.methodOfOffering
  }
}
```

This snippet illustrates several of the key concepts: local state management, contained objects, initialization-time parameterization, custom branching logic and behaviors based on the represented object, and inline text generation through string interpolation.

Once the tree of facts and structures has been established, the process of generating the output text itself is simple and highly performant. The program

utilizes the on-demand string interpolation capabilities of Swift to generate a consolidated output of the entire data tree. Because this final step does not need to consider contextual state information (since that is owned by the behavioral objects being rendered as text), this provides an opportunity point to add decorative textual variation that is not part of the state tree's own representation. For example, in rendering the text for a single "ProcedureStep" in a ritual, the text conversion process can stochastically select from a variety of different introductory phrases, as illustrated in the following code snippet.

```
switch Int.random(in: 0...100) {
  case 0...15:
    str = "Next, "
  case 16...30:
    str = "After that, "
  case 31...45:
    str = "Following that, "
  case 46...60:
    str = "When that has been
completed, "
  case 61...75:
    str = "When that is done, "
  default:
    // Do nothing
    break
}
```

The exact phrase selected has no bearing on the state of the represented facts, which is why it can appropriately be selected at render time.

3.3.1 Example Output

The following are example outputs from the ritual generation process in *Lost Rituals*.

Just before the death of a female member of the community in the dangerous province known as eastern Ky, the most distinguished community members use a ritual practice to mourn and to release the soul into the afterlife.

The ritual requires the following four elements, which may be executed in any order.

To begin, a large cut of pig meat is burned.

When that has been completed, the participants chant while clad in blessed shawls and holding very fine bottles.

When that has been completed, one participant speaks the text of a sacred poem while garbed in a blessed robe and carrying a wand.

Finally, the participants, while attired in embroidered magenta silk shawls, chant.

—

The most respected citizens of Vady, just after the passing of an adult, have a sacred rite in order to express their sadness and to ask that the goddess called Casupac take pity on the soul in the netherworld.

The ritual is comprised of the following three steps.

While garbed in a blessed coat, a selected individual chants.

Following that, a spiced dish of sheep meat is burned.

Finally, a bowl is filled with cold white wine, which is then poured on the ground.

—

Prior to the first rain of the year in the lush forests called Lower Medohu, the female shamans have a sacred rite to ensure a thriving economy and to request the favor of the beloved goddess called Fiquad.

First, a single person dances towards a platform, upon which is placed a wand, while grasping a chalice.

Following that, a crystalline bowl is partially filled with wheat, which is then scattered under a tree.

When that has been completed, the participants speak the text of a sacred poem while holding fetishes depicting the mostly unknown demon known as Geposa.

When that is done, the participants in the ritual, while attired in blessed stoles, speak the text of a sacred poem.

Finally, a specially-prepared fig is burned.

4 Conclusions and Future Work

The use of behavior data objects for text generation certainly made the production of the Lost Rituals application easier, in the sense that it enabled the generation of coherent ritual description text that is internally coherent. The approach also shows promise in other projects, especially those that generate short-form coherent passages that address specific, focused subject matter with particular attributes that must vary in description along with the selected detail variants.

Future work includes increasing the amount of contextual information that is used during the creation of the ritual tree. For example, even though the context object already contains information about the purpose of the ritual, this is not currently used for anything during the generation process. It would be interesting to describe how individual steps in the rituals are intended to relate to the overarching goal of the ritual itself. It would also be interesting to have some of the individual procedural steps build upon the actions of the step immediately preceding them, to create more of a sense of “flow” from step to step.

Finally, this approach shows promise in the goal of creating long-form textual stories. We have not done any substantial work in this area, but the advantages of the strategies described herein offer potential benefits, and these bear investigation.

5 References

[1] NaNoGenMo. Github.io. Retrieved 20:15, November 8, 2020, from https://nanogenmo.github.io
[2] Why I love National Novel Generation Month. Medium.com. Retrieved 21:05, November 8, 2020, from https://medium.com/@liza/why-i-love-national-novel-generation-month-b8f6e58c6422
[3] Context-free grammar. Wikipedia.org. Retrieved 16:04, November 8, 2020, from https://en.wikipedia.org/wiki/Context-free_grammar
[4] K Compton, B Kybartas, M Mateas, “Tracery: an author-focused generative text tool”, Springer, Cham, International Conference on Interactive Digital Storytelling, 2015
[5] Tracery Writer. Beaugunderson.org. Retrieved 16:05, November 8, 2020, from https://beaugunderson.com/tracery-writer/
[6] Markov Chains. Brilliant.org. Retrieved 16:07, November 8, 2020, from https://brilliant.org/wiki/markov-chains/
[7] Markov Chains: How to Train Text Generation to Write Like George R. R. Martin. Kdnuggets.com. Retrieved 16:09, November 8, 2020, from https://www.kdnuggets.com/2019/11/markov-chains-train-text-generation.html
[8] Ziang Xie, “Neural Text Generation: A Practical Guide”, Stanford, web, 2017
[9] Text generation with an RNN. Tensorflow.org. Retrieved 16:12, November 8, 2020, from https://www.tensorflow.org/tutorials/text/text_generation

Twisted bodies: annihilating the aesthetic

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Abstract

The claim that architecture is designed for people is not extravagant, as they both occupy architectural spaces and serve as the scale for their design. That is, the human being and body "consume" and, at the same time, delineate architecture. Vitruvius (1st century BC) is rightly believed to be the first theoretician who saw in the human body not only the means but also the aim of architecture. In architectural practice this body has since been perceived as a paragon of excellence and presented mostly as an analogy of perfection and beauty, of a good gestalt and coherent form.
However, in this article I will raise questions about the maimed body in pain, its twisted and not-beautiful shapes. Has the contemporary idea of architecture addressed this body as well? I will introduce the problem, examine its origins and bring examples where the body is analogous to what is abject, distressed and in pain--all this in an attempt to argue that abjectness is inseparable from our lives.

The body-architecture analogy

In recent years various disciplines have shown a resurgent interest in the human body. Always at the forefront of scrutiny, mainly in the arts and sciences, the human body has become a topic of intense debate today also in other fields, such as fashion, industrial design, communications, architecture and, of course, in the classic disciplines of psychology, anthropology, sociology, economics; even literary studies and philosophy resound widely with questions about the status of the human being and body. This emphasis on bodily aspects raises a vast range of questions. Is the rekindled debate merely a revision of what was once debated but later somehow neglected and forgotten, or is this our natural, yet to be exhausted, curiosity eager to probe deeper at a propitious time? Does the preoccupation with the body spell discontent with its roles in many of the disciplines that should have highlighted its share in the definition of the modern human being's status? Or does the return to the body represent a refreshing, previously unknown, point of view after longstanding, deeply ingrained sexual stereotypes have been discarded?
Though we will be unable to offer an unequivocal answer to all these

questions, facts seem to defy arguments. Thus, one cannot deny that today the body stars in more disciplines than 20 years ago, and even architecture, which boasts a long tradition of focus on the body, has returned once again to this topic, raising new speculations that seemed fantastic and inadmissible a mere generation ago.

Architecture is, indeed, a special case. It does not examine the human being as a body, nor does it claim to present the human body as do the visual arts, fashion, photography, film, and certainly not as do post-modern theories on the connections between the body and sexuality. Still, architecture does deal extensively with the human being, in particular his body,1 and the publications honoring the body and its connections with architectural values are not fewer than in other disciplines.

If this is how matters stand, and analogous lines run between architecture and the human being, what is, then, the connection between architecture and the human body or, to refine the question, is the reference to the body immanent to architecture, a sine qua non if we are to understand its intentions, or does this analogy serve the pedagogical purpose of better explaining the architect's working process?

I would like to argue that the analogy between architecture and the human body is not fortuitous and certainly not trivial, nor does it merely teach us how to read an architectural work. Architecture and the body are two sides of the same coin: on the one hand, architecture views the human being as its purpose, that is, people populate architectural spaces--cities, their squares, streets and buildings that make up the human environment--and, as such, are the natural consumers of architecture, which plans, designs and builds for them. On the other hand, architecture uses images of the human body to justify its contents as paragons and examples of harmonious and proportional structures, but also as a measure for creating a proper and commendable environment suitable to human needs. Notable examples that address the human body include, of course, Vitruvius, whom I will discuss further below, and Le Corbusier who has designed numerous buildings in Europe, mainly during the fifties collaborating with Nadir Afonso (an architect and an eminent artist) using the 'Modulor' - a 'housing unit'2 as a principle of proportion. In these two examples,3 although distant in both time and their visions of the human being, the body and architecture function on two distinct levels, with a one-way analogy stretching from architecture to the human body, which serves here as a sort of schema for the architectonic structure. Against this example one can pit the post-modern architectural conception that refers to the body's connotations and not only its limbs, as does Ayn Rand in her novel The Fountainhead. Rand describes the limbs of the toned, virile body of the architect Howard Roark as though they were quarried from rock; it is on them he models his buildings. Although there is no direct connection between architecture and bodily features, the very drawing of such an analogy points to a reversal in the architectural view of the human body: from the body as a model--for Vitruvius and Le Corbusier--to an interpretation of the body as a metaphor for the building's power, as evident in the collection of projects Stud: Architecture of Masculinity,1 which discusses images of the masculine body in architecture.

1. A broader scope of the issue is discussed in Flesh and Stone: the body and the city in Western Civilization written by Richard Sennett, W. W. Norton and company, 1994. See especially chapter 8 'Moving bodies' in which William Harvey's revolution in anatomy and its influence on city planning, is presented.
2. In French 'Unite d'habitation' also literarily translated as 'housing unity'.
3. One more example worth noticing is Orlan's MesuRAGEs project in which she lies on a floor of a building, marks with a chalk her body, repeating her action till the floor is full with a display of Orlan-corps. See a detailed review in Carnal Art: Orlan's Refacing by: C. Jill O'Bryan, University of Minnesota press 2005, p. 8.

The "affair" between architecture and the body, isn't new, then, and Vitruvius was, as noted, the first to refer to the human body and the human being himself as a means that offers architects working methods he deemed crucial if architecture was to serve its aims properly. His treatise On Architecture features a hefty compendium of instructions on how to build well-proportioned and properly scaled buildings.
The following quote eminently describes the classical architectonic paradigm, which, trickling into the discipline, has become a timeless model:
Proportion consists in taking a fixed module, in each case, both for the parts of a building and for the whole, by which the method of symmetry is put into practice. For without symmetry and proportion no temple can have a regular plan; that Is, It must have an exact proportion worked out after the fashion of the members of a fine-shaped human body".2

Let us examine Vitruvius' central claim implied in this passage. First, however, I must refer the reader to a similar position held in the 5th century BC by Aristotle, who claims that an indispensable code underpins a well turned out tragedy that imitates well the characters' lives. The tangents drawn between art and an external factor aren't new, then. Vitruvius is following an already paved road when he uses the human body to establish standardization in architecture. Let us consider the analogy Vitruvius draws between architecture and a 'fine shaped human body' rather than the human body as such. The emphasis on 'fine-shaped' raises the
question of what underlies the choice of such a human being, rather than any other, as analogous to architecture. Are only the proportions of a fine-shaped human being suitable to the temples the Roman architect envisions? What about the person who does not diet and work out every morning, whose bodily proportions are not those Vitruvius set down in his treatise? Are the proportions of an unattractive person not sufficiently human? Furthermore, did Vitruvius' world teem only with perfectly proportioned people, and, therefore, he required the architect to imitate the perfect body as a basis of standard proportions? Or did Rome display the very opposite, people with regular human rather than ideal proportions, and, to correct this flaw, at least in architecture (as Renaissance painters were to do later), Vitruvius set the ideal body as a model, shunning the body structures of regular people. All these questions share yet another question, namely, why Vitruvius chose the human body at all rather than another external factor for his architectural instructions.

1. Joel Sanders (ed.), Stud: architecture of masculinity, Princeton, 1966. See also George Dodds and Robert Tavernor, Body and Building: essays on the changing relation of body and architecture, MIT press 2002. Susan Bordo, The Male body: a new look at men in public and in private, Farrar, Straus and Giroux (New York), 1999
2 Vitruvius, On Architecture, translated into English by Frank Granger, Harvard U. press, 1932, p. 159

Vitruvius' analogy, certainly not trivial but informed by the view that set the human being and his body at the center, was already drawn in the 5th century BC by the ancient Greeks. They addressed the human body from every possible point of view, investing it with a wide range of meanings that were to animate its perception and description throughout Western culture. Quite plausibly, ancient Greece played this role because, unlike in the Middle Ages, no distinct disciplines had yet emerged, such as religion, myth and mythology on the one hand, and painting, sculpture, theater, philosophy and science, on the other. No pure disciplines free of mutual influences existed in ancient Greece, and the myths, the central axis of daily life, were actually the language of artists, playwrights, philosophers and scientists. In poetry, fiction and even the visual arts, such as painting and sculpture, this self- evident influence requires no justifications, but when the language of mythology is used in the sciences, especially anatomy, a rather developed field in ancient Greece, an explanation is called for: must an anatomical description leave the body untainted by defining and descriptive concepts of the period? Must the scientist ignore the culture he lives in, the beliefs of his contemporaries, their religious principles, myths and mythology and examine the object of his study objectively without any apparently external connections or influences? Is the demand for objectivity possible or an unquenchable yearning? These questions, which inflected the attitude of ancient Greeks toward the human body, defined the latter much as did Vitruvius, although his conception of the body transcended its mechanical system of organs and invested it with a metaphoric meaning. To illustrate this point we will return to ancient Greek art, theater and mythology, which illuminate the human body from two angles: the concrete body moving within the space and time of the play's characters and the eternal body transcending concrete time and space as a symbol of balance (or imbalance) between the human being and his fate.

Sophocles' tragedies are a case in point. The first play in the trilogy tells of Oedipus the King, the cause and effect of the moral imbalance that stems from his very existence as a human being, despite his bravery, wisdom and cleverness. A mortal who solves the riddle of the Sphinx, he unsettles the status quo between the gods and people, paving the way for a chain of transgressions that began with his birth, his abandonment, feet bound, on the mountain, his marriage to his mother and the birth of his four children, and up to the grim end when he plucks out his eyes and is banished from his country. At each of these stages the human body is the ground where the drama of unsettled mythical balance unfolds: between the gods' metaphysics and human life, between the cosmic order and the triviality of earthly events, between the concrete body and the metaphoric body.

Nor is the human body absent in the trilogy's third play, where Antigone asks to bury her brother in defiance of King Creon's decree that forbids his burial because he betrayed Thebes. This is not the place to examine the complex conflict between loyalty and treason, between the king's decree and Antigone's flouting of the law, though we should point out that the entire play revolves around a dead human body that functions as a central image in the disturbed balance between the royal decree and Antigone's conscience, between death and Antigone's fate.

Not only tragedies but comedies, too, address the body. Aristophanes' Lysistrata, written probably in 411 BC during the Peloponesian wars (430-404 BC) between Athens and Sparta, is among the famous. In the play Lysistrata tries to convince the women of Sparta and Athens to abstain from sexual relations with men to make them stop the war. In the best of Greek writing tradition, Aristophanes does not forgo graphic descriptions of both male and female sexual organs and erotic scenes verging on pornography in order to portray human weaknesses and steer bodily passions into the ideological conflict between Athens and Sparta. Many mythological stories flash through the lines, such as the myth of creation and the birth of Gaia's and Uranus' children, the story of the Amazons, and, of course, all the stories about the gods' seductions and betrayals.

But the ancient Greeks looked at and learned about themselves not only in the theater. The much more accessible arts of painting and sculpture presented the bodies of women and men not only as ornaments or aesthetic expressions. Set in a mythic context, the paintings of women and men depicted impossible imaginary situations. This may be why for the ancient Greeks art mediated between mythology and daily reality, between the metaphysical and the physical, serving as a sort of shield for the individual. It is not fortuitous that Aristotle lists catharsis as an important element of tragedy, as it is the only way to see in art allusions to daily life and so-called realistic scenes, even if these are hard, though relevant, to our lives.

In this sense Aristotle was the first, if not the most rigorous, theoretician who understood that art was not only an aesthetic but also a pedagogical activity. Art seeks to present the imaginary, the desirable rather than the extant at a particular moment, to highlight the probable1 rather than only concrete reality as such. Art, then, infuses an apparently trivial reality with an ideational, sublime dimension that rhymes with the gods. The implied tone in Aristotle's claim that the artist must present the universal through the particular and set down the concrete as he highlights the general truth is noteworthy, as it opens the door to metaphoric representations--key mediators in the complete presentation of the concrete.

Vitruvius was well aware that art played this role, whose application in architecture was not fortuitous nor devoid of historical context. His argument isn't, therefore, trivial, if only because in those times, too, the body's arena was not exhausted by the circumscribed field of anatomy but symbolized, more than anything else, the Zeitgeist that was to peak in the Renaissance. After all,

ancient Greece, Rome and Renaissance Florence, too, were swarming with fat and thin, tall and short people, not to speak of the variously disabled. Nevertheless, Vitruvius and the architects of the following generations ignored these variations and exhorted young architects to learn from the image of the perfect, ideational human body that thrived in their wild imagination or, at least, in the world of Platonic ideas.

Surprisingly enough, the theories of Vitruvius resonate even today among contemporary architects, despite the shifts the images of the human body have undergone in art and science. An unusual example in this context is the fascinating work of the architect Le Corbusier who, unlike his colleagues, boasted he was able to and really did infuse the theory of Vitruvius with a modern meaning when he built, inspired by him, what he termed "the Modulor"--a house adapted to the average human body--with the intention of harmoniously organizing his environment inside and outside his home. Located in Marseille, the apartments feature units with proportions adapted to each family member: the rooms for adults are larger than those for children, the proportions of the family living room differ from those of the bedroom and kitchen, etc. Yet for Le Corbusier, says Anthony Vidler, "the body acted as the central reference"2 and is considered the last, to some extent even pathetic, if not tragic, survivor among a community of architects who remained loyal to the model proposed by Vitruvius, and although some architects look to the human body for inspiration, most, certainly unlike Vitruvius, perceive the body as a metaphor.

1. "It is evident, however, from what has been said, that it is not the function of the poet to relate what has happened, but what may happen, - what is possible according to the law of probability or nescessity." Aristotle, Poetics IX 1, translated by: S. H., Butcher, Aristotle's theory of Poetry and Fine Art, Dover publications, 1951.
2 Anthony Vidler, The Architectural Uncanny: essays in the modern unhomely, MIT press,1994, p. 90.

Vidler attributes the rift between classical architecture, in which the building's adequacy is based on the analogy to bodily proportions, and an architecture free of Vitruvian anthropomorphism, to Edmund Burke, the 18th-century Irishman, known also for his religious stance precisely during the Enlightenment, which has tried to throw off the shackles of religion and tradition. Despite his religious-ethical world view, Burke sees in the human being a limited creature subject to the evolutionary laws of nature rather than to divine powers. There is a reason why we hear Burke anticipate the later Charles Darwin, who saw nothing sublime either in the human being but studied him as yet another link in nature's random evolution. Against this background, as general and sketchy as it may be, Vidler's quote from Burke's famous treatise Philosophical Inquiry expresses staunch opposition to the analogy between architecture and the human body. Burke disdains the Vitruvian human being, claiming that To make thus forced analogy complete, they represent a man with his arms raised and extended at full length, and then describe a sort of square… It appears very clearly to me, that the human figure never supplied the architect with any of these Ideas…. Men are very rarely seen in this strained posture; it is not natural to them; neither it

is all becoming… Certainly nothing could be more unaccountably whimsical, than for an architect to model his performance by the human figure, since no two things can have less resemblance or analogy, than man, and a house or a temple".1

Burke's rejection of the analogy dear to Vitruvius and the advocates of proportion who walked in his footsteps unsettles the foundations of the Aristotelian theory that evaluated art by its ability to create sublime, imaginary realities. Instead, art is to be grasped through the human senses, that is, it passes muster as good art if it elicits feelings. If we apply this claim to architecture we realize that Burke does not remove the body from the debate on the discipline's nature, but against the perfect, sublime body depicted in Leonardo da Vinci's famous drawing, he pits the body as it is--the subjective body moving through architectural spaces, with its sensations and impressions as the measure for the building's nature and value.

1 Burke, E., Philosophical Enquiry into the Origins of our Ideas of the Sublime and Beautiful, p. 100 cited from Vidler 1994, p. 72. The same passage is cited in the Opening Statement by Deborah Hauptman (ed.), in her The Body in Architecture, Rotterdam: 010 Publishers, 2006. Introducing Burk's challnge of the Vitruvian body in the very first page of her book is of no coincidence, stressing the point that Architecture should not be based on 'a forced analogy, namely, the ideas of regularity, geometry and proportion as deriving from the human body and being considered the efficient cause for beauty in architecture'.

The advent of the ugly and distorted

Burke's critique of Vitruvius seeped deeply into architecture, whose quest has shifted increasingly to emotion and surprise, often at the expense of functionality. Salient examples would be the works of such architects as Daniel Libeskind (The Jewish Museum in Berlin), Frank Gehry (Bilbao), I. M. Pei (Javits Convention Center in New York), to mention only a few of the current star architects who seem to have carefully read Burke's brief observation that the test of art, including architecture, is its ability to call forth emotions: fear, anxiety, dread and, of course, empathy, joy, etc. In this context Robert Venturi's well-known book Learning from Las Vegas1 (1972) is noteworthy, as it takes issue with Bauhaus sterility in favor of an architecture that conveys the spirit of the place and, therefore, strikes deeper chords than the universal pretentiousness suggested by buildings aiming at the proportional and the
sublime without any reference to their time and place.

It is in this vein that we are to read many theoretical works on architecture with ample references to theoreticians who, were it not for the turnabout in architecture, we would have hardly seen their traces in this discipline: Sigmund Freud, Luce Irrigaray, Judith Butler, Andrew Benjamin, Anthony Vidler, Umberto Eco, Tali Hatuka and Rachel Kallus,2 who have ushered in a new approach to the twisted, ugly, aching, sexual body.

As a gambit to all these, I must refer to Freud's famous essay The Uncanny (1919), where he analyzes a feeling that is neither fear nor anxiety but a special emotion that stems from the repression of a childhood experience of dread. Among the many examples he includes

the dread triggered by automatons moving in space, the recurrent appearance of an object, event or person in our regular surroundings or on our itineraries, such as a certain number in various contexts, or the sudden looming of a person we just thought about, getting lost in an unknown city, and even identical twins, who offer no apparent reason for the discomfort and even dread such identical doubling elicits. Finally, Freud lists as uncanny also certain literary and dramatic characters and events. The ugly, the distorted and the disproportional encountered in art do not elicit fear or anxiety but, rather, discomfort and at times even an uncanny sense that they are about to unsettle the social order.

To continue Freud's idea, we could say that the sense of uncanniness is contrary to the emotion elicited by the beautiful, the sublime, the harmonious and the proportional. The latter offer an experience of pleasure and tranquility, whereas the crippled, imbalanced, wounded call forth discomfort and even dread without any apparent reason. Still, in many cases, something beautiful and harmonious can also provoke dread if presented exaggeratedly with surprising elements.

1 Robert Venturi, Denise Scott Brown, Steven Izenour, Learning from Las Vegas: the forgotten symbolism of architectural form, MIT press 1092
2 Tali Hatuka and Rachel Kallus, "Body", Rachel Kallus and Tali Hatuka (eds.), Architectural Culture: Place, Representation, Body, Resling, 2005, pp. 243-254 (in Hebrew)

I have chosen to open with Freud because two brief passages in his essay refer to architecture. I have already mentioned finding oneself in an unfamiliar street in an unfamiliar city: here the dread stems from the tourist's sudden disorientation as he is looking for his hotel yet returns over and over to the same street he wants to leave behind. The second example is our own home when the lights suddenly go off and we grope in highly familiar hallways but are hard put to find our way in the dark. Both cases elicit a sense of uncanniness and disquiet, not because a figure or an object suddenly appeared in our environment or because a jarring sound burst from an unknown source. We experience uncanniness because our place has become distorted and different, and the familiar and predictable are suddenly unclear.

In line with Freud's concept of the uncanny, we could say that from the mid-19th century modern art has aroused feelings that had certainly not been experienced by art viewers in previous centuries. The very reference to non-sublime body images flouts every aesthetic principle prevalent thus far. The aching, the ugly, the dismembered, the bleeding--all these defied the symmetrical, harmonious body, shedding a critical light on the past with a slice of concrete life in all its grotesque and tragic aspects. This transgression also meant to constitute a new but actually familiar image of the human body ever since--ailing, aching and bleeding--though art, literature, theater and architecture had blurred, if not concealed, its representation. Does this omission stem from the dread elicited by gruesome sights? Has the body in pain been hidden by the fear that it might be perceived as trivial and banal compared to the unequalled sacredness of Jesus'

martyred body? Could the image of the sick, distorted body have changed the very order of such fields as architecture, which used the healthy, harmonious and symmetrical body as a paradigm for a gestalt worthy of imitation?

With these questions in mind, let us examine the body images that emerged in the wake of the French Revolution and whether modern architecture has been mindful of the shift in body images or has remained loyal to the Vitruvian vision of architecture as an imitation of the beautiful body.

1 Linda Nochlin, The body in pieces: the fragment as a metaphor of Modernity, Thames and Hudson, 1994

Images of the fragmented body in modernism

I first became interested in body images in art after reading Linda Nochlin's1 short book The Body in Pieces. Its much more enticing subtitle specifies what the title implies, who the body pieces belong to and in what context they are discussed. Indeed, The Fragment as a Metaphor of Modernity not only reveals the book's tenor but also explains how to spot modernity, which, the author claims, "invented" fragmentariness. That is, the consummate expression of modernity can be found in the body's depiction in art: the greater the fragmentariness, the firmer the body's status as image and metaphor, and, as such, it enhances modernism. Nochlin locates the rift between traditional art and modern art during the French Revolution, and, strange and morbid as this may sound, she considers the guillotine a device that "ushered in the modern period, which constituted the fragment as a positive rather than a negative trope".1

Loss, fragments, the dismembered body are the most apt counter-arguments against "the nostalgia for the past," Nochlin writes, and, in this sense, the emergence of body parts is to be interpreted as the deliberate destruction of whatever is connected to tradition and to what we wrongly perceive as vandalism in the creation of new, unbiased images in art. The guillotine was the first modern mechanical means of execution that stripped the execution of its punitive aspect, turning it into an icon of modernism that purged society of the burden of the old world. While we shudder at the sight of the guillotine and the executions during the French Revolution, in those years they were perceived as a dramatic change in the politics of punishment. If, up to the revolution, the treatment of the convict's body was driven by fundamentalist motives, that is, the restoration of the old order, as in Socrates' case, or selfish motives (kings executed political rivals), never had people been executed, as during the French Revolution, in the name of the Enlightenment and the promotion of humane values, such as freedom, equality and brotherhood. Not surprisingly, artists from all the arts praised and documented the guillotine as the first soldier fighting for lofty values, and the results of executions--heads, hands, legs, etc.--were presented as symbols of progress rather than mere expressions of cruelty or terror.

Indeed, many paintings feature a severed head held by a revolutionary, recalling paintings of David holding Goliath's head or of Judith beheading Holofernes (the

latter by Artemisia Gentileschi, 1635). Despite the time gap and horror, in both cases the severed limb is meant to elicit not only revulsion or dread but also positive connotations. Once the dismembered body settled as a legitimate display in art, the door opened, mainly from the 19th century onward, for many artists who saw the body in general, but also their own, as a ground to express social, national and existential values. Let us recall that during the French Revolution, when both France and Europe were plagued by social and political disorder, quite a few members of the middle class used the circumstances to tout libertine ideas. Contrary to traditional society, which venerated the family and social status, the revolution granted, mainly to men but also to quite a few women, the freedom to meet in cafés, bars and pubs. Free to consume, among others, luxury, fashion and pornographic literature, many, as noted by Margaret C. Jacob1, became aware of their erotic body, of their passions and appetites, which could at last be quenched.

1 Ibid. p. 8

People suddenly discovered that life was not underpinned only by ideas, values and religion, that there were bodies and objects, that the human being had a body whose behavior did not depend on the soul only. The body turned out to be a historical entity but, unlike most other objects, not to speak of the ideas, values and laws by which we live, it has not undergone changes and upheavals in its appearance and functions, nor has it become more sophisticated. Throughout history the human body has remained constant: a complicated, complex system of organs and limbs, whose deviation from normative functioning is perceived as an unusual event, leaving us powerless before the body's overall definition. If anatomical changes did occur, they were external and artificially introduced in order to police the body and restore its normative functioning.

Our insights about the body's essence call for, then, the solution of the following paradox: on the one hand we are aware of the concrete private body, which, as noted, has not changed and will most probably not change dramatically in the future; on the other hand, we cannot ignore the body images depicted by scientists, theologians, philosophers, artists, playwrights, writers and poets, but also architects, who do look at the physical body yet build around it images that do not dovetail its concrete existence. Given this paradox between the concrete body and its images, we cannot but ask where the body is, and which of the above possibilities describes it better. The human body seems to be an enigma: since we have a body, it is accessible and familiar to everyone but its definition in a historical context, the attendant images, the philosophical and psychological dilemmas it raises in the arts and sciences indicate that the body is a "chameleon-like concept" that functions in our discourse as both a physical object and a metaphor. It was Théodore Géricault, in the fledgling years of modernism, who offered the most arresting metaphorical expression of dismembered, scattered human limbs. In a series of paintings of severed limbs he underscored absence, setting hands, legs, heads next to each other as though in an anatomical display of lifeless body parts devoid of context and meaning, as

though they were mere limbs bereft of any address or identity, limbs that belonged to no one in particular, lacked history and could not explain what they were doing and how they entered the painting.

1 M. C., Jacob, "The materialist world of pornography", in: Hunt, L., (ed.), The Invention of Pornography: obscenity and the origin of Modernity 1500-1800, New York 1993, pp. 157-202, See especially p. 159



Théodore Géricault, Severed limbs, 1818

Many artists who came of age with the French Revolution, among them Théodore Géricault, painted the maimed human body. Without memories of the revolution, these paintings would have hardly been accepted. In 1816 Géricault painted also an execution in Italy, wounded soldiers lying on a cart (1818) and a man with a leg prothesis standing in front of a Louvre guard. As noted, these paintings offered harrowing depictions of the guillotine and of France's status and situation in the wake of the Napoleonic wars, as though to remind us that against Napoleon's imperial image (he had been painted by Géricault himself) were pitted human shards as a historical warning of a leader's hubris, a leader who disdained no means to glorify himself. These paintings, says Nochlin, are a reminder for art historians who address the human body only from the iconographic point of view, ignoring its physical, aching and tormented corporeality, which represents, as in the above example, events in the history of France. Nochlin's claim would have been tenable had Géricault been the only one to paint such sights at the time. In this case we would have had to interpret his paintings as historical documents rather than as a metaphorical expression of the human condition. But since Géricault did not work in a vacuum, and since quite a few artists of that period and even later used the body as a central theme in their work, we could hardly accept uncritically Nochlin's claim that this is not iconographic painting. The artists of the French Revolution, as well as those of the 20th century, such as Cindy Sherman, Franco B, Orlan, the Chapman brothers and others, whose work we will examine further below, would not have won such acclaim and legitimacy were it not for the shifts in the vision of the human body with the emergence of scientific materialism several years prior to the French Revolution. This is not the place to expand on this subject, yet it should be noted that scientific materialism emerged concomitantly with the spreading of Protestantism and, later, Calvinism.

There were not only essential theological differences between Catholicism and the surge of Protestantism and Calvinism. The new radical Christian movements, in particular, exerted a marked influence on science and, therefore, on the definition of the human body in the arts. Science saw this turning point in the work of

William Harvey1, who studied the function of the blood vessels, heart and heart valve structure and defined them contrary to the then prevalent approach influenced by Galen, who had written about the structure of the human body and even drawn sketches, now lost. A Platonist, Galen had described the circulatory system in spiritual terms--oxygenated blood carried "vital spirits," whereas the blood returning from the body lacked them.

As it often happens in science and, of course, also in art, the paradigm for a turning point does not originate in the field itself but is animated by external factors. One influential paradigm was philosophy, which, at least in the period under discussion, was closer to science than it is today. Indeed, materialism is usually seen as straddling the religious turning point and philosophical positions, from Thomas Hobbes, through René Descartes and up to Julien de la Mettrie2 (1709-1751), a physician and philosopher who is, I believe, the most pertinent to our context: in his book L'Homme Machine (1748) he mocks the Platonic view, stating that the human being is a machine. De la Mettrie expands here the thesis about the human body elaborated by Descartes, who may have been among the first to propose the machine as a model for understanding the body but, as a rationalist, he remained loyal to the soul's role and God's centrality. De la Mettrie bypasses these two elements but, fearing persecution by the Church, he uses Descartes' reference to God as a ploy that would enable him to publish his work.

De la Mettrie wrote works on dysentery and asthma, and when L'Homme Machine
was published a coalition of Protestant and Catholic priests protested his view that Man is so complicated a machine that it is impossible to get clear idea of the machine before-hand and hence impossible to define it. For this reason, all the investigations have been in vain, which the greatest philosophers have made a priori, that is to say, in so far as they use, as it were, the
wings of the spirit. Thus it is only a posteriori or by trying to disentangle the soul from the organs of the body, so to speak, that one cam reach the highest probability concerning man's own nature, even though one can not discover certainly what nature is.3

1 See an extensive discussion on Harvey's contribution to the understanding of the cardiovascular system in: Jonathan Miller, "The Pump, Harvey and circulation of the blood", in: J. M. Bradburne (ed.), Blood, Art, Power, Politics and Pathology, Munchen 1990, pp. 149-155
2 Julien Offray de la Mettrie, Man a Machine, La Salle, Illinois 1961
3 Ibid. p. 89

In other words, the materialist de la Mettrie seeks to replace the Platonistic, non- empirical research methods prevalent until Harvey's time with scientific materialist methods that treated the human body as a machine not driven by the soul.

It is not clear whether Hobbes', Descartes' and, later, de la Mettrie's materialism directly influenced the artists of their times, but the very circulation of this theory in many intellectual venues at the time must be given its due in a

discussion of the body's place in the visual arts. I cannot review here the entire baroque period, which seems to have responded more than any other to materialist principles, but paintings by such artists as Caravaggio (The Crucifixion of St. Paul, 1601), Rubens (Descent from the Cross, 1611) and, especially, Rembrandt's painting The Anatomy Lesson of Dr. Tulp, 1632, which depicts a guild of surgeons headed by Dr. Tulp operating on the just executed young criminal Aris Kindt, leave no doubt about the sharp divergence from the Vitruvian, that is, beautiful, human being worshipped 150 years earlier, during Renaissance.



Rembrandt, Doctor Nicolaes Tulp's Demonstration of the Anatomy of the Arm (1632)

It is in this vein that we are to look at the works of Géricault, and although I don't know whether he had read de la Mettrie's L'Homme Machine, the very reference to the human body and its parts indicates that the physician's work was known and had somehow reached the painter's doorstep. Because, if any visual representation does loyally depict de la Mettrie's thoughts about the body's materiality, it is in Géricault's morbid paintings. Let us recall that in those years, when he painted these paintings and The Medusa's Raft (1818-19), Mary Shelley published Frankenstein (1818), which blends pseudo-medical anatomical descriptions with the typically romantic desire for immortality.

Still, the force of Géricault's works lies not only in the depiction of severed limbs but in the highlighted absence, the disappearance of the concrete body, with the remnants as sole testimony to its existence. Do Géricault's paintings anticipate Jean Baudrillard's idea of simulacra? Do they foresee the condition of the postmodern human being, whose life is steered by an invisible hand? Though these were probably not Géricault's thoughts, one can easily read his works also a prologue to the works of many artists, such as Man Ray, Gilbert and George, Cindy Sherman, Maurizio Cattelan, Vanessa Beecroft, Sally Mann's corpse photographs, Dinos and Jake Chapman, Sigalit Landau, Robert Maplethorpe, and such performance artists as Ron Athey, Franco B and Orlan. All these represent the simulacra, the remnant or the ersatz of the concrete, so much so that the real connection with the reality to which they are doomed is lost. They all share, then, the dilemma between concreteness and fantasy, between the object as it was meant to be - complete, full, apparently extant - and what the artist actually presents, what seems, at least at first sight, partial, a remnant, an allusion from which we are to infer the complete narrative.

Does not the reference to the body in the works of these artists conceal an unruly desire to look at the I, at any I, even the homely, and don't the gaze at the distorted and ugly, the scouring of the

body and its remnants aim to breach body images in order to reach out to the concrete, to the true? To answer these questions I will examine three notable artists whose work features the body as a central theme. While their place in postmodern art and their influence on many other artists is indisputable, I would like to show that individually, and certainly as a group, they created body images that resonate in other fields as well, including architecture.

Cindy Sherman, Franco B and Orlan

The artists Cindy Sherman, Franco B and Orlan may not be innovative in setting the body at the center of their work. Already in the 1960s and 1970s quite a number of artists, such as Marina Abramovic, Chris Burden and Joseph Beuys staged similar body performances.1 Still, there is something new in Sherman, Franco B and Orlan, manifested in their vision of the body not as a means to rebel against earlier, traditional, art, which dealt with the beautiful, the aesthetic and the artistic object. On the contrary: unlike the artists of the 1960s and 1970s, which were the first to use the body to chart a new artistic path, Sherman, Franco B and Orlan have been seeking a new reading of the body itself or, rather, to restore a long since abandoned reading of the body and to present what is abject, aching, rejected and twisted as an inextricable part of our lives. Of these three Orlan is the most extreme with the live broadcast of her surgeries.2 The various objects inserted under her facial skin distort 1 An extensive overview of the subject can be found in Tracy Marr and Amelia Jones, The Artist's body, Phaidon 2000 2 Quoting Orlan: Carnal Art open 'a new Narcissistic space which is not lost in its own reflection… So I can see my own body suffering … look again, I can see myself down to my entrails… a new mirror stage', in: Kate Ince, her image in a sort of simulation of plastic surgeries people undergo to improve their looks. On the other hand, Franco B, who also cuts into his living flesh, offers once every few months a performance of blood dripping from his veins. In this sense Cindy Sherman is the only one of the three not to slash or change her body through real bodily intervention; at most, she disguises herself in her works, creating a fascinating gallery of figures from the repertoire of Hollywood films and sights glimpsed in New York.

In a video of her early work, in which she stages herself in scenes reminiscent of 1950s films, but also in later, more mature, works, where she disguises herself as imaginary figures, Sherman repeatedly raises the question: "Where, then, is the real Cindy Sherman?" Where is the real Cindy Sherman realized--in simulacra, in the artificial look she has created, or in the flesh-and-blood person living her daily life in New York? If so, where, then, is the simulacra? In art, which reveals Cindy Sherman's real passions and desires, or in daily life, which forces her to curb her passions and desires and abide by cultural principles set down by others? To which arena--the one called art or the one called reality--are we to ascribe truth values?
And what is the body's place in this story? Is it invoked because it is physical, a concrete object that cannot be disowned and, as such, enables concrete reference, as to other objects surrounding it, such as a chair, table, etc.,

or does this object's ontological status differ from that of others and, therefore, raises questions about identity, memory, consciousness, which are not the share of regular available objects? Would it be correct to say that Sherman, like other artists who address the body, expresses dichotomies that haunt contemporary culture but were already discussed by Aristotle: concreteness / fantasy, reality / simulacra, true / imaginary?

These questions emerge more poignantly in Sherman's last works from the 1990s, in which she has replaced costumes with dummy parts--hands, legs, faces--to stage morbid scenes reminiscent of horror movies. I will first address her work and show that the body images she has created are neither fortuitous nor trivial, and that their influence on the conception of the human being as a whole and on disciplines touching on the visual arts, such as architecture, helped shatter several mainstream views.
Throughout her artistic career Sherman has used herself as the central theme of her works. In her early works from the 1970s she photographed herself in urban environments, her attire evoking film noir and Hollywood classics. Only in the 1980s do we notice a shift with her imitations of horror film scenes, later echoed in the Orlan: Millenial Female (Dress, Body, Culture), Oxford 2000, p. 49. For a broader discussion on Orlan's works, see C. Jill O'Beryan, Carfnal Art: Orlan's Refacing, University of Minnesota press, note especially dramatic scenes featuring medical dummies and twisted dummy parts. Indeed, after presenting herself as a pig, she photographed vomit and scraps of used clothes; starting in the 1990s she has used dolls as a sort of simulation of the human being and his condition in modern society.

chapter 2: 'Looking inside the Human Body'.



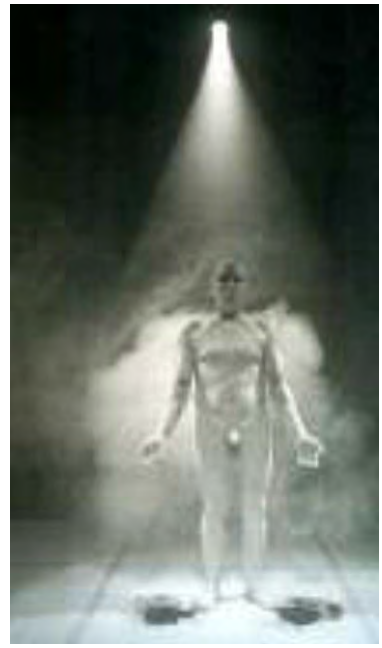
Cindy Sherman, untitled, 1992

While Sherman was not the first to include dolls in her work--Man Ray preceded her with a series of dummies in erotic, at times rather provocative, postures--the very reference to the body as a still life, and not just any but a doll imbued with all our cultural connotations, paints its use in somber colors. Sherman replaces the concrete body with slashed, twisted, maimed, injured dolls. In some works the dolls look at us, laughing madly and grimacing, at times they look at us straight, horrified by what is happening around them. Almost all the works refer explicitly to sex, pornography and death, with special emphasis on the face, sexual organs, severed hands, legs and gaping bellies. Here and there figures wear masks sported in S&M clubs and marginal communities, flaunting body parts with various accessories inserted in them. The abject, disgusting, repulsive, compounded by distortions and crippleness, offer a highly painful visual experience reminiscent of Géricault's, Man Ray's and even Maplethorpe's

works. Still, there is a vast difference between Sherman and other artists who address the body in their work, if only because she uses artifacts rather than real body parts, which animate her work with a hysterical aspect that reflects sweeping despair and loss of humanness brought about by the nihilism we are steeped in. In an interview she stated that her works are not meant to please and comfort. On the contrary, they seek to wake up, "to bite" and elicit self-awareness about the place of the distressed, tormented, aching body as an archetype of modern life and its demands for considerable level of alienation. The shocking effects and added value of this series stem from its intensity, which elicits in the sensitive viewer familiar with art history a self-reflexive response about the body's and his own place vis-à-vis the raw erotic images of these staged photographs.

Elizabeth Smith rightly compares this series to Francisco Goya's well-known work The Sleep of Reason Produces Monsters (1797), which depicts what may happen when human logic falls asleep: the sinister forces hidden just beneath the surface would burst out and settle among us like familiar family members. It is generally assumed that in this work Goya meant to herald the advent of surrealism, but in our context, g despite the distance in time, there is no doubt that Sherman, too, also sees the rotesque as a faithful expression of our Zeitgeist. The twisted body is a metaphor for the culture, politics and fragmented life typical of modernity and its nihilism, cynicism, competitiveness and lack of values.

While Sherman expresses her insights through the fantastic realities she builds with dummies, Franco B1 goes one step further. In his performances he exposes abjectness, distortion and ugliness with his own body, as though sacrificing himself in the very presentation of what is despised, bleeding, wounded and maimed.



Franco B 1998

Most of Franco B's works are very hard to watch, as they touch on sights we would rather avoid. In a television interview he said that his performances touch the raw nerves of the bourgeois who averts his gaze from wretched cripples, beggars, AIDS patients, homeless, refugees from the East, foreign workers, singers and musicians in subway stations, servants, home cleaners and cab drivers who roam the streets of the big cities in the thousands yet are hardly noticed.

1 See Susan Hiller's paper "Part of what art is about is to find ways of beginning to say things about the darkness of culture" in: Franko B, Block Dog Publishing, no pages indicated. For a much more elaborated analysis of Franko B's works in the context of Carnal Art, see Fransceska Alfano Miglietti "About wounds", in Extreme bodies: The Use and Abuse of the Body in Art, Skira, pp. 17-41

In Franco B's work, the bruised, wounded, twisted, aching, punctured, tortured body wallowing in its own blood functions as a lighthouse whose beacon reaches out to our bleak culture. Perhaps, through his performances, he wishes to help us, the viewers, to imagine the evil that may be yet our share in the future. Perhaps he is writing the looming apocalypse on his body, now that the illusions about the eternity of Western culture--with everything it implied about the future of the human species-- were shattered. Franco B's performances are unsettling and haunting, his chalk-white painted body casts a spell on the viewer, its shocking self- sacrifice recalls ancient myths in which humans and their body parts were sacrificed to appease the gods. To top it all, Franco B the Catholic believer grants his body sacred status, evoking Jesus' body, and his bleeding veins raise associations familiar to every Westerner. All these elements dialogue with the familiar past and the alienated present, with quite a few clichés about the tragic axis of the modern human being who, despite progress, is unable to escape his body in pain. The very use of the body as a medium, with emphasis on pain and abjectness, is certainly not the only factor that has influenced postmodern architecture, but I have no doubt that the legitimacy Franco B has enjoyed in presenting the ugly and the twisted has sent ripples through other disciplines too, including architecture.



Orlan, The second mouth, 1993

Franco B's self-flagellation and Orlan's surgeries function not only as metaphors, they have also deeply affected our conception of human essence. Invasive body performances have triggered an epistemological upheaval not only in the concept "body" but also in the latter's very way of being. For Orlan the body is not a means of artistic practice; she has turned her body and public surgeries, broadcast live throughout the world, into the very purpose of her artistic practice. Facial changes made with a surgical scalpel (it should be noted that only Orlan's face, but never her body, is operated on) offer, on the one hand, a new reading of the concept identity when surgical metamorphosis "grants" a new identity. On the other hand, Orlan's work suggests that the body is flexible and can be changed any time, that the face is not cast in stone, it is neither sacred, nor beautiful, nor something wrongly perceived as the ideational blueprint of the human body, but a sort of appearance, a battlefield that teaches us about our life. The predilection for pain and distortion in art, for ugliness and the body's decay, its presentation by Sherman, Franco B and Orlan as an assemblage of fragments, a random,

trivial collection of limbs--all these indicate to what extent the body, though deemed sacred, is actually a material like any other, and hurting it desecrates nothing but only offers a new channel of addressing it. As noted, Orlan is far ahead of the others, as she uses plastic surgery to create natural distortions permanently marked on her face. Instead of correcting and embellishing, as the consumption culture of plastic surgery urges us to do, Orlan uses the same technique and surgical scalpel to offer a subversive reading of the hankering after beauty, perfection and eternal youth. This inversion reflects a cultural ambivalence: people sway between the desired imaginary body and the material body living here and now or, specifically, between Orlan's slashed face expressed in art and the yearning for the perfect face and beautiful body touted in ads. Orlan is, then, the mirror image of our consumption culture and, showing the ugly and distorted other, even if deliberately and artificially created, she offers an alternative to what is perceived as beautiful and perfect.

Epilogue

Can we translate Orlan's, Franco B's, Cindy Sherman's and many other artists' vision of the body into architectural language? Can the twisted and ugly be applied to architecture? Is the Vitruvian analogy valid also when body images do not even skirt the ideational body? Would it be correct to say that the conception of space, envelope and structure in postmodern architecture has been influenced by the aforementioned artists' vision of the body? If so, can the Vitruvian analogy between the body and architecture predict, over and over, architectural "fashions," or is it a pedagogical tool meant, at most, to elucidate and help us better understand architecture without claiming that it deals with factually determined laws? I cannot offer a reply to these questions within the scope of this article, but there is no doubt that Vitruvius' intuition is neither trivial nor lacking implications for contemporary architecture. A considerable number of buildings sport an innovative, revolutionary expression of architectural principles--structure, space and envelope--that challenge prevalent views. It is enough to look at the buildings of Frank Gehry, I. M. Pei, Daniel Libeskind, Zaha Hadid and many others, who, even if they have not been directly influenced by the sweeping shifts in artistic body images, have, for the most part, defied traditional conceptions in architecture and created dissonances that could not have been realized during Vitruvius' times, when body images were slanted toward beauty, harmony and perfection.

I want to thank Beatrice Smedley for translating and editing this paper.

RABISCO

An artistic creative environment using movement as a form of self-expression

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Abstract

The use of technology in the context of Generative Art has reached far beyond we could imagine. It is possible to verify the direct effects that the digital environments have on artistic expression and aesthetics, enabling new perceptive experiences. Immersion and stimulation are characteristics of the artistic experience, however, with the advent of interactive environments, a new type of involvement has emerged. In interactive computer-based art, the activity takes place through contact between people and artifacts; the user (or audience) and the machine, together, form a relationship capable of producing a unique artistic result at each encounter. This article presents Rabisco, an artistic creation environment that captures the movement of the visitor's right hand and shows its trajectory on a screen, in an analogy with a scribble, or Rabisco in Portuguese. People enjoy playing games and painting in the new virtual space and Rabisco offers both opportunities, surprising and inducing the participant to a continuous reorganization. In addition

to an interactive environment for creation, Rabisco is a possibility of self-expression through the movement with which even a naive interactor is capable of producing a visual composition and engage the audience in the performance. We talk about the hybridization in interactive art and approach the concepts of embodiment and enaction in this context. Designing and implementing technologies are creative processes in themselves, but researchers in the area of interactivity also contribute by developing tools to support creativity as well as providing research platforms for artists.

1. Introduction

The use of technology in the context of Generative Art has reached far beyond we could imagine. It is possible to verify the direct effects that the digital environments have on artistic expression and aesthetics, enabling new perceptive experiences [1, 2, 3]. New media includes technological tools, installation formats, performances, happenings and earth works, among others. Dividers between art genres such as sound, theatre, cinema and the visual arts were torn down. The traditional barrier between viewer and artwork was challenged. [4, 5].

With the advent of computer-based interactivity, a new kind of art experience has come into being. In computer-based interactive artwork, the activity is not only psychological, but also constituted through exchanges that occur materially between a person and an artefact. Today the opportunities for including audience participation have been increased significantly by the widespread availability of digital technology [6, 7]. Recent literature presents specific and elaborate concepts for the term interaction, such as dialogue, transmission, optimal behavior, incorporation and the use of tools [8]. Further, these concepts are associated with different contexts and ways of constructing causal human-machine relationships – emphasizing the need to improve scope and specificity to better clarify the agency and the effects that computers have on the interaction.

In this article, we present Rabisco, an interactive installation that aims to provide, even to a naive visitor, a creative and expressive experience, through another form of interaction based on movement studies. Rabisco allows the visitor to produce multifaceted two-dimensional compositions. It captures the movement of the visitor's right hand and shows its path on the computer screen, in analogy with a scribble (*rabisco* in Portuguese), in different colors and visual effects.

We consider that in this human-machine relationship, the computer acts as a sentient autonomous and adaptive guide, which helps humans to explore creative spaces and discover new patterns [9]. In Rabisco, we created a new possibility of interaction based on studies of movement, developed and used in a previous work, MovieScape [10].

In the next section, we talk about the hybridization process in art. In Sections 3 and 4, we depict Rabisco, its components and conceptual space. In Section 5, we describe the interaction with Rabisco and following we reflect about interactivity, embodiment and enaction. Finally, we present the conclusions.

2. Hybridization in Interactive Art

Kwastek [11] identifies interactive art as an example of the hybridization of the arts and of their various genres. Hybrid forms in interactive art arise out of the conjunction of elements of theater, music, film, video art, and the visual arts with a variety of digital technologies. The essential characteristic of the hybridization of the arts is that the hybrid form cannot be broken down into its individual components: the whole is more than the sum of its parts.

Since the 1960s, contemporary art has been a prominent setting for such hybrid, intermedia practices, partly because its environment tends to be comparatively permissive. Shortly before, becoming impatient of conventional methods, Jackson Pollock put his canvas on the floor and dripped, poured or threw his paint to form surprising configurations. He probably remembered stories of Chinese painters who had used such unorthodox methods and the practice of American Indians who make pictures in the sand for magic purposes. Pollock has thus been hailed as one of the initiators of a new style known as “action painting” or Abstract Expressionism [12].

Nowadays, motion sensing technologies enable interfaces where a performer moves the body “in the air” without manipulating or contacting a physical object. Such technologies are becoming more and more common in different contexts [13, 14, 15].

In Rabisco, we present the trajectory of the visitor's hand movement on the face of a “conceptual cube”. We can rotate the cube, providing six different possible views of the object. The visitor can choose between three different track formats to display the trajectory on the screen. In addition, each face of the cube has a different orientation; the same gesture performed with another face has a different result. As in a game, this feature is explored and causes surprise, inducing the visitor to change his behaviour when she starts to act on another face of the cube.

3. The Components of Rabisco

Rabisco has three main componentes: 1) a physical motion capture sensor; 2) a programming environment / language for visual effects; 3) a projection screen, depicted in Figure 1.

For the first component, we used the Microsoft Kinect V2 sensor [16] which uses the combination of two images (color and infrared) to track the body of the visitor. With this device it is possible to represent the visitor's body by a set of 25 points, or together, as they are called. In addition, we were able to capture the state of the visitor's hand, open, semi-open, closed or not tracked.

For the visual effects we used Processing3 [17] a graphical programming environment based on the Java programming language. Processing3 supplies the library ProcessingKinectV2Skeletons Tools [18] that integrates the sensor into the software through an API. This library also has a movement smoothing algorithm for all joints. In order to improve the accuracy and response time of the sensor, it updates the physical model generated by Kinect over time. With each new measurement of the

sensor, the algorithm predicts the current estimated position, calculates a confidence factor based on Kinect information, and then defines how much the new estimated position will consider of this new measurement the next iteration.

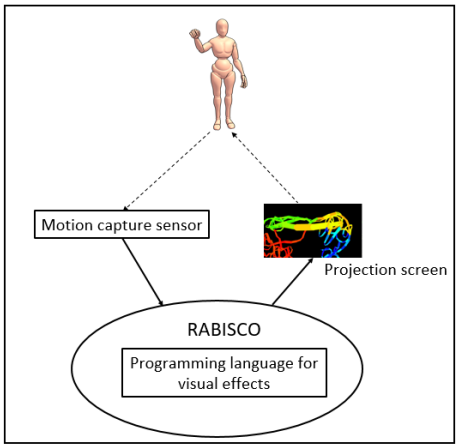


Figure1. The three main components of Rabisco: the sensor, the graphical programming environment and the projection screen. Above, a person interacting with the system.

For the third and last component, we used a 52-inch screen, which can be replaced by a computer screen, a projector or an immersive environment, such as the ImCognita laboratory. The ImCognita Lab provides physical space and audiovisual resources to experiment with visualization, sonification and interact with generative processes via computer support, such as soundscapes, interactive video, animation and 3D graphics.

4. Rabisco: the Conceptual Space

Conceptually, in Rabisco the visitor will be drawing on the face of a cube every moment, as depicted in Figure 2.

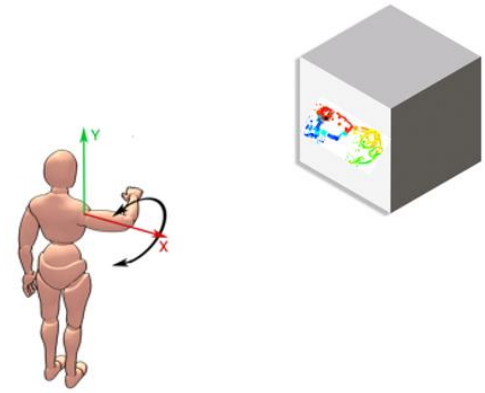


Figure2. The conceptual space of Rabisco: the visitor draws on the face of a cube.

However, on each face of the cube, the coordinate system changes, causing a surprise reaction and inducing the participant to adaptive behaviour. Thus, the same movement produces different results on each face. Figure 3 shows the coordinate system and its behaviour on each one of the six faces of the cube.

The trajectory evaluated by Kinect has three dimensions, but the representation of the movement has only two dimensions. Thus, it is possible to choose which coordinates to use on each face, in order to produce a unique system for each of them. In addition, in order to enrich the artistic proposal, each face has a unique color system.

4.1 Navigating the cube faces

Through a gesture called "arc" the interactor can navigate the faces of the cube. Specific recognition functions identify the associated movement and recognize the gesture. Each rotation of

the arm around the coordinate system, associated with the right shoulder as shown in Figure 4, represents a rotation of the cube.

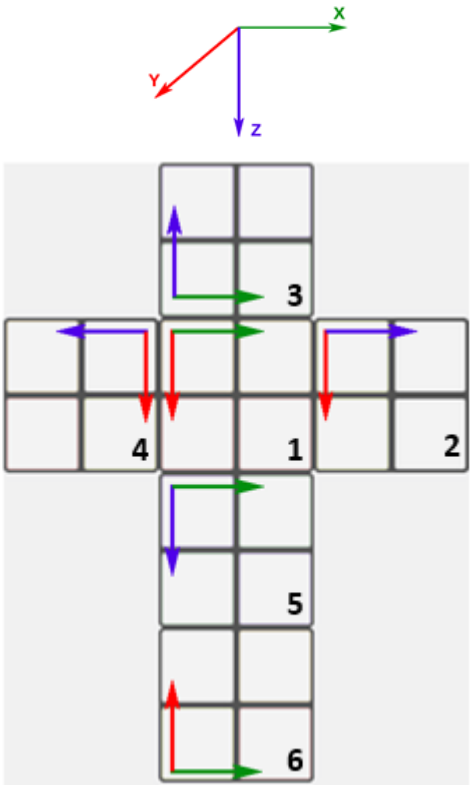


Figure 3. In green, red and blue the coordinate system and how it operates on each face of the cube.

Thus, a positive rotation of the arm around the Y axis will produce a rotation of the cube to the right, while a positive rotation about the X axis will produce a rotation of the cube upwards. As a result, a negative rotation about the Y axis will produce a rotation of the cube to the left and a negative rotation about the X axis will produce a rotation of the cube downwards. With that, we were able to create a sign language for navigation through the faces of the cube.

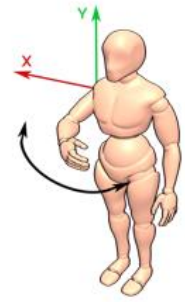


Figure 4: Representation of the arc movement chosen as a form of control.

Another programmed action was to save the composition created on the current face in a .jpg file, and then delete that face. This action happens when the visitor raises both arms above his head.

4.2 The Representation of the Paths

It is also possible for the visitor to alternate between three types of lines, combining them to produce different compositions: a normal straight line, a line where each point of the trajectory creates a sphere, and a line where each point of the trajectory creates a square.

Designing and implementing technologies are creative processes per se, but interactivity researchers also contribute to art and design by devising creativity–support tools [19] as well as by providing design research platforms for artists [20].

5. Interacting with Rabisco

Interactive art involves interaction between art objects, the audience and the viewer. Interactive artists are also interested in the relationships that exist, or can be developed, between the physical world and virtual ones or

between physical movement and symbolic representation. Some use movement in a space as an integral part of their interactive works, so that performance and visual art are brought together.

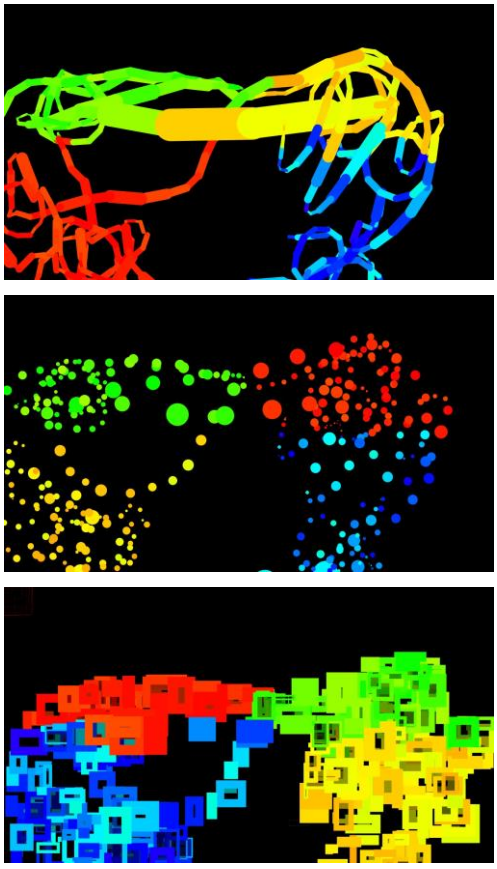


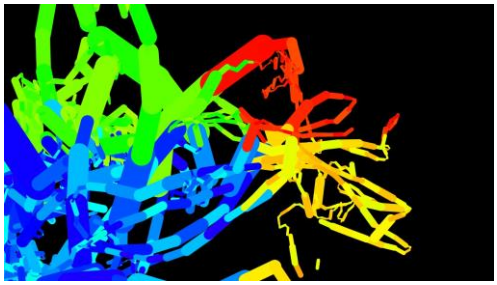
Figure 5: The three possible path representations in Scribble: lines, spheres and squares.

Like a painter starting a work, in Rabisco the participant initially faces an empty canvas. Once the process has started, when the viewer closes his right hand, the movement results in a visual effect on the screen, stimulating the continuation of the visual production. We noticed that some became enthusiastic about the production, as well as the audience that watched. When exploring a new face of the cube, a hand movement performed on the previous face has a different effect, which causes a surprise reaction and induces a new examination, with adaptation, inciting to investigate the other faces of the cube.

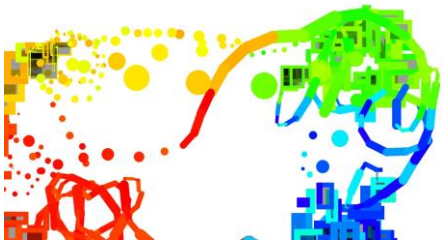
The production of the participant can become performative, resulting in an interesting spectacle for the audience. Observed aspects were the excitement of the interactor with his visual creation, as well as the audience with the visual result and the observed performance, instigating others to experiment Rabisco. The visual composition can be considered the record of an activity, which can be saved and later retrieved for contemplation, on a computer screen or in a printed material, becoming a memory.

Figure 6 presents some visual compositions created with Rabisco. Those with a black background were created in an immersive environment, the ImCognita Lab at NICS/Unicamp. The others were created at Cyberphysics Lab at CTI Renato Archer.

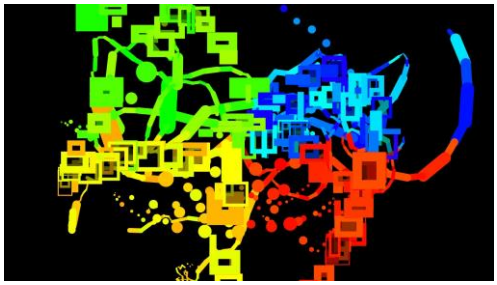
Research shows that creative works can be obtained by exploring, combining, or transforming existing ideas in the conceptual domain [21]. But the mere imagination of an original concept does not fulfill the definition of creativity; rather, it must be materialized or represented as a product (drawing, composition, sculpture, etc.). Therefore, in creativity the process of manifestation is critical.



(a)



(b)



(c)



(d)

Figure 6. Compositions created with Rabisco

People often use the arts to express their emotions and internal states, and art is often designed to provoke empathetic responses and other emotions in audiences. When technology considers a person as an affective system, not merely as an information processor, it should consider how to deal with their expressing, regulating, estimating, understanding, and influencing emotions and affect. Artists can expertly manipulate or influence people's emotional states, Also, artists can utilize their own emotional states and audience's emotional states to complete their own artworks with the help of technology [20].

6. Interactivity, embodiment, enaction

Penny [22] argued that the strategy of contemporary art should be shifted from a representational model to a performative model. Therefore, the application of embodied interaction to interactive art offers a new paradigm of aesthetic practice involving behaviour design. Theories of embodiment present new topics that artists and researchers can consider in their interaction design. Klemmer et al. [23] pose that: (1) Users can learn through doing. They think by gesture and movement and identify implicit constraints and problems easily. (2) Users can act through an artifact, rather than act on it. They perceive the artifact as an extension of their body, rather than as an independent object. This explains the rise in importance of emotions and affect in interaction design [20] (3) Users can easily perceive the status and response of other users, as suggested by distributed cognition theory [24]. (4) Embodiment provides an opportunity to integrate physical and

digital worlds, which was previously unavailable.

By embodiment, we refer to the multimodal, experiential, motor and pragmatic component of Embodied Cognition [25]. In Rabisco installation embodiment allows for a continuous behavioural adaptation acting on the codetermination between participant and environment, where we include the audience.

Although the Embodied Cognition paradigm emcompasses several models and theories, the central concept is that most cognitive processes take place through the body's control systems, especially through the interaction between higher cognitive functions and the sensorimotor system [26]. According to the enactive approach of Varela [27], an autonomous system (agent) has continuous interactions with its environment so that this process influences the configuration of the sensorimotor system. Enactivism, in turn, attributes a crucial role to perception as a particular type of exploratory activity mediated further by the knowledge of sensorimotor contingencies [28]. Thereby, adaptations occur both from the agent and from the environment [10].

In addition, when audience members participate in an art process or piece, they often feel like they are in a different time and place, invocating the sense of “presence”. Sometimes, interactive art implies having virtual presence.

Conclusion

Just as audience involvement and experience are crucial to the success of contemporary interactive art, engagement and user experience are fundamental to the area of interactivity, while art focuses on aesthetics and emotions. From the point of view of art, the area of interactivity can provide new experiences of presence for the public and new possibilities for artists to carry out more research and experimentation. From the point of view of interactivity, art can create new representations and interactions based on incorporation and help to design interactive and emotionally intelligent systems.

From a compositional point of view, Rabisco provides a gestural interface, three types of strokes and a four-color scheme, but the variation of the coordinate system on the different faces of the cube surprises and induces the participant to a continuous reorganization. We consider increasing the possibilities of visual composition or the sonification of gestures, which can modify the performance of the participant.

People enjoy playing games and painting in the new virtual space and Rabisco offers both opportunities. In addition to an interactive environment for creation, Rabisco is a possibility of self-expression through the movement with which even a naive interactor is capable of producing a visual composition and engage the audience in the performance.

References

1. Santaella, L. (2003). Culturas e Artes do Pós-humano: Da Cultura das Mídias à Cibercultura (1a Edição). Paulus Editora.

2. Giannetti, C. (2002). Estética Digital: Sintopia del arte, la ciência y la tecnologia. L´Angelot, Barcelona.

3. Arantes, P. (2005). Arte e Mídia: Perspectivas da Estética Digital. Senac, São Paulo.

4. Wilson, S. (2010). Art + Science. Thames & Hudson, New York.

5. Manzolli, J., Moroni, A., Partesotti, E., Hebling, E., Paiva, C., Dezotti, C., Spagnol, G., Antunes, M., Rossetti, D., Figueiredo, A., Cielavin, S., Pereira, C., Botechia, T. (2019) Audio-visuals in shared space as a metaphor for mindscapes: generative creation in a network performance. Proceedings of the Generative Art, Futuring Past-XVII Letterature Festival Internazionale di Roma, Roma, p. 66-75.

6. Candy, L., Edmonds, E. (2002). Explorations in Art and Technology, Crossings: eJournal of Art and Technology, Volume 2, Issue 1, ISSN 1649-0460, http://crossings.tcd.ie/issues/2.1/Editor/

7. Muller, L., Edmonds, E., & Connell, M. (2006). Living laboratories for interactive art. Codesign, 2, 195–207.

8. Kim, J., Seifert, U. (2007). Embodiment and Agency: Towards an Aesthetics of Interactive Performativity. Proceedings SMC'07, 4th Sound and Music ComputingConference, 11-13 July2007, Lefkada, Greece231

9. Manzolli, J. (2015). Multimodal generative installations and the creation of new Art form based on interactivity narratives (p. 32–45). XVIII Generative Art conference GA2015. https://www.generativeart.com/

10. Hebling, E. D., Partesotti, E., Santana, C. P., Figueiredo, A., Dezotti, C. G., Botechia, T., da Silva, C. A. P., da Silva, M. A., Rossetti, D., de Oliveira, V. A. W., Cielavin, S., Moroni, A. S., & Manzolli, J. (2019). MovieScape: Audiovisual Landscapes for Silent Movie: Enactive Experience in a Multimodal Installation. Proceedings of the 9th International Conference on Digital and Interactive Arts, 1–7. https://doi.org/10.1145/3359852.3359883

11. Kwastek, K., Daniels, D., & Warde, N. (2013). Aesthetics of interaction in digital art. http://site.ebrary.com/id/10762927

12. Gombrich, E. H. (1978). The Story of Art. Oxford :Phaidon, 1978.

13. Freeman, E., Brewster, S., Lantz, V. (2016). Do That, There: An Interaction Technique for Addressing In-Air Gesture Systems. Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems.

14. Dahl, L. (2014). Triggering Sounds from Discrete Air Gestures: What Movement Feature Has the Best Timing? NIME - Proceedings of the International Conference on New Interfaces for Musical Expression, 201-206 .

15. Kopinski, T., J. Eberwein, J., Geisler, S., Handmann, U. (2016). "Touch versus mid-air gesture interfaces in road scenarios - measuring driver

performance degradation," 2016 IEEE 19th International Conference on Intelligent Transportation Systems (ITSC), Rio de Janeiro, 2016, pp. 661-666, doi: 10.1109/ITSC.2016.7795624.

16. Kinect - Windows Application Development https://developer.microsoft.com/pt-br/windows/kinect/

    Accessed in 2019, August.

17. Processing3. https://processing.org/ Accessed in 2019, August.

18. Figueiredo, A. S. (2020). Andresbrocco/Processing_KinectV2_SkeletonTools [Processing]. https://github.com/andresbrocco/Processing_KinectV2_SkeletonTools (Original work published 2019)

19. Shneiderman, B. (2007). Creativity support tools: accelerating discovery and innovation. Commun. ACM 50 (12), 20–32.

20. Jeon, M., Fiebrink, R., Edmonds, E. A., & Herath, D. (2019). From rituals to magic: Interactive art and HCI of the past, present, and future. International Journal of Human-Computer Studies, 131, 108–119. https://doi.org/10.1016/j.ijhcs.2019.06.005

21. Boden, M.A., 2004. The Creative Mind: Myths and Mechanisms. Routledge.

22. Penny, S.G. (2009). Someday, we will have Shakespeare of computer games. In: Chin, J.K. (Ed.), Media art: The Frontline of Art. Humanist, Seoul, South Korea.

23. Klemmer, S.R., Hartmann, B., Takayama, L., (2006). How bodies matter: five themes for interaction design. In: Proceedings of the 6th Conference on Designing Interactive Systems, pp. 140–149.

24. Hollan, J., Hutchins, E., Kirsh, D., (2000). Distributed cognition: toward a new foundation for human-computer interaction research. ACM Trans. Comput.-Hum. Interact. 7 (2), 174–196.

25. Anderson, M. L. (2003). Embodied Cognition: A field guide. Artificial Intelligence. 149, 1 (Sep. 2003), 91–130.

26. Caruana, F. and Borghi, A.M. (2013). Embodied cognition: Una nuova psicologia. Giornale Italiano di Psicologia. Giornale Italiano di Psicologia.

27. Varela, F.J., Thompson, E., Rosch, E. (1992). De cuerpo presente: las ciencias cognitivas y la experiencia humana. Gedisa.

28. O'Regan, J.K., Noë, A. (2001). A sensorimotor account of vision and visual consciousness. Behavioral and Brain Sciences. 24, 5 (Oct. 2001

What Starfish Know: Situating Autonomous Systems in a Generative Art Practice

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Abstract

art making systems are often considered central to a notion of generative art. But these heterogeneous indirect production methods encompass a wide range of complexity, agential sophistication and relative autonomy—and may be engaged with by an artist from an array of positions. In a 2018 paper, “The Machines Wave Back,” this researcher defined a classificatory taxonomic system to categorize autonomous art making systems, and to begin to characterize the shared power dynamics within these systems between rules structures and artists. Part of this effort involved developing a graphic a starfish plot to visualize these systems and their relationships. The current paper invokes the starfish as a broader metaphor to investigate a more personal and evaluative meditation of working within an autonomous art making system, and on that peculiar space at the tip of the starfish’s legs: the possible and preferred relationships between artist and rules structure, considering questions of voice, vision, intention, discovery and joy.

Introduction

In a 2018 paper titled “The Machines Wave Back”—that title being a nod to James Bridle’s essay that introduced his vision of the New Aesthetic [1]—I laid out a taxonomic scheme to classify Autonomous Art-making Systems (AAS), understood as generative partnerships between artists and rules structures [2]. The purpose was not only to categorize and compare existing works of art and design, but also to think more broadly about the dynamics of generative practices.

This scheme borrows a conceptual structure from the world of software development to posit five types of activity (rendered as primitive operations or “verbs”) such systems undertake, including gather, alter, generate, curate and distribute. These terms describe operations on heterogenous array of potential components of an artwork which could include such things as pixels, words, sounds, algorithms, found objects, spatial coordinates or virtually anything at all that could comprise a high- or low-level component of an artwork, up to and including (perhaps recursively) the entire

artwork itself. It is important to stress that although rules structures may be encoded in a programming language to be executed by digital computers, this is not a necessary condition: creating a hexagram of the *I-Ching* counts as a fully autonomous rules structure in a generate operation even if the outcome is arrived at by flipping coins or casting yarrow stalks rather than by software running on a digital computer.

Within the scope of the five verbs there is consideration for representing the relative degree of autonomy exercised in each operation by the artist and the autonomous system from none, to some, to full. These comparative pairings do not represent zero sum games. It is possible that neither the artist nor the system exercises any autonomy in a given verb (if, for instance, there is no application of that particular verb in a piece) or it may be that both the artist and the rules system have full autonomy (if the decisions of each do not impinge on the other). Taken together, these pairings suggest the contours of the relationship between the artist and the rules structure—a topic that was inadequately explored in the previous paper.

Finally, there is the matter of the scope of agential sophistication of the rules structure of the art making system within each primitive operation. This measure ranges from a sophistication level of 0, a list of prohibitive rules that arguably do not rise to the level of generative art [3], to a sophistication level of 5, where a rules structure may define its own goals as well as the criteria for meeting them. This measure of agential sophistication exists only for the rules structure as it is assumed that the artist within the system possesses perfect agency.

Before speaking further to relationships between artists and autonomous art-making rules structures, it is first necessary to more clearly define the five primitive operations expressed by the model. These operations are not expressed with a time component and so may occur serially or in parallel, linearly or recursively: the operations are meant only to capture the domain of activity. They are analogous to a signal chain in audio production, a set of operations that eventually yield a mixdown.

A *gather* operation is one that aggregates elements, composite objects or even other rules structures into something like a collection. It is somewhat difficult to conceptualize a gather operation without some attendant curation, but I believe a distinction may be drawn, for instance, between a raw grab-all-you-can scenario and a more curatorial filter-then-grab activity; in the former situation one will gather whatever is available without specifying characteristics beyond bare presence. This sort of procedure is especially conducive to discovery and surprise.

In an *alter* operation, the aim is to transform one or more elements or objects. These operations range from simple direct substitutions of elements to variously complex spatial or chromatic transformations all the way to deep simulations (or actualities) of biological growth and mutation.

The *generate* function is perhaps the most critical component in an autonomous art system if one is to consider the output (or process) of a system “generative art.” Elements, objects, rules and rules structures may be brought into being through a vast range of techniques from basic chance

operations to extremely sophisticated evolutionary solvers. These generative solvers may also have co-operations so that they generate through a routine of multiple alter-and-curate moves, iteratively mutating elements and then checking for fitness to some criteria.

Curate operations encompass notions of discrimination, phronesis or judgement. At the lowest end of agential sophistication, a rules structure within an autonomous art making system performs a curate operation by acting as a basic seine or filter: it excludes certain elements from objects or objects from sets. In addition to acting as a terminal operator to decide whether to preserve output, curation may also be employed as a classifier to split sets into categories and sub-categories for further operations.

Possibly the least sexy of operations, some method to *distribute* results is nonetheless critical to garnering an audience for the artwork—although distribution is often not explicitly included as part of the artwork as this sort of operation is generally considered a post-process. However, digital distribution methods aligning with digital generative methods may change this situation.

While this model attempts to describe the combinations of relationships between an artist and her chosen or invented rules structure, it does not explicitly explore the emotional or ludic qualities of those relationships, nor even begin to evaluate the various value propositions inherent in them—particularly in their multitude of permutations. It is also in no way meant to be a totalizing model, but rather a first cut at a conceptual framework. The remainder of this present essay will be to begin to consider some of these questions within this framework.

Relationships

There are myriad reasons an artist might take up a relationship with a rules structure within an autonomous art making system.

One potentially large, if obvious, advantage to working with a rules structure that can be operationalized as a machine-executed algorithm is that the pace and scale of exploration may be vastly increased through automation. High speed application of a rules structure makes high volume or repetitive tasks achievable for an individual artist and can expand the scope of what is possible. Manually applying rules structures, such as performing Conway's cellular automata game of life in a gym with soda cans and stop-motion animation are severely constrained when compared to the possibilities afforded by the application of even rather modest computational power and pixel-based displays.

For an artist, one of the critical (if sometimes overlooked) functions of a sketch is to externalize thoughts as visual artifacts so as to initiate and sustain a dialogue with herself. This is both for reasons of precision of expression—since it is easy to gloss over details in the work when it is still only in the mind—and as a feedback loop for exploration, discovery and elaboration.

An autonomous rules structure with adjustable parameters may serve much the same function as a traditional sketch, not only in concretizing and clarifying an artist's intention, but especially in creating an observe-adjust-observe feedback loop that has value as a vehicle to more deeply engage with the grain of an artwork.

I have long entertained the notion that working “alone,” with a less-than-perfectly-stable self, over time could form the basis for a theory of collaboration: the person I am in this moment is not self-identical to the person who earlier externalized thought or feeling through writing, drawing or recording. The radical version of this theory would contend that any work not able to be executed instantaneously (that is, all work) would then be a sort of collaboration through the feedback and reflection with an externalized artifact of a previous self. One aspect of working within an autonomous system, especially those with a rules structure with substantial generative characteristics, is the pleasure of surprising results that manifest even when the artist or designer has carefully crafted the rules structure. Even more delightful is when the initial surprise of an outcome turns to recognition of the self in the work; more on this shortly

Even without the more radical take, invented rules structures may provide a particularly rich example of a more interactive second self with which an artist may collaborate. Re-identifying with a construct of a former self, externalized through the expression of a rules structure, is one of the potentially ludic dimensions of working within an autonomous art system. John Cage once asserted: “I use my work to change myself.” [4]

Of course, there can be downsides to working with (or worse, using) rules structures for the contemporary artist.

There is an inherent tension in working within an autonomous art system between totalizing control by the artist, which tends to tamp down generative benefits and preclude surprises, and too little investment or involvement in the rules system by the artist. This lack of “skin in the game" may produce a high yield of surprising and/or novel outcomes but can also cast doubt on the necessity of the role of the artist (or at least any particular artist) in the process at all. Leaning too hard on an algorithmic rules structure, especially one not designed (or even well-understood) by the artist may produce outcomes that, if not coupled with an aggressive artist-led curation operation, will be blandly generic. Arbitrary rules may not always advance an artist’s vision.

In a related issue, rules structures have the potential to unintentionally blunt the expression of an artist's particular voice (gained through lived experience) by lacking grain fine enough to fully interface with artistic intention. In this case, the rules structure may level and smooth outcomes in a way that elides the subtle contours of intention. I relate this situation to the inevitably lossy digital quantization of analogue signals that invariably sculpts slopes into stairsteps, blindly discarding everything under the curve.

Finally, there is the potential problem of being seduced by the ease, virtuosity, or simple monkey-brain pleasure at the appearance of the complexly unexpected that may spring from poking a sophisticated rules structure. The resulting dopamine hit may drastically erode conceptual underpinnings and result in a race to the shiniest.

It would be futile to list all possible configurations of relationships between artists and rules structures within an autonomous art-making system. Instead I would like to suggest some common and not-so-common possibilities as a

jumping-off point to seed further discussions.

Perhaps the most common (and straightforward) relationship between an artist and a rules structure in an autonomous art making system is one of a high-autonomy generate operation for the rules structure combined by a high-autonomy curate operation by the artist, either serially or interleaved in parallel. In this scenario, the artist first chooses or creates a rules structure that generates candidate elements, objects or rules, and then the artist judges the fitness of the outcomes of that operation for distribution. This condition encompasses a great many works of what are called generative art and may be represented as rs.generate⇢a.curate.

A second curation stage could be added as rs.generate¬⇢rs.curate⇢a.curate in which the rules structure makes a preliminary fitness pass over the generated outcome before the output is passed to the artist for final curation. Or, the artist generates objects that are altered by a rules system and passed back to the artist for curation: a.generate⇢rs.alter⇢a.curate.

But there are also many less apparent relationships that may be performed. In a sort of crowd-sourcing scenario, a rules structure (rs1) could distribute elements to a second rules structure (rs2) for an alter operation (perhaps performed by a mechanical Turk) and the gathered results are then curated by the artist: rs1.distribute⇢rs2.alter⇢rs1.gather⇢a.curate.

It is worth considering the prevalence of a curate stage performed by the artist at the tail of these examples and note some of the differences in ability between current rules structures and artists. Perhaps the broadest difference is that living artists are, by accident of necessity, extreme generalists. Rules structures, by contrast, are equally extreme specialists that are often created to perform a single task.

The strength of rules structures is that they are, especially when formulated as code for execution on digital computing machinery, swift, tireless, relentlessly precise, and can reliably exhaust a task space without becoming distracted, bored or resentful. Even if not created as executable code, rules structures can bring consistency and focus to a task when enacted or performed by a human artist.

The strength of human artists, on the hand, is the their embodied, lived experience in the world. Such experience in the individual—and in the species—enables astonishingly sophisticated acts of phronesis and fine distinction, but also allows for sensitive, intuitive, abductive and unplanned (but fully justified) leaps, including improbable but poetic connections made across the full range of human encounters with the world and each other. Artists are almost impossibly broad, but parts of their experience, judgements and prejudices may be separated and codified into rules structures, and these rules structures retain their human DNA even if, once separated from us, it is not always recognized.

Conclusion

Why Starfish? The diagrams meant to visualizes autonomous art-making systems in “The Machines Wave Back” (which look distressingly like airport terminal plans in hindsight) graphically

map the five primitive verb operations to the legs of an abstract starfish. The diagram's morphology has practical implications but also thematic ones. What is perhaps most known about Starfish is their radial symmetry (never ask a starfish for directions!) and their ability to re-grow lost limbs, or, in some species, even to regenerate an entirely new body from a lost limb.

Canadian media critic Marshall McLuhan had some things to say about technology and metaphorical amputation. One of his primary contentions in this regard was that human technologies were always already extensions of the body: clothing extends the skin, the telescope extends the eye, the gun extends the fist, the wheel is a sort of diagram of feet in motion…

McLuhan argued that because people do not consciously realize that technologies are extensions of the body, they become psychically anesthetized to that reality. He maintained that these extensions were largely invisible to us, until the twentieth century extension of the central nervous system in the form of electric global media suddenly made this situation uncomfortably apparent. So, as media extends, it also amputates. Although electric technology extends the central nervous system, "such amplification is bearable by the nervous system only through numbness or blocking of perception." [5] Thus, McLuhan asserts that a process he terms "autoamputation" accompanies any extension of media.

"Physiologically, the central nervous system, that electric network that coordinates the various media of our senses, plays the chief role. Whatever threatens its function must be contained, localised or cut off even to the total removal of the offending organ." [6]

Yet the starfish shows us that amputation can be the basis for (re)generation, and that recognition of parts of our severed selves as ourselves carries the salty tang of growth about it.

"The Machines Wave Back" concludes with an assertion that technology is itself thoroughly human, and that we will increasingly see ourselves in our artistic partnerships with machines and rules structures. It is vital to argue for the deep humanism of collaborations within autonomous art making systems and to understand rules structures and their technological substrates as structured and bounded but nonetheless valuable expressions of humanity.

As a strategy that both inoculates against some of the darker aspects of working with rules structures within an autonomous art system and prepares a path for growth it is important that we enter into these relationships with the awareness that rules structures are not alien or abject, but condensed and extended aspects of our own humanity (even in the case of "natural law") and that by recognizing them as such, we may learn a great deal about human potential. As we see ourselves more and more in the algorithmic rules structures and technology substrates that enable them, we may learn from the machines to be more human. What starfish know is that which is cut off from us, is still us. And that not only may we (re)generate what has been separated, but that which has been separated may also (re)generate us.

References

[1] Bridle, James. "Waving at the Machines." *Retrieved April* 5 (2011): 2012.

[2] Eby, Chad Michael. "The Machines Wave Back." *Media-N* 15, no. 1 (2019): 69-81.

[3] Galanter, Philip. “Generative Art and Rules-Based Art.” Vague Terrain, 3 (2006), 3.

[4] Cage, John, and R. Kostelanetz. "Conversations with Cage." (2003): 67-8.

[5] McLuhan, Marshall. *Understanding media: The extensions of man*. MIT press (1994): 43.

[6] McLuhan, Marshall. *Understanding media: The extensions of man*. MIT press (1994): 64-5.

Certainty and Fragility: reassessing the role of automatically generated aids to the making process

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Abstract

This paper considers the role of automatically generated guides, supports and other material that are intended to aid the making process. Increasingly, work and even daily life are supported by systems that automatically create text, lines, images and other forms as an aid for numerous types of activity. These include the auto-suggestions of search engines and messaging apps, and the guides and supports generated by graphics and 3D modelling software. This study focuses on the role of these assistants in the production of media artefacts. It revaluates the temporary creations which support creative processes but which are rarely considered at great length beyond their originally intended purpose.
This paper will discuss how a repurposed 3D printer has been used to reinvent the support material generated by 3D slicer software as drawings and images in their own right. In doing so it describes how the transition from digital proposition to analog realisation often traverses a line between certainty and fragility. It will reflect on what this might reveal about the perceived relationship between human and machine, and between the manmade and the mechanically produced. This in turn invites a reassessment and rebalancing of these roles.

Introduction - The normalization of computer aids

We are now said to live in a ‘post-digital’ world such is the normality and ubiquity of computing. Computing has entwined itself into the everyday not only in the sense of the spread and integration of computing devices as in Mark Wieser’s Ubiquitous Computing [1], but also through the logic of computation that has come to shape and inform our relationship with the world.

We now live in and with what has been termed code/space [2]. This describes the way in which we are dependant on

code for our experience of spaces and the functions that take place within them. Similarly, James Bridle argues that labour is increasingly coded and our social lives mediated through algorithmic processes [3]. This mediation takes place through an array of devices and software that help us to create the things on which our work and social lives have come to depend.

These aids are often cast as 'features' and selling points on devices such as the latest iPhone, offering to automate and guarantee 'perfect' images, or at least images that will be more successful in the 'network of images' [4] they will inhabit. At other times they can be more functional and discreet or mundane such as the auto-suggestions of text messaging software. These everyday uses are easily overlooked precisely because of their ubiquity. Even to those of us used to making our own tools and privileged to have a degree of control and understanding not afforded to most, the role of automated aids to making can be easily overlooked.

The speed with which we access and interact with these aids makes them all the more difficult to observe. An example would be the filters of imaging apps that offer seemingly infinite versions of an image, created in an instant and either selected or immediately discarded. We may not even consider these to be images but only potential images, even though they have been created and displayed, if only briefly. Automation may appear to speed up the process of taking a photo or composing a text, part of the acceleration within contemporary life that Virilio describes and that has been termed accelerated culture [5]. This might suggest that they facilitate a certain dynamism. However, as Goldsmith notes, as we approach Virilio's absolute speed so inertia increases [6]. Instead we might observe a stasis in the uniformity of the results. It has been shown that the auto suggestion of text messaging has changed the way we construct sentences, anticipating and then influencing our choice of language and leading to a reduction in variety. Perhaps unsurprisingly, predictive text leads to predictable outcomes [7]. As Fuller has observed, familiar hi-tech appliances can be "somehow inert, territorialized into certain kinds of highly fixed behaviours" [8].

Meanwhile debates are often concerned with whether machines can be creative while overlooking the fact that we are already surrounded by machine made media such as automated journalism which is indistinguishable from that of humans [9]. This may be aided by the lack of originality or at least a conventionality in the certain types of media.

The way that our tools may shape the things we make has been discussed in relation to everything from word processors [10] to photography [11]. There is always an interplay between the human and the machine, and a "threshold between document and user" [10]. It is this threshold that this paper will examine.

This paper is concerned with the tools and algorithmic processes that aid making. Rather than considering all creative software applications it is interested in the way the aids to making automatically generate material, be it images, text, lines, or supports. This has involved turning to a less instantaneous form of making, 3D printing. Not only is the 3D printing process comparatively

extended, but the products of its automation are more visible and tangible.

An approach is outlined that combines a pragmatic aesthetics perspective with a glitching and deformance attitude to practice. Several images and objects made using a 3D printer are used to explore the role of aids as shaped by several factors. These include how the machine and the human may have differing or 'dual' perspectives on the work at hand, how conceptualising our machines as tools or apparatus may alter our understanding, and the role of risk and error.

Experiencing Technology and Technology as Experience

3D printing a model file involves a number of aids and automatically generated elements produced largely through the use of 'slicer software'. These applications prepare a model for printing including generating the supports and infill added to models to ensure they print correctly. The slicer software also has a large influence on exactly how the model is constructed by the printer, creating a set of instructions in the form of 'G-code' for the printer to follow. Many variations of instructions are possible to print the same model. The process of creating models is not considered here. Creating models using software tools such as Blender or Fusion 360 involves a host of other automated processes and aids which open up a number of debates around authorial control and creativity. Although also relevant here, these debates are not the central focus. Slicer software and 3D printing are typically at the end of a workflow, even if part of a larger iterative process. By deliberately looking at what is perceived as a less creative stage of making it aims to draw attention to what creative possibilities remain.

3D printing usually involves a blend of proprietary, open source and off the shelf tools as well as a high level of custom, hacked and tinkered technology. 3D printing has not yet become the closed off hi-tech appliance that Fuller connects to inertia. It also seems well placed to address both the digital and analog, the virtual and the concrete. Fazi and Fuller note of computational aesthetics that it sets into motion a reorientation of the "circumstances in which art occurs in that it endures as a conjoint condition of the abstract and the concrete" [12].

The approach involved reimagining the 3D printer, not as a means of replication, but one that might produce a variety of results. This was done by playing with slicer settings, subverting the way it would typically be used, aiming to produce variation rather than regularity or uniformity. By attaching a pen to a 3D printer, turning it into a plotter, it was possible to produce 2D images from 3D models and create records of the temporary support material and travel lines of the printer. This process bears relation to some glitch practices which aim to subvert and misuse processes to break the flow of existing relationships with media [13]. It might also be connected to the 'deformance' of McGann [14]. Deformance involves the altering and reworking of a media (often text) and then re-presenting it in order to gain insight into its constructed nature [14]. This is an approach I have expanded on elsewhere [15]. This paper discusses the use of fused filament fabrication or FFF printing although many of the processes are applicable to all 3D printing.

In order to better understand our relationship with the processes in question we might turn to the pragmatic aesthetics of John Dewey [16]. This shifts the focus to the experience of processes as they unfold rather than or as well as the outcomes they can produce. Pragmatic aesthetics has been a used in studying our relationship with computers, informing HCI design. The work of McCarthy and Wright in relation to 'Technology as Experience' extends Dewey to show how it is equally applicable to technology as to our experiences of art [17]. They argue that we don't just use technology but live with it and engage with it in terms of an 'aesthetic engagement'. In this way the aesthetic realm extends beyond and is not the preserve of art. It might equally be applied to all human computer interaction. So a spreadsheet will provide an aesthetic experience just as the greatest works of art. Once thought of in this way we might ask what might be shaping our experiences of these technologies and our perceptions of what they produce?

While McCarthy and Wright might suggest that we don't always consider the aesthetics of our interactions with machines at other times it is more prominent. This can be seen in the products and artworks described in terms of a 'machine aesthetics'. This addresses the existence of, and even a preference for, things which appear machine made or mechanical. Exhibitions such as 'Machine Art' shown at the Museum of Modern Art in New York in 1934 praised machine-made objects for their "precision, simplicity, smoothness, reproducibility" [18] many of the qualities looked for in the perfect 3D print. Broeckmann traces a history of the 'Aesthetics of the Machine' and while we might see these as historically situated attitudes to machines, James Bridle has identified what he calls automation bias [19]. This see us drawn to and preferring the products of algorithms and computers. This might go some way towards explaining our willingness to let our phones dictate what constitutes a 'good' image. Figure 1 shows how the programmed aesthetic sensibility of a digital camera will happily edit out the effects of air pollution.



Figure 1 Twitter posts showing automatic colour correction - @teriarchibbles

Meanwhile Vito Campanelli describes a 'Machinic Aesthetics' that acknowledges the role of imperfection especially in machine making. It is important he notes to understand the creative potential in the error and that machines do not always do what has been asked of them [20] This leads him to suggest a 'dual subjectivity'

– that belonging to the human and that which might be called 'machinic subjectivity'. This draws attention to the fact that software, computers and machines are not neutral. In fact, he argues to consider them as such is to misunderstand the 'contemporary condition'. This reminds us that as well as considering our experience of the process we also need to account for the autonomy of the machine.

Dual subjectivity

The employing of software in workflows "does not guarantee creative results" [21]. Indeed, reliance on software, it has been suggested, can stifle creativity leading to derivative results constrained as they are by the conventions encoded into the tools [21]. We need to be "wary and alert" to the way in which software can both "constrain creative practice, as well as opening up opportunities for original solutions" [21] Software is not neutral but influences outcomes and "every computer, every input device has its own personality that cannot not influence the creative process" [20].

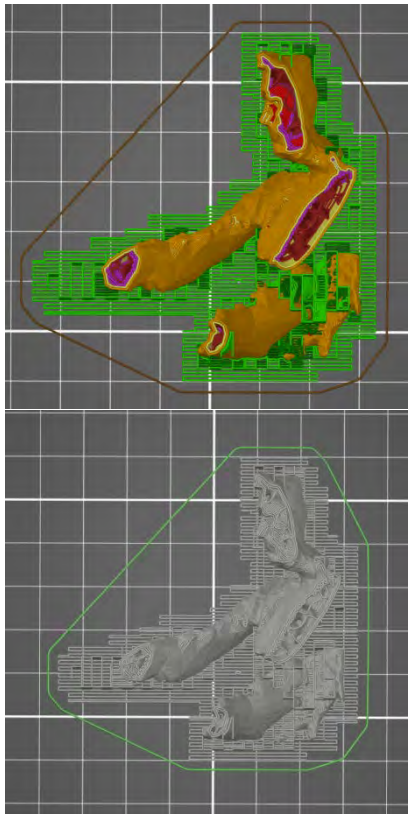
In software, predetermined settings called 'defaults', presuppose what acceptable and appropriate results might be. The extent to which we can deviate from these is usually determined by a limited set of options sometimes called 'preferences'. We often only become aware of these when we need to prevent interruptions to the making process caused by automated defaults and by turning off features. Pold notes the irritation that arises from realising our limited ability to fully control the software tools, as it becomes clear the interface is structured around the principles set up by the 'sender' rather than the 'receiver' or user [22]. Thus, Pold concludes "my preferences are not purely mine" [22]. The software models itself on its model of the user and in particular what Fuller calls the 'anticipated user' [10].

Clearly we might question if such a user exists and how it was arrived at. This is perhaps why those interested in exploring the new possibilities presented by generative art turn to making their own tools. Although even then it is impossible to escape all of the layers of the system and perhaps all we can do is to acknowledge it.

Slicer software typically involves a wide assortment of preferences and defaults anticipating not so much a typical user but a typical use or end goal, that of the 'perfect' print. Rather than using these to tailor personal preferences, the human role is often to provide a contextual understanding of how the automated choices of the software are likely to translate to the real world. This includes understanding their own 3D printer's idiosyncrasies. We are perhaps better placed to know how the effects of gravity may impact an overhang in practice. We also bring contextual understanding of the object's function in the real world. Which way up is it intended to be, which is the presentation side? This is information the software does not have but it also lacks an understanding of the world. The slicer software's understanding of the object is confined to its construction not its place in the world.

Here we can see what Campanelli describes as the 'dual subjectivity' of the human and the machine [20]. Each having differing understandings of what the aim is and how it can be achieved. Each views the problem at hand from a different perspective. An example of how the machine sees is the way that slicer

software distinguishes between ‘types’ of material’ even though there is usually only one type of material used, either a plastic filament or a resin. This shows how the machine understands the object and its construction. It can distinguish between parts based on function such as supports, shell or infill, or based on their production, such as fan speed, temperature or extruder speed. For the human though the main distinction is between the material to be kept and the material to be removed in post-processing in order to leave the desired object.



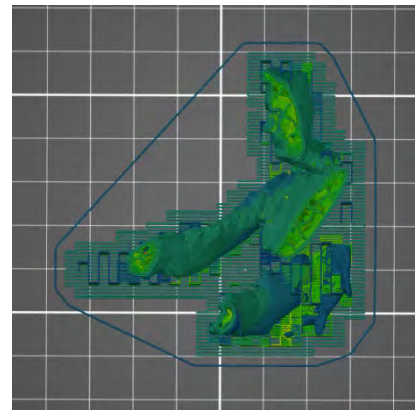


Figure 2, screenshots of slicer software showing colour coding of different ‘types’ of material in a model to be printed

These visualisations of how the software understands the model suggest a complexity that can be visually alluring and enchanting [23]. Much like the exploded diagram, they do not explain how they are made but transfix us with their complexity [24]. They are suggestive of the complexity of the system without fully explaining it. We might take a pleasure in the intricate balance between order and chaos and even a confidence in its abilities which may seem far more detailed and technical than our own. It is this perception of complexity that may lead to the automation bias described by Bridle.

Tools, Machines and Apparatus

How do we conceptualise our relationship with and use of 3D printers? Are they tools or are they machines? Broeckmann notes that a tool is handled but the machine is tended [25], suggesting an autonomy in the machine and a more passive role for the human. This is especially interesting to consider in relation to 3D printers which are typically seen as tools for making the

objects we choose, as any 3D printer owner will attest they also require attending to. Rather than debate whether a 3D printer is a machine or a tool it is more relevant to consider if the way we view them changes how we use them. The question of autonomy raises a number of issues especially in relation to generative art and the creative autonomy of machines, which will not be dealt with here. Instead we might consider whether a perceived greater autonomy changes how we see our own role in making.

The algorithms and digital tools that aid us tend to be integrated in such as way that they are what Heidegger would call 'ready-at-hand', withdrawing as an independent entity [26]. Familiarity with tools tends to see them disappear from view. However, this invisibility is also associated with greater autonomy for the tool. Mario Costa describes 'neo-technologies' which are no longer McLuhanian extensions but tend to become autonomous [27]. As Campanelli explains: "They complete the process begun in the 'technical' era, the 'era of the hand', in which individualized, stable and discrete tools, such as the hammer, respond directly to human needs, and continued into the era of 'familiarism', in which technologies such as electric light and photography give rise to complexes, sequences and hybrids that effectively marginalize the subject." [27]. As Goldsmith notes 'when we use an apparatus eventually it becomes invisible' [28].

Flusser also uses the term 'apparatus' in his description of the camera. Here the user of an apparatus is cast in a subservient role, even when we might think we are using it for our own purposes. So the camera as apparatus leads us to churn out boring repetitive content, making for the apparatus rather than for ourselves [11]. The products are interchangeable with those produced by others – our photos are indistinguishable from those of others. This is a phenomenon that has been explored by artists such as Penelope Umbrico's *Sunset Portraits from Sunset Pictures on Flickr* and Jason Salavon's *100 special moments*. These collages and amalgamations of hundreds of images reveal their similarities and an underlying redundancy. The apparatus seduces us into making content which is ultimately constrained by the limitations of its programming.

If the 3D printer is an apparatus in the vein of Flusser, content produced by a 3D printer is the apparatus itself [11]. That is to say the content is the capacity of the printer to reliably produce an object. While some will print their own model files, most will take their models from sharing sites such as Thingiverse.

One of the most printed objects is the 3Dbenchy. Intended as a so called 'torture test' to put a printer through its paces and ideally produce a flawless copy. An image search for 3Dbenchy (figure 3) shows the range of successes and failures.

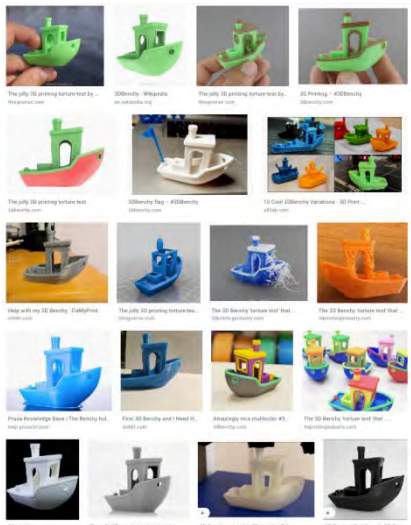


Figure 3 Image search results for 3Dbenchy

And yet what this shows us is the unique character of each of the apparatus. No 3D printer is the same, no operator will tend their machine in the same way. What is interesting is that there is a variety of tools, processes, software all being used not to create something original or that may in itself be considered creative but instead to try and converge on the same thing. In many ways the errors are more engaging. It is as though we want the 3D printer to be an 'apparatus' that can control and constrain the output. And yet to do so requires greater involvement of the operator/user, making modifications and altering settings. A great deal of effort and creative problem solving goes into trying to turn the machine into a tool which responds more directly to our needs.

Error and Risk

It is not anticipated that the slicer software and 3D printing be a 'creative' stage, as opposed to the actual design of a model. It could be considered as what David Pye calls the workmanship of certainty. As Ingold explains, in workmanship of certainty the result is pre-determined before the task has begun and is given in the "settings and specifications of the apparatus of production" [29]. In the workmanship of risk, the use of aids such as jigs and rulers might mitigate risk but crucially the end is not predetermined. As Ingold notes, even when using an aid such as ruler it is not possible to ever draw a perfectly straight line. Seen in this way the 3Dbenchy is aspiring to something that does not exist. It is caught up in a machine aesthetics of perfection but undone by the machinic aesthetics of error.

If perfection is removed as the intention, then other possibilities are presented. Simply by rotating the model to an angle such that it then requires supports, the resulting print is an amalgam of model and support (figure 4). Where one ends and the other starts is not as clear as might be expected and is a matter of interpretation. When looking at the 3D models encased in their supports like the ones in figures 5 and 6), do we read this as error, recalcitrance of the materials or simply the dual subjectivity? A semantic intersection perhaps?



Figure 4 3Dbenchy encased in support material

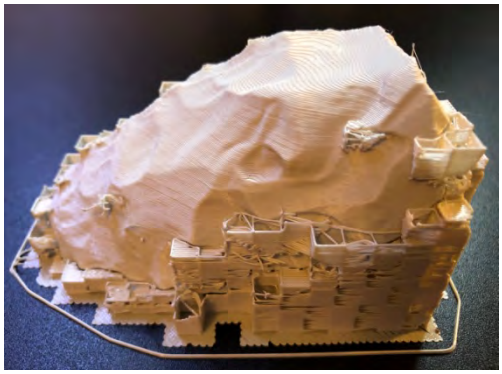


Figure 5 3D print of a handaxe encased in support material

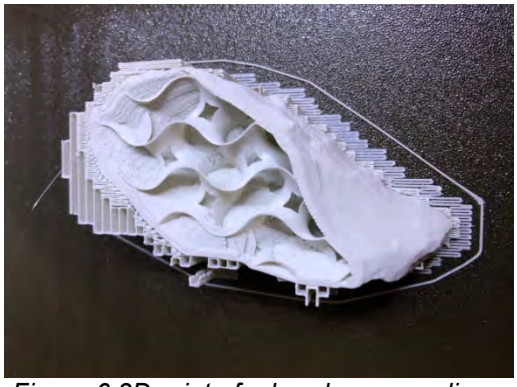


Figure 6 3D print of a handaxe revealing infill and encased in support material

Figures 7, 8 and 9 show drawings produced by replacing the extruder with a pen to turn the movements of the printer into a 2D image rather than a 3D object. The image shows the support material such as the 'brim' that hold the model on the print bed and the infill that gives support to the surface structure. These parts that are usually discarded or not seen are given equal value within the result. These aids that are typically intended to produce a certainty have been opened up to risk. To produce these images a number of defaults need to be disabled, warnings ignored or overridden in order to manufacture the risk.

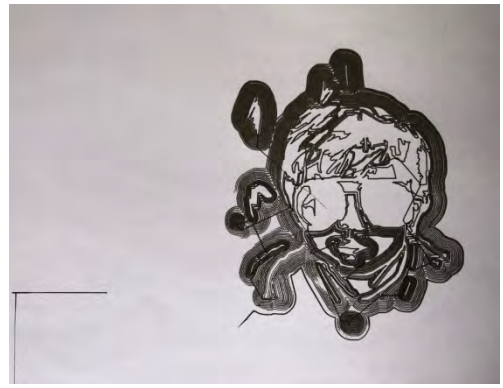


Figure 7 Plotter drawing of support material

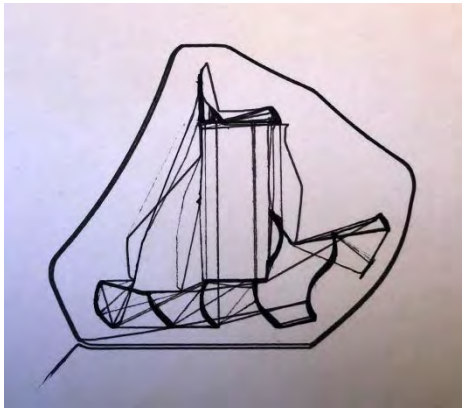


Figure 8 Plotter drawing of 3Dbenchy

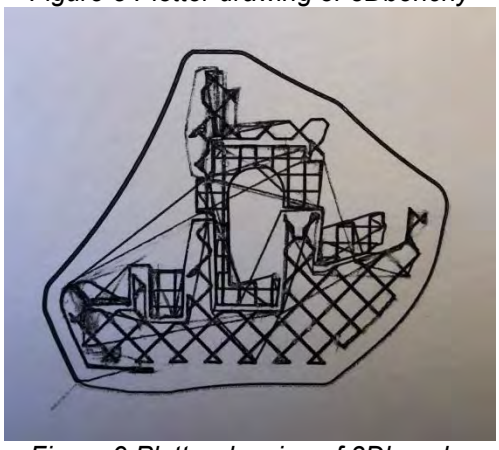


Figure 9 Plotter drawing of 3Dbenchy

How we view our work, as either concerned with certainty or with risk, shapes how we approach making but also how we interpret the results. Even if intended to mitigate error, the possibility for misuse of the apparatus and the reintroduction of risk is always there.

Campanelli argues that allowing the machine to have the upper hand "often means opening up to a genuinely surprising and rewarding universe of options" [20]. Yet if disposed to the workmanship of certainty the machine may need some encouragement to open itself up to such new and surprising possibilities.

Conclusion - Certainty and Fragility

In repurposing the 3D printer as a drawing machine and reimagining it as a tool for inventing new forms, the tension between the human and machine, and between machine and material has come to the fore.

The transition into the physical exposes the fragility of the digital proposition. The certainty of the automated decisions made largely by the slicer software's predetermined 'preferences' gives way to the almost inevitable errors. Risk can never be removed entirely which might suggest that instead it might be more productively embraced. The illusion of control and certainty provided by the unifying grid space [30] of the slicer software is undone. Industrial manufacturing processes can undoubtedly reduce error (or 'tolerances') to the point that they are beyond human perception. But this is just to disguise the relationship rather than to alter it.

For Ruskin the aesthetics of imperfection are superior to the aesthetics of perfection. From this perspective the marks of the machine might be reimagined and valued for their own sake just as the 'principle admirableness' of the Gothic cathedrals was that they were made by the labour of 'inferior minds' out of 'fragments full of imperfections' [31]. Rather than ask whose mind is inferior here, or who is responsible for any imperfections, human or machine, we might reinterpret them as simply being more honest since they acknowledge the process and a meeting of subjectivities.

Impermanence and fragility have been

described as “defining conditions of the digital age” [32]. Despite popular perceptions of digital media and especially ‘cloud’ storage as providing permanence, the digital is and always has been fragile. Susceptible to ‘bit rot’, corruption and even the obsolescence of the machines needed to read digitally stored data.

In trying to look beyond binary oppositions of analog and digital Christiane Paul describes a ‘neo-materiality’ [33]. For Paul neo-materiality strives to describe objecthood such that it “reveals its own coded materiality and the way in which digital processes see our world” [33]. If we do live in a post-digital world of coded materiality in which digital technologies test the thresholds between human and machine perhaps this might best be understood as an interplay between fragility and certainty.

References

[1] Weiser, Mark. “The Computer for the 21 St Century.” *Scientific American*, vol. 265, no. 3, 1991, pp. 94–105. *JSTOR*, www.jstor.org/stable/24938718 Accessed 9 November 2020.

[2] Kitchin R. and Dodge M. (2011) *Code/space: software and everyday life* The MIT Press: Cambridge, Massachusetts

[3] Bridle, J. (2018) *New Dark Age: Technology and the end of the future* Verso: London (p38)

[4] Rubinstein, D and Sluis, K. (2013) “Concerning the Undecidability of the Digital Image” in *Photographies*, 6:1, 151-158, Taylor and Francis

[5] Redhead, S (2004) *Paul Virilio: Theorist for an accelerated Culture* (2nd ed.) University of Toronto Press: Toronto

[6] Goldsmith, K (2016) *Wasting Time on the Internet* Harper Perennial, Harper Collins: New York

[7] Arnold, K.C, Chauncey, K & Gajos, K,Z. (2020) “Predicitive Text Encourages Predictable Writing” in *25th International Conference on Intelligent User Interfaces (IUI ’20).* ACM: New York. Available at https://doi.org/10.1145/3377325.3377523 Accessed 9 November 2020

[8] Broeckmann, A. (2016), *Machine Art in the Twentieth Century* The MIT Press: Cambridge, Massachusetts (p158)

[9] Bridle, J. (2018) *New Dark Age: Technology and the end of the future* Verso: London (p123)

[10] Fuller, M. (2000) “*It looks like you’re writing a letter: Microsoft Word*”, available at https://monoskop.org/Matthew_Fuller Accessed 9 November 2020

[11] Flusser V. (2014) *Towards a Philosophy of Photography*, trans. Martin Chalmers, Reaktion Books: London

[12] Fazi, M.B. and Fuller, M. (2016) “Computational Aesthetics” in Paul, C. (ed.) *A Companion to Digital Art* John Wiley & Sons Inc: New Jersey (p286)

[13] Menkman, R. (2011) *The Glitch Moment(um)* Institute of Network Cultures, Amsterdam

[14] McGann, J. and Samuels, L. (2001) ‘Deformance and Interpretation’ in McGann (ed.) *Radiant Textuality: Literature after the world wide web* Palgrave: New York

[15] Fry, C. (2018) 'Enchanting Algorithms: How the reception of generative artworks is shaped by the audience's understanding of the experience', XXI Generative Art Conference Proceedings, available at: http://www.generativeart.com/GA2018_papers/GA2018_Christopher%20Fry.pdf Accessed 8th November 2019.

[16] Dewey, J. (1958) *Art as Experience* (12th impression) Capricorn Books: NY

[17] McCarthy, J. and Wright, P. (2004) *Technology as Experience* The MIT Press: Cambridge, Massachusetts

[18] Broeckmann, A. (2016), *Machine Art in the Twentieth Century* The MIT Press: Cambridge, Massachusetts (p12)

[19] Bridle, J. (2018) *New Dark Age: Technology and the end of the future* Verso: London (p40)

[20] Campanelli, V. (2010) *Web Aesthetics: How Digital Media Affect Culture and Society*, NAi Publishers, Rotterdam (p222-224)

[21] Kitchin R. and Dodge M. (2011) *Code/space: software and everyday life* The MIT Press: Cambridge, Massachusetts (p121-123)

[22] Pold, S. (2006) "Preferences / settings/ options/ control panels" in Fuller, M. (ed) *Software Studies \ A Lexicon* The MIT Press: Cambridge, Massachusetts (p218-219)

[23] Gell, A. (1992) *"The Technology of Enchantment and the Enchantment of Technology"* in Coote, J. and Shelton, A. (eds.) 'Anthropology, Art, and Aesthetics' Oxford University Press: Oxford, pp. 40-66

[24] Munster, A. (2013) *An Aesthesia of Networks* The MIT Press: Cambridge, Massachusetts

[25] Broeckmann, A. (2016), *Machine Art in the Twentieth Century* The MIT Press: Cambridge, Massachusetts (p18)

[26] Dourish, P. (2004) *Where the Action Is: The Foundations of Embodied Interaction* The MIT Press: Cambridge, Massachusetts (p109)

[27] Campanelli, V. (2010) *Web Aesthetics: How Digital Media Affect Culture and Society*, NAi Publishers, Rotterdam (p171-172)

[28] Goldsmith, K (2016) *Wasting Time on the Internet* Harper Perennial, Harper Collins: New York (p92)

[29] Ingold, T. (2016) *Lines: a brief history* Routledge Classics, Routledge: Abingdon (p166)

[30] Janovich, D. (2016) 'Fictions: A Speculative Account of Design Mediums' in 'Drawing Futures', conference proceedings, The Bartlett School of Architecture

[31] Boden, M. and Edmonds, E. (2019) *From Fingers to Digit*s The MIT Press: Cambridge, Massachusetts (p161)

[32] Rubio, F., & Wharton, G. (2020). "The Work of Art in the Age of Digital Fragility" *PUBLIC CULTURE*, 32(1), 215-245. Available at https://escholarship.org/uc/item/4vs431tv Accessed 9 November 2020 (p219)

[33] Paul C. (2015) *"From Immateriality to Neomateriality: Art and the conditions of Digital Materiality"* in Proceedings of the

21st International Symposium on Electronic Art. Available at http://www.isea-archives.org/docs/2015/proceedings/ISEA2015_proceedings.pdf Accessed 19 November 2020. (p1)

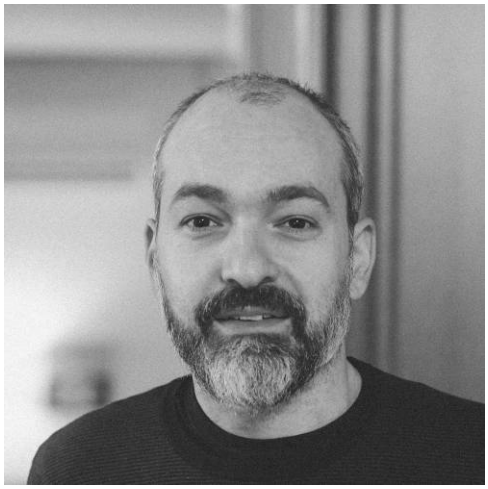
Beyond Representation: Drawing as a Generative Field

This paper is dedicated to the memory of the late Stavros Vergopoulos

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Abstract

Architectural representation in the digital era was defined early on by the concept of photorealism. Fuelled by the much older desire to reproduce reality, to become able to double it within another medium, photorealism became both a means and an end. It also became the most obvious case of simulation in architecture and made relevant again the concept of the simulacrum. The 'definition of fake' for Plato, or the result of a hyper-reality detached from any real connection to the world for Baudrillard, the simulacrum describes how a photorealistic architectural rendering can be the ultimate reduction of the architectural drawing. A copy of a copy that becomes void of any meaningful purpose for the design process.

And yet there is a different way to understand the simulacrum: Through affirmation rather than negation it is transformed into a generative machine. It can be called again 'an architectural drawing', only that now it does not represent anymore. Instead it functions; as part of the design process itself.

1. The Quest for Photorealism

Digital technologies entered the field of architecture in a rather 'violent' way during the last 30 years, as they have penetrated and altered virtually any other aspect of our lives. The speed at which changes occurred, coupled with the ability of the computer to simulate with an ever-increasing efficiency the real world, blurred the limits between what is real and what is simulated, between what is physical and what digital, in essence between what exists and what doesn't. While this 'blurriness' extends to several different aspects of contemporary architectural practice, maybe one of the most obvious cases is the one of architectural representation. Our relatively newly acquired ability to produce life-like digital images has a profound impact on the ways we chose to represent our designs. In that context, photorealism becomes one of the main examples that illustrate how digital simulation can interfere with - and change our perception of what is - reality.

Photorealistic rendering has been for many years - from the very beginning of computer generated images - the 'holy grail' of computer graphics. Rendering, in computer graphics, is the process of creating a 2-dimentional image from a 3-dimentional digital model. That includes on one hand the projection of the geometry on a plane and on the other hand a process of representing the visual qualities of the model, namely color, lighting, shadows and textures.

While the geometrical part – the projection of the objects on a plane – is relatively easy to solve, the second part – the visual representation of those projected objects – proved to be a much more challenging task [2]. Programmers realized soon enough that an accurate simulation of the way the light works in the physical world would be almost impossible, because of the computational power needed. Therefore they started looking at alternative methods that could create realistic looking images without having to calculate every single photon of light: From the pixel by pixel method of the scanline rendering, to ray-casting and all the way to ray tracing and today, with the increase in available computational power, to unbiased and real time rendering, the quest was always for more and more realistic effects. All this process, which involves a huge amount of effort, highly complex mathematical simulations, some of the most advanced programming algorithms and an endless line of Utah teapots, stems essentially from a very simple will: that of *'recreating' reality*. The doubling of what we perceive in the real world inside the computer. In other words, photorealistic rendering is yet another attempt of the – almost purely philosophical – desire *to double our world inside another medium*.

Behind that desire, hides another fundamental debate, that poses a question of an equally philosophical nature: that of whether computers are able to reach the operational level of humans.

In that sense, the course of the developments in computer graphics has many parallels with the developments in the field of artificial intelligence. In first years of research on AI the final aim was also to create computers able to operate at the same level with humans. In effect the fundamental concept is the same. In both cases we have on one hand something perceived as the 'real' - the human mind performing logical

operations in the case of artificial intelligence and the human mind again, perceiving in a specific way the physical world in the case of computer graphics - and on the other hand we have a digital simulation having as its final target to reach the level of its respective model. In the field of artificial intelligence the focus of the research has been reconsidered several times: where scientists were initially trying to simulate the function of the human mind, they ultimately shifted their approach and started to look at the ways according to which they can simulate the intelligence displayed by much more humble physical organisms, but in much higher numbers. Swarm intelligence - the way large flocks of relatively simple organisms like slime molds, ants or bees behave - proved to be a task where computers could perform much better [3]. And suddenly digital computers started displaying astonishing levels of intelligence; perhaps not human but intelligence all the same. A simple look at applications as diverse as Amazon's recommendation system or genetic programming is fairly convincing.

2. The Simulacrum

The parallel with artificial intelligence is important in order to understand that computer graphics are not operating on a different level or direction to other fields of computation. On the contrary, in several cases the fundamental motives stem from the same desires. In computer graphics though, the aim was never reestablished, while one could argue that today this aim is accomplished - or so it appears. As computational power was increasing and research was advancing, digitally generated photorealism started to reach new levels of accomplishment to that an extend that today is quite common to encounter a situation where it is impossible to tell a digitally generated image from a photograph.

However, if we try to be accurate, a photograph is not 'reality itself'; instead it is already a copy of the physical world; already a representation. Fredric Jameson, commenting on photorealism in painting notes: "*There is here a striking parallel to the dynamics of so-called photorealism, which looked like a return to representation and figuration after the long hegemony of the aesthetics of abstraction, until it became clear that its objects were not to be found in the 'real world' either, but were themselves photographs of that real world, this last now transformed into images, of which the 'realism' of the photorealist painting is now the simulacrum*" [4]. In photorealism in the arts [5], a painting is created as a double of a photograph, already itself a copy of the real world. Therefore the painting in that case is a copy of a copy, in other words a *simulacrum*.

The concept of the simulacrum is hardly a new one. It has its roots in Plato's Sophist: Plato in this dialog, written during his late period, makes a distinction between two kinds of reproduction. He urges that a reproduction can be either a faithful one – that is one that doubles reality by being 'faithful' to it – or one that is intentionally distorted – that is one that alters on purpose some aspects of reality in order to achieve some aim other that the act of representation itself. While for Plato the former is what a representation should be, the later should be avoided and is what he calls a simulacrum [6]. A notable example of the later – of the simulacrum – are the 'optical refinements' applied in ancient Greece both in

sculpture and architecture. Statues for example would be intentionally crafted disproportionally larger towards the top so they would appear without the distortion imposed by perspective to someone that observes them from below. In the same line of thinking the steps of the Parthenon are slightly curved, but only in order to appear perfectly straight to the viewer that approaches the temple.

From Plato and onwards, simulacrum becomes a common philosophical theme for several thinkers, up to the point where Jean Baudrillard extends that thinking and distinguishes not two, but four types of representation, according which the image:

(1) is the reflection of a basic reality,

(2) masks and perverts a basic reality,

(3) masks the absence of a basic reality and

(4) bears no relation to any reality whatever: it is its own pure simulacrum.

Baudrillard further explains: "*In the first case, the image is a good appearance: the representation is of the order of sacrament. In the second, it is an evil appearance: of the order of malefice. In the third, it plays at being an appearance: it is of the order of sorcery. In the fourth, it is no longer in the order of appearance at all, but of simulation.*" [7] According to Baudrillard therefore, the simulacrum is a copy of a copy. A representation that while it resembles something real, it does not have any connections to any kind of objective reality. On the contrary, a simulacrum creates its own reality, which Baudrillard calls hyper-reality, and becomes totally independent of the 'real' model.

3. Architectural Simulacra

If we shift the discussion in the field of architectural representation, while computer graphics entered the picture quite late in relation to the timeline of the development of the concept of the simulacrum, the approach was similar. When computers started to be used extensively in the domain of architectural design, photorealism became initially one of the main challenges in terms of architectural representation. As software engineering was advancing, the creation of life-like images was becoming easier to accomplish and therefore photorealism became a standard tool in architectural representation. Today, photorealistic rendering is literary 'one click away', with advanced rendering software offering – through a user-friendly interface that abstracts all the 'unnecessary' technical information – the ability to produce photorealism to all their users. As a result, a vast amount of computer renderings is produced, where the limits between realized buildings and digital representations are blurred to the extent that in many cases photorealistic renderings are preferred over photographs of a realized project in order to describe and publish it.

The case seems to be identical with the case of photorealism in painting: The architectural rendering looks like, not the built object of course, but like a photograph of it. With one – important – difference: In photorealism in art, reality pre-exists, it is then doubled by the photograph, which is then doubled a second time by the photorealistic painting. In architecture that sequence is inversed: in most cases the rendering comes *before* the building itself, and it therefore tries to model a hypothetical

photograph of an imagined building. The actual building follows and one is tempted to say that the built object becomes a copy of the rendering – it is of no surprise then that several new built edifices are photographed in such a way that the photographs resemble computer renderings [8].

Returning to Baudrillard, it is interesting to note that he opens his book with a reference to Borges' short story '*On Exactitude in Science*'. There, in the length of one paragraph, Borges describes an Empire where the art of cartography attained such perfection that the map of the empire that the cartographers created, ended to have the same size as the Empire itself. The following generations lost appreciation in cartography and the map was abandoned to the elements, becoming eventually a ruin. Baudrillard comments: "*Abstraction today is no longer that of the map, the double, the mirror or the concept. Simulation is no longer that of a territory, a referential being or a substance. It is the generation by models of a real without origin or reality: a hyperreal. The territory no longer precedes the map, nor survives it. Henceforth, it is the map that precedes the territory - precession of simulacra - it is the map that engenders the territory and if we were to revive the fable today, it would be the territory whose shreds are slowly rotting across the map.*" [9]

For Baudrillard therefore, today it is no longer the map that is left in ruins, but the territory itself, because "*the map precedes the territory*". Such is the case with computer generated, photorealistic, architectural renderings: they become a simulacrum, they create a hyper-reality out of nothing and they even force us to perceive built objects as 'realized' renderings – in a way, turning the actual buildings into copies. So the photorealistic rendering is not just a hyper-fake image, "*the commercial illustration and depiction of architecture, that in all its sophistication and accuracy is not particularly intended to convey any theoretical, strategic or spatial properties*" [10]. It also becomes the model for the actual, built object. It is therefore apparent that the questions arising are far surpassing the limited area that concearns architectural drawing and representation; they affect fundamentally the way we create and perceive architecture.

4. A Generative Simulacrum

In the light of the above observations, it is rather fortunate that digital rendering techniques have reached a high level of efficiency. Because this overproduction of photorealistic architectural images leads inevitably to a downgrading of the importance of the medium: since photorealism is not anymore the product of a – digital – virtuosity, its value is questioned and new directions for the digital architectural drawing need to be sought after. Therefore, before we ascribe the creation of an 'architectural hyper-reality' to computer graphics and we abandon digital tools as the means to create architectural drawings, it might be useful to consider a different approach to the idea of the simulacrum.

It is true that Baudrillard's conception of the simulacrum describes the situation created by photorealism in architectural representation adequately and efficiently. Computer generated images create indeed a type of hyper-reality. But his

approach is clearly a negative one; and at the same time, it is an approach not void of a certain nostalgia for what is perceived as an ideal 'real'. Gilles Deleuze on the other hand is offering a different approach on the concept of the simulacrum: "*If we say of the simulacrum that it is a copy of a copy* […] *we miss the essential point: the difference in nature between simulacrum and copy* […]. *The copy is an image endowed with resemblance, the simulacrum is an image without resemblance*." [11] Deleuze here, contrary to Baudrillard, tries to define the simulacrum in a positive way. The simulacrum, not as something that imitates, but rather as something that creates. "*The simulacrum is less a copy twice removed than a phenomenon of a different nature altogether: it undermines the very distinction between copy and model*" [12].

It is the difference between the simulacrum and the model that becomes of importance and it is the same difference that becomes a generative force. Again, we can find a relative example from the history of art: During the Renaissance a faithful representation of 'reality' became the focus of the artists. Around 1520 however and as the painters had truly mastered their technique, they started to add details in their paintings that were diverging from faithful representation towards a more personal approach. Consequently, mannerism emerged – and finally led to the Baroque. A very illustrative example is El Greco's '*The Burial of the Count of Orgaz*'. The painting is clearly divided in two parts. The lower part, depicting the funeral on earth, is closer to a realistic representation. We recognize human forms as faithful representations of actual humans. The upper part of the painting however, depicting the acceptance of the deceased count in the heavens, starts to distort the forms, change the analogies and our perception of space. The painting is transformed, from bottom to top, from a 'copy' to a simulacrum. Only that the simulacrum here, is no longer understood as a 'detached' hyper-reality but instead as a new element in a series of transformations that start from a model – in our case the physical world – and move toward new perceptions and new 'species' that are as real as the actual model of the 'representation'.

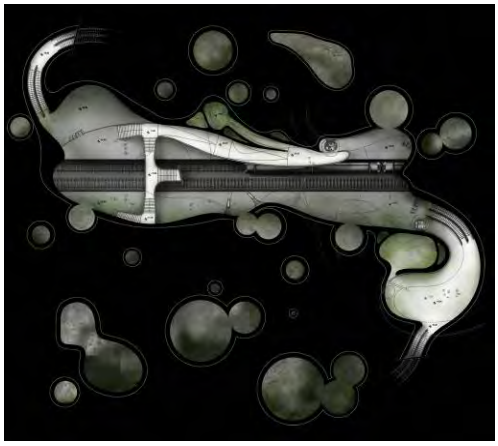


Figure 1: El Greco, The Burial of the Count of Orgaz (1586–1588, oil on canvas, 480 × 360 cm, Santo Tomé, Toledo)

5. Beyond Representation

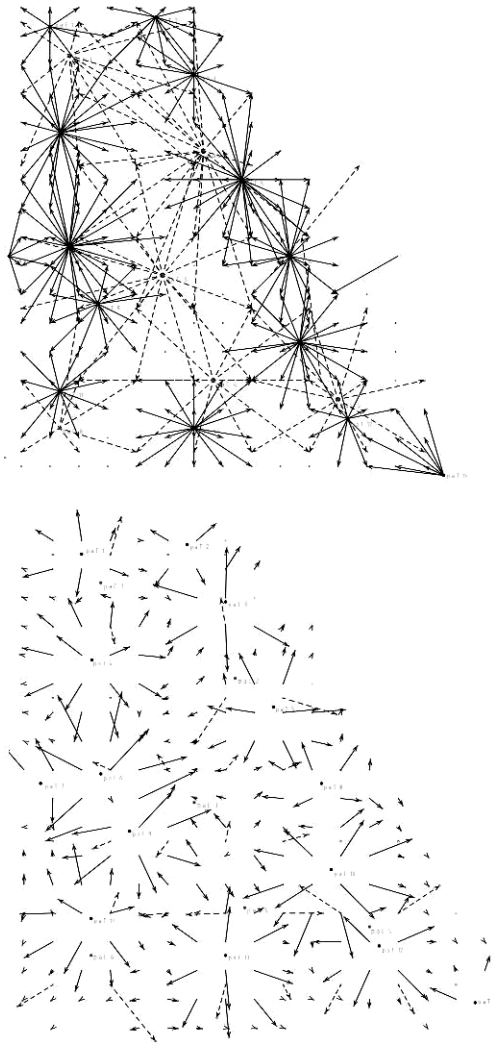
In essence however, what Deleuze asks for, or what is needed in order to change our understanding of the simulacrum from a negative to positive one, is *to*

move away from the concept of representation. A painting, or an architectural drawing, does not necessarily *represent* something else; it can also *generate* something new. Deleuze, this time in his book on the paintings of Francis Bacon, proposes the concept of '*sensation*' as the means for the figurative arts to escape representation. He suggests "*that there are two general routes through which modern painting escaped the clichés of representation and attempted to attain "sensation" directly: either by moving towards abstraction, or by moving towards what Lyotard has termed the figural.*" [13]



Design for a metro station. Degree Project, School of Architecture, AUTh. 2009. Students: Maria Chiou, Dimitra Koroni. Supervisors: Stavros Vergopoulos, Dimitris Gourdoukis.

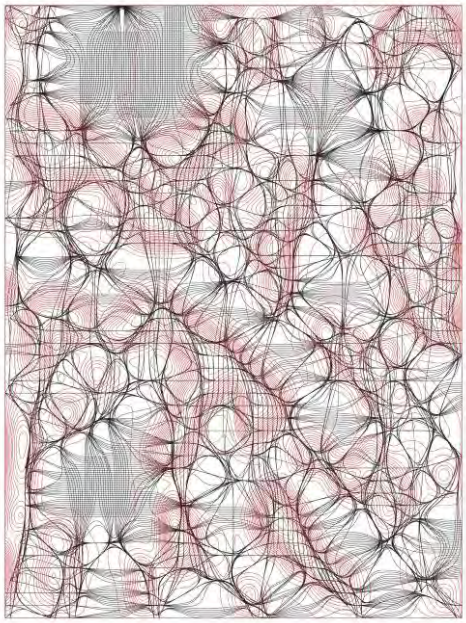
We might be able to find two similar ways for digital architectural drawings, in order for them to escape representation and hyper-reality. The first, in accordance to abstraction, might be the (re)use of line drawing; while a very old mode of drawing, digital tools are offering the means to use lines in new ways and create drawings that are not simple plans or sections but rather series of transformations. That way abstraction happens not by removing details but by removing some aspects of the image, like lighting, shadows or textures: "*abstraction of visual representation means exaggeration of certain aspects on the cost of others*" [14] as Birger Sevaldson notes. In addition to that – somewhat more traditional – conception of abstraction, we can think of lines that do not represent anymore a border, a dividing line, but instead a vector. We can think therefore of a line with a direction and a magnitude that is able to represent flows and movement. And while a simple vector might not carry enough information, several of them, locally differentiated, become a field, able through its transformations to generate new forms or organizations. At the same time the drawings do not represent anymore – as a plan represents a specific view of a building – but *they function*. In that sense, an architectural drawing is part of the design process. It is a drawing that does not convey meaning by referring to something else but functions as a tool that will generate the next step in that process: The drawing as the design process and not the representation of it. Similarly, line drawings can be used in order to 'dissect', analyze and essentially understand 3-dimentional models created in the computer. The abstraction imposed by the lines on a 3-dimetional model provides the means to focus on those properties that are more important each time, while shifts our understanding from a clearly defined object to a field that is virtually infinite and ever-changing.



Shaping a plan through vectors. Degree Project, School of Architecture, AUTh. 2010. Student: Vasilis Papakonstantinou. Supervisors: Stavros Vergopoulos, Dimitris Gourdoukis.

Equally, the second way, the of moving towards the figural, would be to distance ourselves from the visual aspects of what is drawn. That means using visual means to communicate information concerning an atmosphere, a situation or a condition. Such a drawing therefore focuses not only on the visual qualities of an architectural object, but also on those that would be understood in the physical world through all human sensors, while impact is valued over meaning and sensation over interpretation. Again, we are moving from a visual object towards a visual field where, while the means are not new; it is their coupling with the digital computer and simulation that offers new possibilities.

In both cases, either through abstraction or through the figural, architectural drawing transcends its role as a representational tool and incorporates both the intentions of its creator and a field of possibilities in relation to what could emerge out of it. Each drawing becomes a new step in a series that through the differences of its elements and through constant modulation becomes the generative force of design. That difference is exploited by the designer – both creator and spectator of his own drawings – in order to set the design process in motion: "*The simulacrum includes within itself the differential point of view, and the spectator is made part of the simulacrum, which is transformed and deformed according to his point of view*" [15]. As with the approaches of Baudrillard and Deleuze in the case of the simulacrum - the first one based on negation, the second arising through affirmation - we can trace a similar dichotomy for the 'blurriness' that digital tools bring in the limits between real and not-real: We can negate it and fight it as something that obstructs our ability to tell what is real and what not; or we can embrace it as the means to produce new kinds of reality.



Generative drawing. Toolpaths for a CNC milling machine. Fabrication Protocols / Digital Crafting. School of Architecture, Washington University in St. Louis. Student: Jeffrey Glad, instructor: Dimitris Gourdoukis

6. Notes and References

[1] Stavros Vergopoulos, professor at the School of Architecture of the Aristotle University of Thessaloniki passed away in August 2020. The present paper was written by the authors in 2010 but remained unpublished until now. It outlined however the basic principles followed by the authors when teaching both representation and design courses and therefore – in a certain sense – accomplished its intentions. The paper therefore is presented finally here – with only minor changes and updates – as a tribute to Stavros and the legacy that he left at the School of Architecture in the Aristotle University of Thessaloniki. A last paper on the two subjects that he mostly worked with: architectural representation and digital design tools. A small addition to his contribution to the field. He will be greatly missed as a researcher, educator, and above all, as a friend.

[2] The projection of the objects on the plane and the calculation of light and shadow, are not necessarily two separate processes. However, for the scope of this article is safe to consider the later as the main focus of research in the field of computer rendering.

[3] John Haugeland, Artificial Intelligence: The Very Idea (Boston MA: MIT Press, 1989).

[4] Fredric Jameson, Postmodernism, or, The Cultural Logic of Late Capitalism (London: Verso, 1991).

[5] Photorealism in painting is an art movement of the late 1960s and early 1970s that was developed mainly in the USA. Key figures of the movement include Richard Estes, Ralph Goings and Chuck Close.

[6] Πλάτων, Πλάτωνος Σοφιστής (Εν Αθήναις: Εκδοτικός οίκος Γ.Φεξη, 1910).

[7] Jean Baudrillard, Simulacra and Simulation, trans. Sheila Faria Glaser (Minneapolis: University of Michigan Press, 1995), 6.

[8] On that subject, see a very interesting article posted by Lebbeus Woods on his blog, concerning the photographs for Zaha Hadid's Guanghou Opera House. Woods closes his post writing: "*This appraisal is not simply about images, but about buildings, even masterpieces of architecture regarded as an extension of an architectural history of masterpieces, that are utterly oblivious to the uncertain and conflicted human condition of today, which is unprecedented in history*." Lebbeus Woods, "Zaha's Way", n.d., http://lebbeuswoods.wordpress.com/2011/03/27/zahas-way/.

[9] Jean Baudrillard, Simulacra and Simulation, p1.

[10] Marjan Colletti, "Ornamental Pornamentation, The Abstract and the Exuberant Body of Ornamentation" (n.d.).Marjan Colletti, ed., Exuberance: New Virtuosity in Contemporary Architecture: Architectural Design, 1st ed. (London: Wiley, 2010).

[11] Gilles Deleuze, "Plato and the Simulacrum" in October, no. 27 (winter 1983), p 48.

[12] Brian Massumi, "Realer than Real: The Simulacrum According to Deleuze and Guattari", n.d., http://www.anu.edu.au/hrc/first_and_last/works/realer.htm.

[13] Daniel W. Smith "Translator's Introduction" in Gilles Deleuze, Francis Bacon: The Logic of Sensation, 1st ed. (Minneapolis: Univ Of Minnesota Press, 2005).

[14] Birger Sevaldson "Computer aided design techniques", n.d., http://www.birger-sevaldson.no/phd/Computer%20aided%20design%20techniques.pdf.

[15] Gilles Deleuze, "Plato and the Simulacrum", p49.

The Archetypes of Mendeleev's Periodic Law of Elements

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Premise



The work is an illustrative continuation of Wolfgang Pauli's idea about archetypes in modern science, about the symbols that have a dual function: pre-scientific (religious, mythical, ornamental, etc.) and scientific in the modern sense of the word. Pauli in his arguments relied on the work of Plato, Johann Kepler, Carl Gustav Jung.

1. Archetypes

One of the creators of quantum mechanics Wolfgang Ernst Pauli wrote: "The process of understanding nature as well as the happiness that man feels in understanding – that is, in the conscious realization or new knowledge – seems thus to be based on a correspondence, a "matching" of inner images pre-existent in the human psyche with external objects and their behavior. This interpretation of scientific knowledge, of course, goes back to Plato and is, as we shall see, advocated very clearly by Kepler… These primary images, which the soul can perceive with the aid of an innate "instinct," are called by Kepler archetypal. Their agreement with the "primordial images" or archetypes introduced into modern psychology by C. G. Jung and functioning as "instincts of imagination" is very extensive… A true spiritual descendant of the Pythagoreans, … he attached the utmost importance to geometric claiming that its theorems "have been in the spirit of God since eternity". His basic principle was "Geometria est archetypus pulchritudinis mundi" (Geometry is the archetype of the beauty of the world)." [2]

2. Priori of knowledge

Pauli notes that one must guard against

transferring this *priori* of knowledge into the conscious mind and relating it to definite ideas capable of rational formulation.
My work is a humble attempt to transfer "this *a priori* of knowledge into the conscious mind". Geometric forms proposed for consideration are those that "had simultaneously a religious and a scientific function" in the past and could serve as "spontaneous images" to visualize the periodic law of elements.

2.1 Pythagoreans and Figurate numbers

The mathematical study of figurate numbers is said to have originated with Pythagoras, possibly based on Babylonian or Egyptian precursors. The fourth triangular number of ten objects, called tetractys in Greek, was a central part of the Pythagorean religion. Figurate numbers were a concern of Pythagorean geometry. To generate any class of figurate numbers, Pythagorean used gnomons. The connotation of the term *gnomon* is that originally given by Hero of Alexandria, namely, 'A Gnomon is that form that, when added to some form, results in a new form similar to the original.

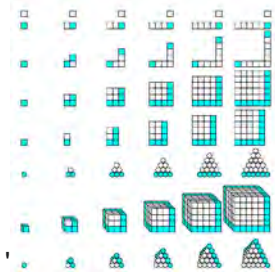


Fig.2 Some figures and their gnomons.

2.3 Plato and mathematics

While not a mathematician, Plato was considered an accomplished teacher of mathematics. Like the Pythagoreans he believed the mystery of the world to be contained in number.

There is the dualism or opposition between the ideal and the actual – the soul is prior to the body, the intelligible and unseen to the visible and corporeal.

In the dialogue *Timaeus* Plato associated each of the four classical elements (earth, air, water, and fire) with a regular solid (cube, octahedron, icosahedron, and tetrahedron respectively) due to their shape, the so-called Platonic solids. The fifth regular solid, the dodecahedron, was supposed to be the element which made up the heavens.



Fig.1 Platonic solids.

All of these shapes are made of triangular grid. Therefore triangle can be regarded as an atomic element in Democritean sense.

2.4 Kepler

"For the purpose of illustrating the relationship between archetypal ideas and scientific theories of nature, Johannes Kepler (1571-1630) seemed to me (W. Pauli) especially suitable, since his ideas represent a remarkable intermediary stage between the earlier, magical-symbolical and the modern, quantitative-mathematical descriptions of nature." [2]



Fig.3 Kepler's Platonic solid model of the Solar System (1596).

3 Variety of Periodic Law Archetypes

The key archetype, in our opinion, is the concept of the square and its gnomon. This is due to the well-known fact that the electron filled shell contains $2n^2$ electrons, and the number of electrons on the subshell is twice the odd number — the gnomon of the square.

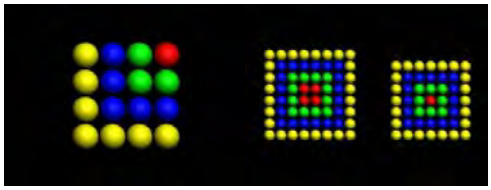


Fig.4 Squares (two-dimensional objects) and gnomons of square (one-dimensional objects).

3.1 Line

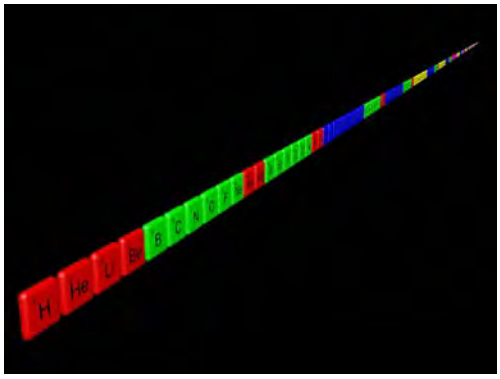


Fig.5 Line - beads, rosary, chain – 1D object.

3.2 Grille

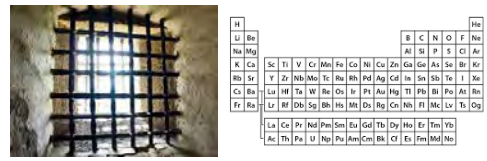
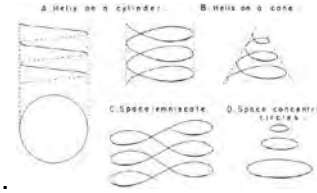


Fig.6 The common modern table. The established tradition is to divide the table into lines and columns.

3.3 Spiral



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Fig.7 From Edward G. Mazurs Collection of Periodic Systems Images.

3.3.1 The Phyllotactic Periodic Table of elements

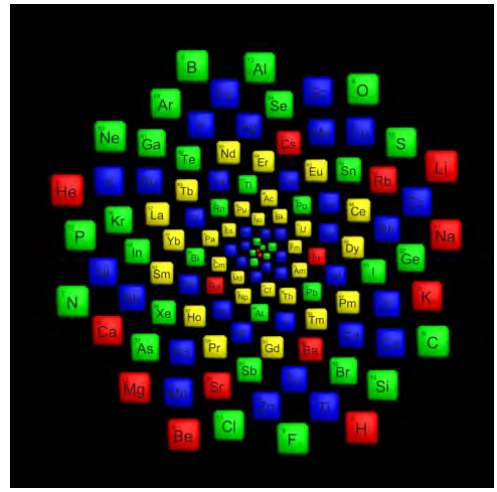


Fig.8 The distribution of elements on a sunflower head pattern. The charge of atom nucleus corresponds to the age of the seed in the collective fruit. (author's model).

3.4 Shells



Fig.9 Any multiple shell object.

3.5 Pyramid

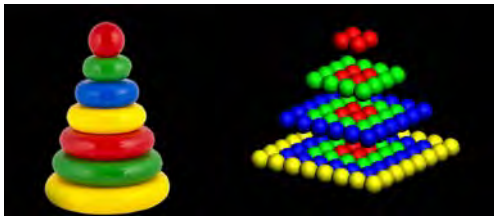


Fig.10 Every next layer of the pyramid is its gnomon. An addition maintains self-similarity.

3.6 Platonic solids

3.6.1 Octahedron

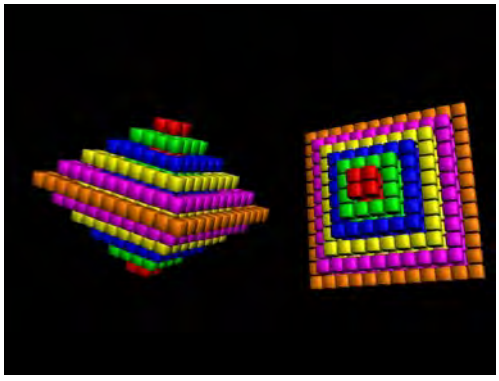


Fig.11 Octahedron (author's model).

3.6.2 Gnomons of Tetrahedron

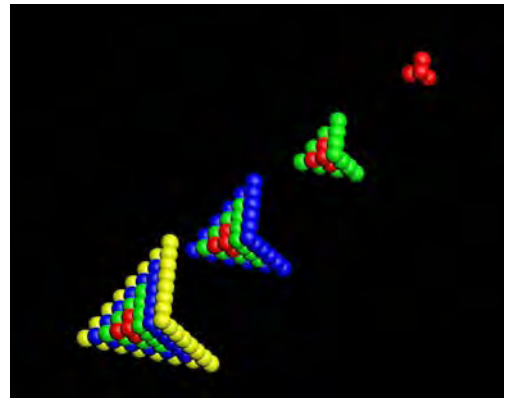
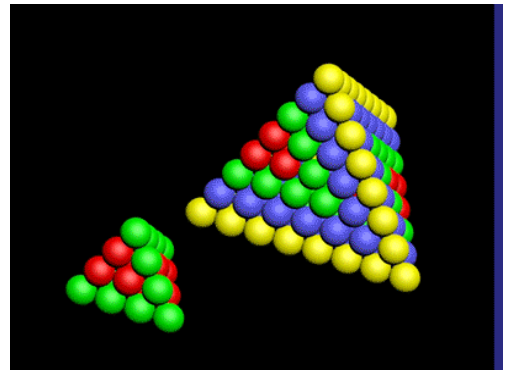


Fig.12 Bended squares as gnomons of Tetrahedron.

3.6.3 Tetrahedron



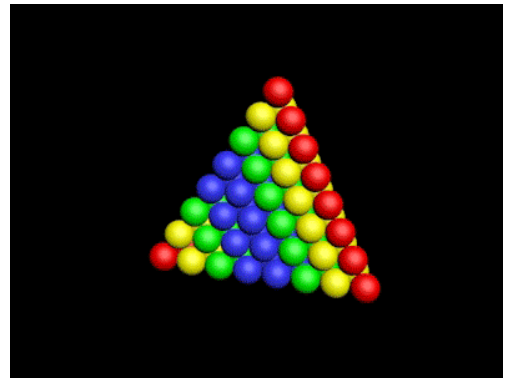


Fig.13-14 Tetrahedron (author's models).

These models were made even before I became acquainted with the works of Pierre Demers. Apparently, the priority of creating a tetrahedral table and pyramidal shapes on a quadrangular base (Fig.10 on the right) - one large pyramid 120 and four pyramids 30 - belongs to this amazing Canadian scientist. Pierre Demers left this world in 2017 at the age of 102. I'm sorry I didn't get in touch with him.

I see the novelty of my work today in the idea of a *gnomonal* construction of a table in the context of the Pythagorean figurate numbers approach.

3.7 Triangle

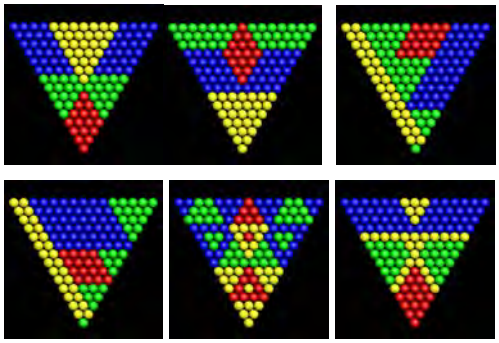


Fig. 15 By happy coincidence, 120 is a tetrahedral and a triangular number at the same time.

3.8 The tables built on the motifs of ornaments

The tables of the periodic law built on the motifs of ancient folk and modern ornaments take a special place. They include not only geometric archetypes, but also magic-symbolic, cultural and religious archetypes of the collective unconscious. Note that the periodic law table, built on the basis of the Native American ornament, surpasses the modern Mendeleev table in the parameter reflecting quantum numbers in its structure.

3.8.1 Ancient folk ornament Octagonal star



Fig.16 A pillow with Octagonal star.

Octagonal star as ornament motif appeared before the birth of Christianity. This symbol (Alatyr, Svarog's Cross, Vasmirog) remained in ethnic religion and ancient patterns predominantly of Slavic, Finno-Ugrian, and Turkic peoples.

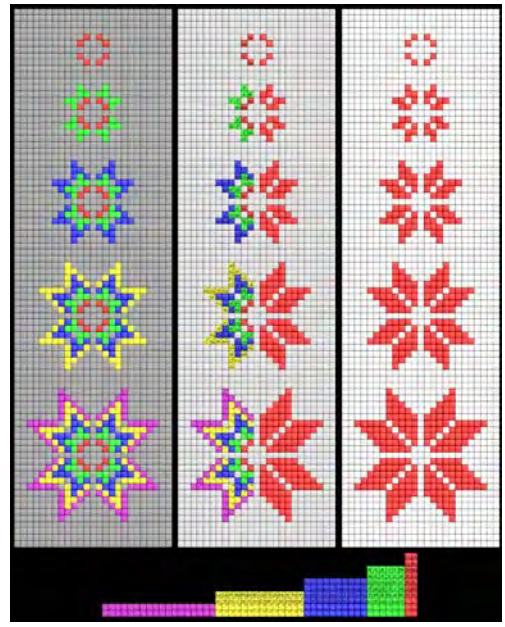


Fig.17 The table of the Periodic law built on the motif of Octagonal star.

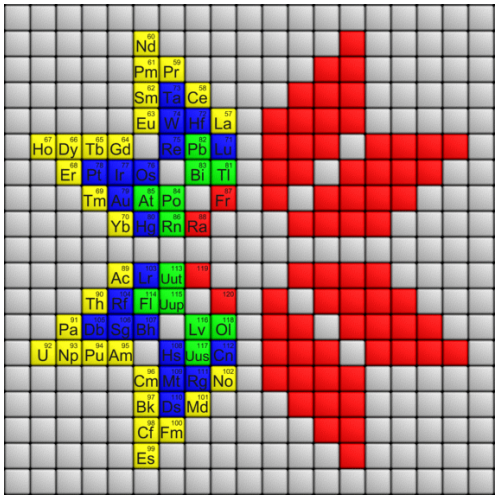


Fig.18 The detail of the above figure: 7-8 periods.

3.8.2 Native American Indian ornamental Periodic Table



Fig.19 Ancient Native American Indian ornament.

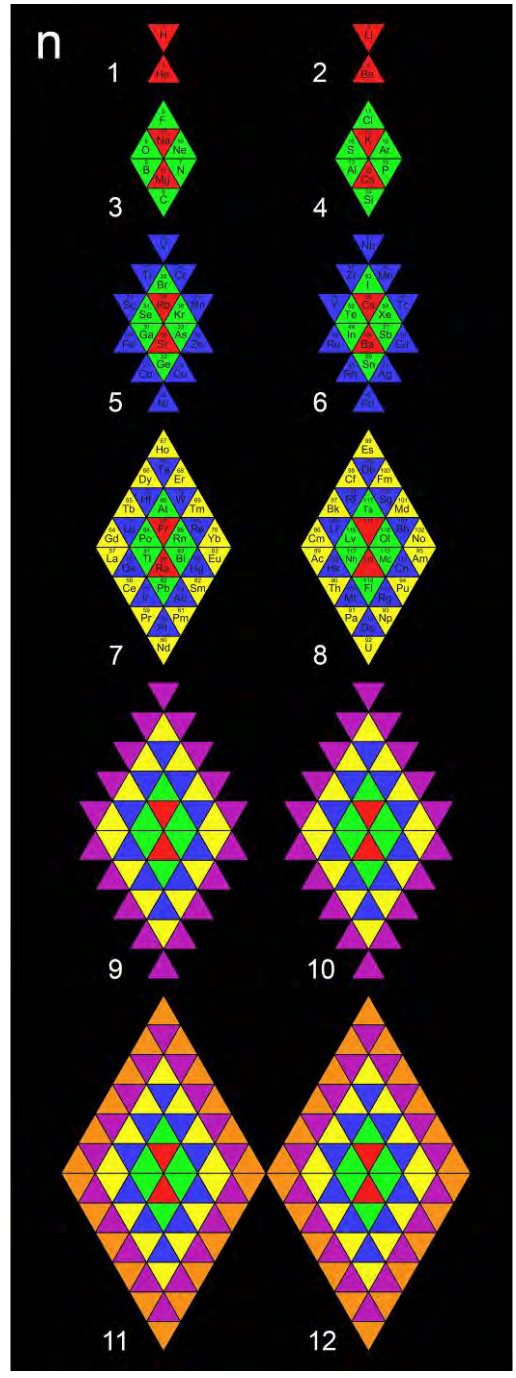


Fig.20 The principal quantum number n *designates the principal electron shell.*

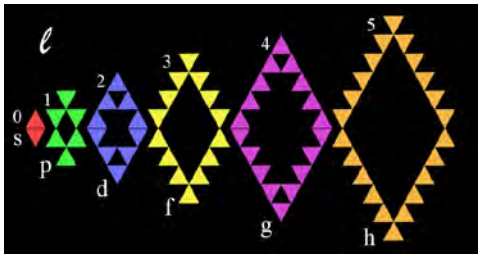


Fig.21 The orbital angular momentum quantum number l *determines the shape of an orbital.*

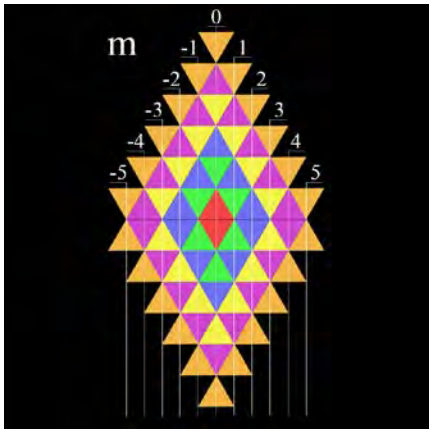


Fig.22 The magnetic quantum number m_l *determines the number of orbitals and their orientation within a subshell.*

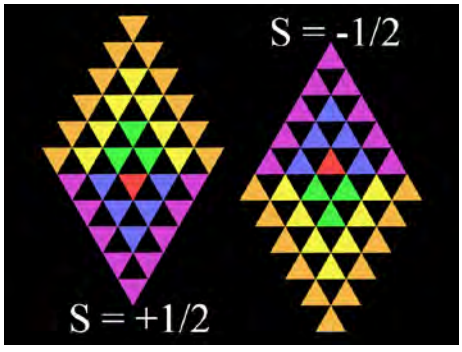


Fig.23 The electron spin quantum number m_s *designates the direction of the electron spin.*

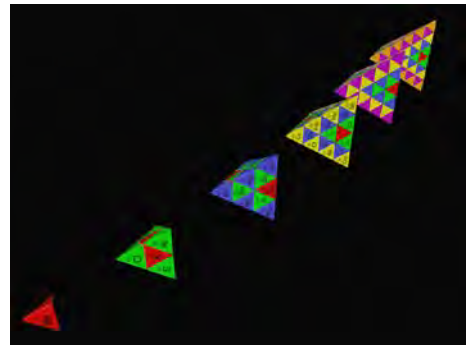


Fig.24 The Tetrahedral Periodic Table based on Native American Ornament

3.8.4 Ancient and Modern Patchwork Patterns

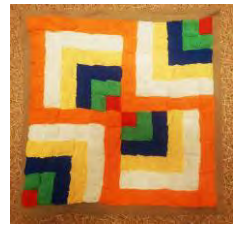


Fig.27 The Projection of Periodic Law on the patchwork ornament.

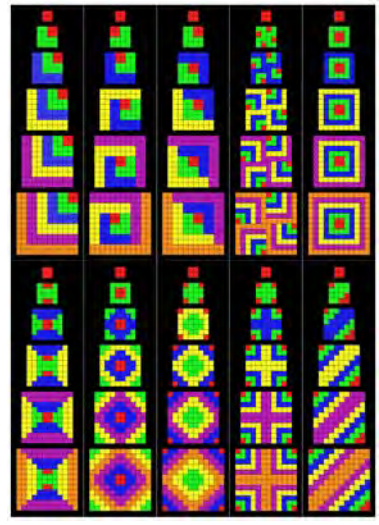


Fig.28 Ancient and Modern Patchwork Patterns

3.9 The tiles on the pavement



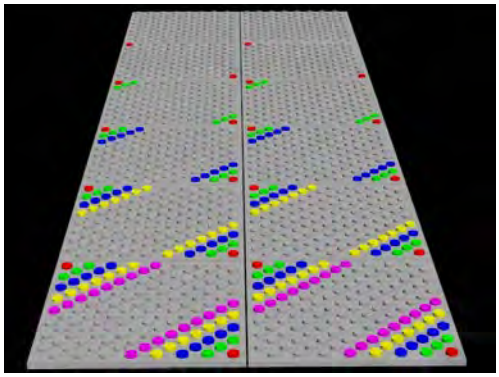


Fig.29 The projection of Periodic Table on the pavement tiles.



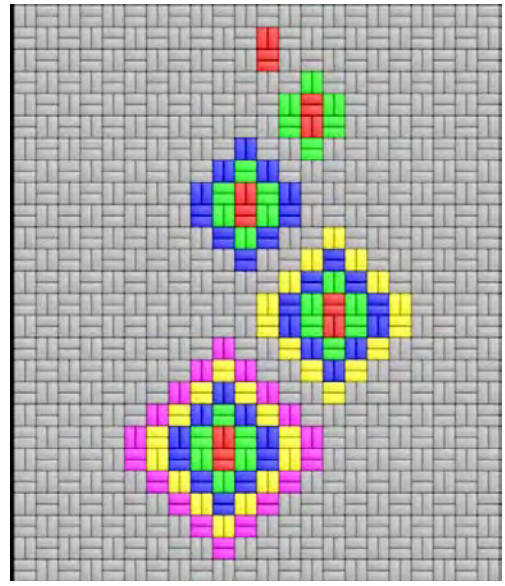


Fig.30 The projection of Periodic Table on the pavement tiles.

3.10 An architectural example from nuclear physics

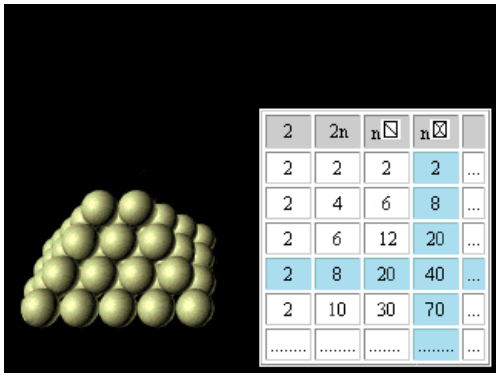


Fig.25 Oblong pyramidal numbers for atom nucleus and its gnomons



Fig.26 Oblong pyramid in ancient architecture.

3.11 Periodic Law archetype in painting

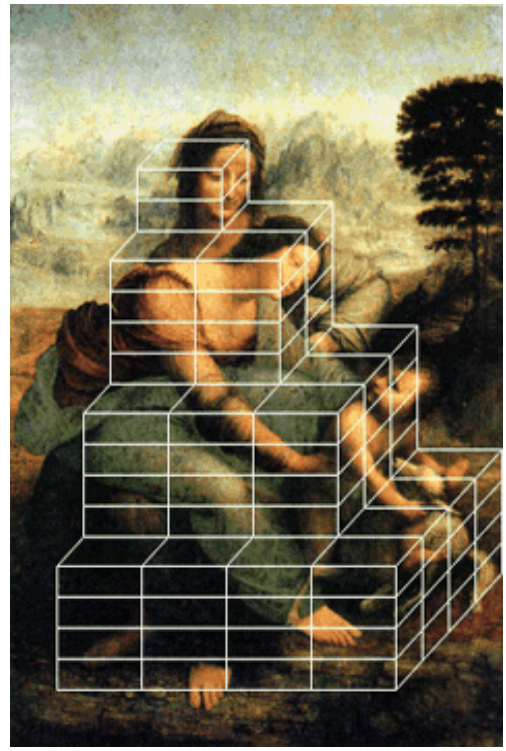


Fig.31 Leonardo da Vinci. Madonna and Child with St Anne. c. 1510. Oil on wood, 168 x 130 cm. Musée du Louvre, Paris

*"*An example of using a pyramidal composition in combination with a technique *Mise en abîme* .

In Western art history, *Mise en abîme* is a formal technique of placing a copy of an image within itself, often in a way that suggests an infinitely recurring sequence. In film theory and literary theory, it refers to the technique of inserting a story within a story.

3.12 Periodic Law archetype in literature

Shells	Subshells	This is the house that Jack built
K	s	This is the house that Jack built.
L	p	This is the malt that lay in
	s	the house that Jack built.
M	d	This is the rat that ate
	p	the malt that lay in
	s	the house that Jack built.
N	f	This is the cat that killed
	d	the rat that ate
	p	the malt that lay in
	s	the house that Jack built.
O	g	This is the dog that worried
	f	the cat that killed
	d	the rat that ate
	p	the malt that lay in
	s	the house that Jack built.

Fig.32 Conformity of filling of electron shells to some children's literary works by the example of a poem "This Is The House That Jack Built". The structural principle is repetition with addition.

4 Periodic system for kids

Our view on the symbolic representation of the Dmitri Ivanovich Mendeleev's Periodic Law of elements suggests a new approach to teaching chemistry and physics as academic courses.

The teaching is divided into two stages. At the first stage, which, according to Jung, can be called *subconscious*, the child at the sensual level is introduced to the geometric archetypes of Periodic Law. Educational games with cubes, balls, pyramids, mosaics, coloring, constructors, beadwork, kirigami, modeling et cetera in an entertaining and safe form will not only strengthen the intellect, but also prepare the child for the second, conscious stage of obtaining academic knowledge. This *conscious stage* for the vast majority of students is very painful and difficult to pass now. Thus, the age threshold for the beginning of chemistry and quantum physics studying will be reduced from 14 to 1.5 – 3 years old

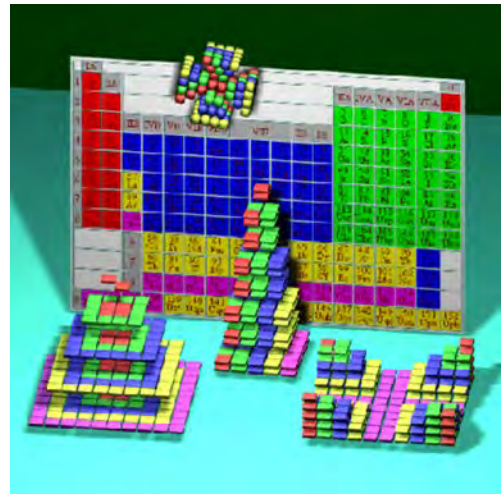


Fig.33 Periodic system for kids.

References

[1] Plato, *"Timaeus"* http://classics.mit.edu/Plato/timaeus.html

[2] Pauli,W.E. (1948) *"The Influence of Archetypal Ideas on the Scientific Theories of Kepler"* https://ru.scribd.com/document/45712272/The-Influence-of-Archetypal-Ideas-on-the-Scientific-Theories-of-Kepler.

The instant

Paper

Topic: Poetry-Philosophy-Generative Art

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Premise

I dare say you never even spoke to Time!"
"Perhaps not," Alice cautiously replied;
"But I know I have to beat time when I listen to music."
Lewis Carroll, Alice's Adventures in Wonderland

This is an investigation about the Parmenides concept of instant inside the generative process of art in our times for discovering in this so ancient philosophical concept possible connections with the GA digital process.
After a long investigation for perhaps 30 years in researching and teaching Ga processes, I have focused instant as a site where GA variations can live following order of Harmony in endless variations together as in Nature *organicity*.

How is the best way for this kind of knowledge? Following Leonardo, that should be included between the most important founders of the modern science of Nature, science is the spiritual in the sensitive, the number, the shape, the reason of the senses. Following these procedures, he became the inventor of a unique shape of images and of chiaroscuro,
Like a magical chromaticism where objects dissolve, like a new form of visualization of the invisible.
An instant of the complexity of living.
This uniqueness may live too in infinite all equal parallel worlds following the vision by Borges and the theory by Hugh Everett III, but **the unrepeatable uniqueness where past, present, and future** live together simultaneously seems to be a philosophical approach perhaps closed to a digital generative art vision.

Objectives

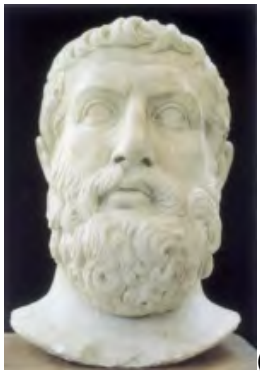
Connections between the GA digital *numbering* process for endless variations and the concept of instant in Parmenides.

How they identify themselves, how they work, possible open results *in fieri*.

Points of investigation:

The instant in Parmenides, Einstein, Prigogine, crossing St. Agostino.
The voice in poetry: open variations in a fixed text.
The popular voice: a generative collective sound for writing
Numbering: an open process for identity
Imagination: active acting of memory
Variations: endless similarity

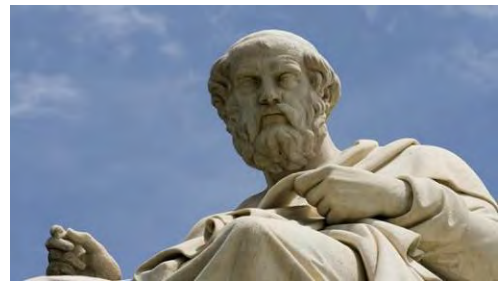
The instant in Parmenides philosophy


(VI-V century BC)

Παρμενίδης is **a** Greek philosopher son of Pyres, born in Elea (Velia) around 520 BC.
Of his **poem** "*Περί φύσεως*" (*About nature*), nine fragments rest that have transmitted his doctrine to us. The main exponent of the Eleatic school, he is the founder of ontology.
In Parmenides' poem, the *nun* has a special status *vis-à-vis the other form of time:*

οὐδέ ποτ' ἦν οὐδ' ἔσται, ἐπεὶ νῦν ἔστιν ὁμ οῦ πᾶν,
ἕν, συνεχές
"Neither was it no will it be, since it is now all together,
One, continuous" *(*fr *8,5-6a)*

Plato about
"The instant in Parmenides"


Plato[1]

"When the One becomes Many?" Here is one of the great questions by ***Plato*** *about Parmenides instant- "So when does it change?" It does not change when it is unmoving or when it moves, nor does it change when it is in time.*
"Is there the extraordinary state in which it should be when it changes?
The instant. In truth, this seems the meaning of the word instant: that from which the changes in the two opposite directions start. In fact, it is not from still stillness, nor from movement still in motion, that there is ***a change****; but it is this instant of extraordinary nature,* ***placed in the middle.***
Between movement and stillness, and which is not in any time, what towards which and from which: What moves in stillness and what is stationary changes in movement". (Parm. 156c-156e)"
"-Tell me one thing: don't you think is ***a distinct idea of similarity*** *in itself, and another, opposite to it, which is the* ***Idea of dissimilarity****? That of these, which are two, belong I, you, and all those realities that we call* ***plurality?*** *That those who participate in the similarity become by the fact of participating in it and in the measure that they participate in it, and those who participate in dissimilarity become dissimilar, while those who*

participate in both have both ***characteristics?*** *However, what is strange, if all things participate in both opposites that those same things are, for this double participation, similar and dissimilar together?" (Parm.128e-129a)*
"If someone demonstrated that those things, which are similar in themselves, become dissimilar, or that dissimilar become similar, this would be ***extraordinary.*** *On the other hand, it does not seem strange to me, Zeno, if what participates in both reveals to be affected by both similarity and dissimilarity. I wouldn't be surprised if someone showed that everything is One, because it participates in* ***unity****, and it is also* ***many*** *because it participates in* ***plurality****. If, on the other hand, it proves that what is One, precisely for this same, is many, and that what is many is One, I would be marveled for this. The same reasoning applies to all other determinations. It is right to be surprised if someone shows that* ***the same genres and ideas*** *are affected in themselves by* ***these opposite affections****."* (Parm. 129b-129c)
The transition from movement to rest, from one contradictory opposite to the other, therefore has to conceive in a way that preserves this separation. Plato's solution in the *Parmenides* is to have this transition happen at an instant (***exaiphnês***) that neither belongs to rest nor motion, but rather is **'between'** both.
This means that an instant is not a part of time, since at any part in time things are either in motion or at rest. This idea we also find it in Aristotle's account of ***nun*** where the now looks as a limit of time, in contrast to a part. But with Plato, the *exaiphnês* ***it is also outside of time and not in time at all:*** it is μηδ' ἐν ἑνὶ χρόνῳ (156c3) and ἐν οὐδενὶ χρόνῳ (156e6), and ἐν χρόνῳ οὐδενὶ οὖσα in 156e1.
For Plato, motion and rest work thus clearly separated with the help of something that is in between movement and rest and is neither the one nor the other.

Followers of Parmenides: Kierkegaard, Gadamer

It was first the Danish philosopher Soren Kierkegaard in his *"The concept of anguish*" to highlight the passage that speaks to us of the timeless instant, impossible to measure and therefore extraneous to the alternative between quiet and movement.
"He who is educated by anxiety is educated by possibility…"

"…. When such a person, therefore, goes out from the school of possibility and knows more thoroughly than a child knows the alphabet that he demands of life absolutely nothing, and that terror, perdition, annihilation, dwell next door to every man, and has learned the profitable lesson that every dread which alarms may ***the next instant become a fact****, he will then interpret reality differently…*"[3]

The immediacy of intuition, the mysterious essence of the sudden instant is the concept that focuses on the analysis of the German philosopher **Hans Georg Gadamer** on this aphorism of Plato's Parmenides.
It was Kierkegaard, Gadamer tells us, to show that the essence of the moment is the mystery of our psychic and spiritual presence, which encompasses all the differences.

Time

"Time is a game played beautifully by children."
Heraclitus, On Nature (c. 535 – c. 475 BCE)

For understanding better the instant concept by Parmenides, some reflections about the time concept. The Greeks evoked time through three different terms:
χρόνος ,καιρός, αἰών
χρόνος is the succession of instants, time in its chronological and **quantitative** sequence, as well as a terrible and powerful divinity
καιρός indicates the occasion, the propitious moment to seize in its rapid instantaneousness: here time seems to live only as **a present**, compared to which a watchful reading or "capture" ability determines the development of the future. In the military strategy, in the doctor's anamnesis, in the ability of the rhetorician, above all the καιρός operates, and with this the development of a time free from the will of the gods, in which the autonomous action of man is placed. This possibility, which arises from intelligence and knowledge of signs, can determine the happy outcome of the future.
αἰών on the other hand, alludes to life as **duration**, in the intermittences and anachronisms of personal existence. This distinction works in part as that introduced by Henri Bergson between the time of physics, quantitative and calculable, and duration.
Time as an eternal return: the Greeks themselves anchored a cyclical vision to the linear conception of time, to the succession of seasons and years.
In this perspective, the future loses its special nature of time *"to come"* and becomes entangled in the plots of an eternal return of ***the identical.*** This is the case for Heraclitus, for whom "god is day-night, winter-summer, and satiety-hunger", according to a cosmological vision in which **the coexistence and unity of opposites translate into an event of eternal change and return.** Even for the Stoics, each event occurs in a precise order and destined to repeat itself eternally, always identical to itself, within individual temporally finite cycles. Each historical cycle ends with a huge universal configuration, a primordial fire in which everything consumes itself dies and from which everything is reborn. ***"Every truth is curved. Time itself is a circle,"*** says Nietzsche in Zarathustra

Sant'Agostino*, unicum* and *unrepeatable* time

"About what is time, if nobody asks me, I know;
if I try to explain it to those who ask me, I don't know",
St. Agostino


Botticelli, Sant' Agostino

"The present ***"one and three"*** ... neither future nor past exists, and only improperly it is said that the times are three, ***past present and future***, but more correct it would perhaps be to say that the times are three in this sense:
The present of what is past ***[memory***],

The present of what is present [***perception***], And the present of what is future [***anticipation***] ". Confessions, XI book, 397 AD
In a generation of art time, each event is unique and unrepeatable. This uniqueness is strongly similar to the morphogenetic process of Nature, where the memory of the process produces an evolutionary path from experience after experience. It works as a collection action and performs a singular/plural recognisability.
This process runs from micro to macroscale by following a singular poetic vision as a possible interpretation. Maybe this rule similar to a universal rule?
From ancient times, the discovering sound is the music of the spheres, declaimed by Dante too.

Modern Times



C. Chaplin, ***Modern Times***, *in the middle* between sonority and silence

«… devons-nous reconnaître que le temps sépare l'homme de la nature, ou bien pou-vons-nous construire un mode d'intelligibilité qui s'ouvrirait à l'idée du temps humain comme expression exacerbée d'un devenir que nous partageons avec l'Univers? »
"*Do we must recognize which moment the man from nature separates, or we can build a way of intelligibility that will open up to the idea of human time as an exacerbated expression of a becoming, with whom we share the universe? "Prigogine and Stengers, 1988*

"Being is ... now" and Einstein

"In his poem "On nature", Parmenides said that Being is eternal: it would make no sense to say that being first is and then is no longer. Therefore, this Entity above all and everything works compared to a sphere, as equal in space and time, finite but apparently infinite for anyone inside it. In the twentieth century, the Parmenidean conception of Being was taken up again with scientific arguments from Einstein who imagined a more or less homogeneous curvature of space-time; so we do not live in a boundless but spherical universe in which we do not realize the curvature of the trajectories".
For Einstein, the analogy with Parmenides came out also in these terms: for the theory of relativity, all the events of the world are as already recorded in the" spool", like a spool of movie that contains all the events of the world. It is certainly a deterministic conception, but if all events are like frames in a spool, then there is no past, future, and present, it is only a matter of projecting the spool. This is the analogy that leads Einstein's discourse, which therefore excludes a not yet being and a no more being. This for the reason that in the spool all the frames are at the same time.
This is the analogy between Einstein's theory and Parmenides' instant concept.

A Generative science for art in an

instant

GA is an art and science process, connected to the past toward the future, where past and future stay together in endless variations. Art and science with imagination.

….The time for beauty has passed. Humanity, except to return to it, does not know what to do with it for more than a quarter of an hour. The farther you go, the more scientific art will be, as science will become artistic. Both will join at the top after separating from the base. No human thought can now foresee to which glittering psychic suns the works of the future will unfold. In the meantime, we are in a shaded corridor, groping in the dark. We lack a lever, the earth slips under our feet. …. But since everything has a reason, and the imagination of an individual seems to me as legitimate as the appetites of a million men and can occupy just as much space in the world, we must, abstracting ourselves from things, and regardless of the humanity that denies us, live for our vocation…..



Gustave Flaubert, letter to *Louise Collet,*

Poetess, 24 April 1852

"…Both will join at the top after separating from the base." This was the main aim that I researched connecting poetry and architecture in a Generative Art process in my discovering art and science processes and my teaching experience too from 1994.
GA works following a numbering digital process for endless variations.
In poetry, ***numbering*** is performed by identified elements as numbers and a figured whole **(set)** as a shape structure. Each part and the whole generate an open result in transformation following the voice sound.
Each identified transformation produces a unique result in the time of the generation process. The numbering process works on logics due to growing and expanding knowledge and discovery, following *(in a specular way*) **the complexity of Nature.**
In Nature, an alive mirror of this transformation process is **the tree**.
The transformation time works in ***an instant*** following Parmenides's definition.

Numbering for imaginative constraints

… El presente està solo. La memoria /The present is alone. The memory
Erige el tiempo. Sucessiòn y engano/ Erects time. Succession and deception
Es la rutina del reloj. El ano /Are the routine of the clock. The year
No es menos vano que la vana historia./Is no less vain than the vain history.
Entre el alba y la noche hay un abismo/Between the dawn and the night there is an abyss
De agonìas, de luces, de cuidados;/Of agonies, of lights, of care;
el rostro que se mira en los gastados/The face that looks itself in the worn
espejos de la noche no es mismo./mirrors of the night is not the same.
El hoy fugaz es tenue y es eterno;/The fleeting today is evanescent and eternal;
Otro Cielo no esperes , ni otro Infierno,/Another Heaven don't hope, nor

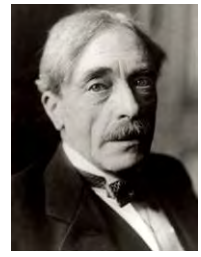
another Hell.
Jorge Louis Borges, El Istante

How numbering gains a time instant is a secret by discovering.
In the theory of the two separations of the brain in human activities also connected to the research on the left side of the brain for creativity in drawing, how the concept of the instant in Parmenides may be connected? Is this the moment that can determine a character in the creative process? How to check it in a generative process? Is it always the instrument of the word the most suitable for constructively following an operability sequence? Is it the instant a crisis, a connector, or an estrangement? Are we still able to trace creative paths where we become the creators of visionary connections? [5]
An answer to these so deep questions about a process of art comes from the imaginative world of poetry, where for performing a text many tools are actioned memories, sounds, feelings, impressions, chromatic visions, smells of infancy and a lot perhaps infinite of feelings strictly focused to the theme of investigation.
The numbering process can control of these so different elements that can be associate also in a unique line of verse, following an instant.

Variations in a Generative Art process

The concept of multiplicity results as variation is **the main character** of a generative art process.
Many artists use random for gaining uncontrolled differences, but sometimes this works as an easy reduction of the open complexity of a GA process.
Transformation time in GA works in ***a time instant*** following Parmenides definition:
"Being is ... now"
“The time is appearance because its existence would imply that appear in the being of events, or an absurd passage from their previous non-being (what is future is not yet) to being (the present)”.
How numbering gains a time instant is a secret by discovering for so many centuries.

Numbering structure in “Le Cimitière marin” by **Valery**



The first sestina of *“Le Cimitière marin”*:

Ce toit tranquille,
où marchent des colombes,/ This quiet roof, where doves walk,
Entre les pins palpite, entre les tombes ;/ Among the pines throb, between the tombs;
Midi le juste y compose de feux/ At noon the righteous composes of fires
La mer, la mer, toujours recommence/ The sea, the sea, always restarting
Ô récompense après une pensée/ O reward after a thought
Qu’un long regard sur le calme des dieux !/ What a long look at the calm of gods!

A *"monologue of my ego"* will say Valery of his composition.
Recalling, many years later, *Le Cimitière marin*, the poet will say that the first movement towards poetic writing was born from ***a purely rhythmic sensation***, devoid of meaning, filled with vain

syllables, which had become an obsession:
In short, ***a musical phrase*** that settles in the mind, devoid of words, but which tries to fix itself in the metric measure of the decasyllable.
At the same time, that measure, as it rang, showed on itself ***"the shadow of the twelve***", the Alexandrian syllabic number, with its "power", and at that threshold, it tended and withdrew from it. For this half of the twelve, ***the sestina*** becomes the strophe of the composition, and the double of the twelve, ***twenty-four***, becomes the whole of the stanzas.

The silence in numbering

Ennio Morricone: «*Silence is music, at least as much as sounds, perhaps more. If you want to enter into the heart of my music, look through the voids, between the pauses.*
Each sound is only the pause of silence. My music starts from here, from this idea….. And by two giants, Johann Sebastian Bach and Igor Stravinsky."
In his life, each day Maestro Morricone walked perhaps for 5 Km staying at home, ***numbering*** each step from the starting one until its ending last step.
This is a silent shape for music.

THE VOICE

Each part and the whole generate an open result in transformation following ***the incoming voice*** sound. This process follows the oral tradition. It was not until the '60s that people remembered that Homer did not write *The Iliad* and *The Odyssey*: he spoke it. Or better *they* spoke it. All of a sudden, all of this consciousness expansion, which is just allowing orality to be not the precursor of writing but *a consciousness* that was the equivalent of writing.

Imaginative variations: Celine, ***rhythm*** in punctuation



The *instant* sound of life: **a popular voice.**
Céline is on the *recherché* for colorful expressions on the mouths of the characters he attends: old and new friends, show people, artists, shopkeepers, and bums, exponents of the bad and common people.
The Argot sound becomes an active logos traduced by his poetic voice in written words. Its real innovation lies in the syntactic and semantic breaks that agitate the period, in *the dislocation of words*, which are anticipated or postponed in the sentence, creating effects of **surprise**, **estrangement, suspension**, multiplying unprecedented **resonances**; hence the impression of ***emotional swing*** which is one of Céline's programmatic objectives.
"Wanting to make the spontaneous effect of spoken life written, you have to twist the language in pure rhythm, cadence, words, and it is ***a sort of poetry*** *that produces a great spell - the impression, the charm, the dynamism - and then you*

have to choose your subject - Not everything can be transposed".
Céline praises the *"precision"* of the movements, **the mathematical exactness** of the gesture that manages to deny itself for transforming itself into the abstract arc of movement, in the enchantment of ***an instant*** that becomes a sign, an ideogram.
When the typescript of **The *Voyage au bout de la nuit*** was sent to composition, the printers, amazed by that unusual style, decided to intervene *ex officio* on the punctuation, removing commas, giving a grammatical arrangement to what seemed a little excessive. Celine when learned of this wrongdoing, made a scene to the editor: "***… Do not add a syllable without telling me! You would blow the rhythm to me like nothing! ... I have a scrambled air but I know perfectly well, what I want***. "

I guanti dei muti/ The gloves of silent

Where do you come from?
And where are you going?
Look up, speak nicely,
and don't twiddle your fingers all the time.
Lewis Carroll, Alice's Adventures in Wonderland

GA is a process performed by the translation from the silent language of numbers into the figurative language of shapes, following the tradition of the poetic tongue too. The connection between numbers as structures and shapes as results is in a transformation tool able to cover as a glove the hidden manipulation of acting. This works without any sound in a mute transformation: the gloves of silents.
These are a very thin connector between the numbering fingers and the incoming configurations as a performing trip of transformation from Nature to art.

WORDS

τοῦ λόγου δὲ ἐόντος ξυνοῦ ζώουσιν οἱ πολλοί
ὡς ἰδίαν ἔχοντες φρόνησιν- I. p. 77. Fr. 2.
"Though the word is common, the many live
as if they have the wisdom of their own."

ὁδὸς ἄνω κάτω μία καὶ ὠυτή
I. p. 89Fr.60.
"The way upward and the way downward is one and the same."
Fragments, Heraclitus

"…Words move, music moves
Only in time; but that which is only living
Can only die. Words, after the speech, reach
Into the silence. Only by the form, the pattern,
Can words or music reach
The stillness…...
Not the stillness of the violin, while the note lasts,
Not that only, but the co-existence,
Or say that the end precedes the beginning,
And the end and the beginning were always there
Before the beginning and after the end.
And all is always now. .."
T.S.Eliot, "*Four Quartets: Burnt Norton"*
[6]

Consciousness and the instant, where real and abstract coexist in a single voice.
"…..About reading a piece of real poetry, in verse or prose, one can say what Sterne said about a smile: ***it adds a thread to the very short canvas of our***

life."*Leopardi,Zibaldone*

Interpretations

"So when one person has said 'Moses thought what I say', and another 'No what I say', I think it more religious in spirit to say 'Why not rather say both if both are true?' And if anyone sees a third or fourth and a further truth in these words, why not believe that Moses discerned all these things? For through him the one God has tempered the sacred books to the interpretations of many who could come to see a diversity of truths."
St. Agostino, The Confessions 12.30 (41)

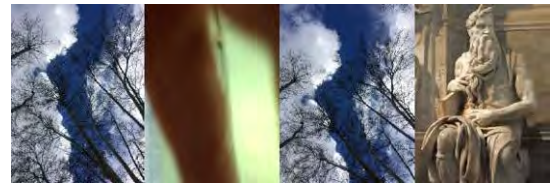
Dante himself wrote on the nature of interpretation in his early work "***Il Convivio"***.
There, he reflected the traditional medieval understanding that interpretation can take place on four levels: the literal, the allegorical, the moral, and the anagogical.
The ***literal*** represents the most obvious reading.
The ***allegorical*** tends to understand the literal set of actions as being symbolic of certain other principles.
The ***moral*** draw ethical principles from the literal action.
The ***anagogical*** applies the principle to the final state of the believer.
To these, the ***abductive*** concept by Pierce is a useful tool for GA process.

Variations

Each identified transformation produces a unique result in the time of the generation process. The process is in abstractly recharging a figurative expression. The numbering process works on logics due to growing and expanding knowledge and discovery, following *(in a specular way*) **the complexity of Nature, as *natura naturans, in a dynamic process of generation.***
In Nature, an alive mirror of this transformation process is the tree.
The great German-speaking Bohemian poet, Rainer Maria Rilke, in his "*Sonnets to Orpheus*", in the best way describes this *overpowering* by the notes:

"…..There a tree raised.
Oh pure being above!
Orpheus sings! Greatness of the listening trees!
And everything was silent. But precisely in that silence
There was a new beginning, a sign
and a change happened.
(...) you created for them a temple in hearing ".

Natura *Naturans*



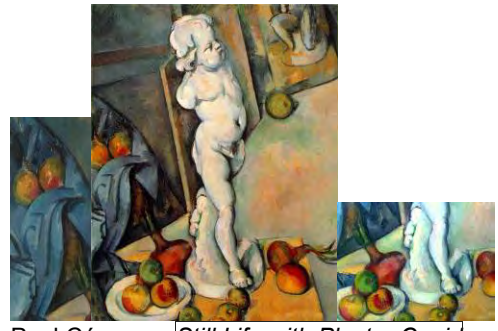
L'istante antico / The ancient instant

L'istante antico, essere plurimo in unicità, /The ancient instant, plural being in its unicity,
Fremeva tra le foglie in espansione: / Trembled among leaves in expanding:
Toccava l'unità della *natura naturans* / It touched the uniqueness of the *nature naturans*
Come fissità di un eterno instabile. / As fixity of an unstable eternal.
"Eppur si muove" urlò Michelangelo / *"And yet it moves"* shouted Michelangelo
Colpendo il suo Mosè sul ginocchio / Hitting his Moses on its knee
Per estrarlo dall'uguale tempo, fissato

nella pietra come passo eterno. / For extracting it from the equal time, fixed on the stone as an eternal step.
Il precario è ucciso per sempre, / The precarious is killed forever,
L'unicità dell'attimo si fissa nel flusso naturale, /The uniqueness of the instant fixes itself in the natural flux,
Dove si specchiano variazioni con lo stesso pathos. / Where variations with the same pathos reflect themselves.
Specchi *curvi* infiniti. Trame di vita organica dove si flette / Infinite *curved* mirrors. Plots of organic life where flexes itself
Il raggio verde della vita sulla città curata nel cuore, / The green ray of life on the city attended in the heart,
"Poiché ai tuoi servi sono care le sue pietre / "Since to your servants your stones are dear
E li muove a pietà la sua polvere." /
And its dust moves them to pity. "

ἐξαίφνη

From **Exaiphnes-ethopoieia**: of a ***sudden, suddenly, unexpectedly***
In his essay "*Mathematics and Dialectic in the Republic VI-VII*", F.M.Cornford [8] speaking of the adverb *ἐξαίφνη* [suddenly], states that in *the Symposium*, *the Phaedrus* and *the Republic:*
"Plato adopts the language of the Eleusinian mysteries, because as the initiation ended in the ἐποπτεία, in the sight of certain sacred objects" in a flame of light ", so the cognitive process founded on mathematics and dialectics is a passage from darkness to light and ends in a different order experience, ***in a vision****".*
A hypothesis of mine reads "*Still life and Plaster Cupid" by Cezanne* as a fragment of a space where a central axis folds *the vision,* building time structures according to *ἐξαίφνη concept.* A passage not only spatial but also deeply chromatic as ***an allegory*** between nature and art, from classicism together with the caducity of the fruits of nature. This transfiguring vision traces an almost eternal ***abstract time*** that results caduceus and intense in the lightness of only an instant, an unexpected time. Cezanne also tries to synthesize in his painting the phenomena of rational interpretation that lead to the recognition of forms and space. However, to do this, he never used the traditional tools of drawing, chiaroscuro, and perspective, but the only color. His great ambition was to solve everything only with color, going where no painter had ever gone before: to synthesize in color the optical vision and consciousness of things.
He said that *"In painting, there are two things: the eye and the brain, and both must help each other".*



Paul Cézanne, *Still Life with Plaster Cupid*, 1895, oil on canvas (Courtauld Gallery, London) with two fragments[7]

This is one of Cézanne's most complex late still-life. Beyond the foreground table on which stands a plaster Cupid, the space and the arrangement of figures become highly ambiguous. The green apple on the floor in the far corner seems

too large and the floor itself appears tilted. The blue drapery in the painting, propped up against the wall at the left, merges with a similar fabric in Cézanne's still-life.
Cézanne may have been using these paradoxes to stress the artificiality of the composition, and perhaps, to comment on the act of painting itself. He was not looking for scientific painting, but rather poetic. His painting, however, remains very difficult to decipher and explain.
If we analyze the relationships of the line we have relationships that we can add or subtract. However, if we immediately read discontinuous non-linear relations we can discover relations that translate from imagination to configurable reality.
Voltaire wrote deeply in *Zadig* about this kind of process.
This approach to art seems to fellow also the Leonardo active approach to painting by a contemplation produced by the handwork, where the thinking action becomes prompter visible, comprehensible to man as man, in his human measure.
For them, all that is real crosses *thought human senses.*

On Roman Time Representations

At the National Archaeological Museum of Naples, there is a four-sided marble memorial stone that goes under the wording ***Menologium Rusticum Colotianum*** from the name of its owner, the humanist bishop Angelo Colocci. It appears on the four sides of a marble altar base, inscribed in twelve columns (one per month).

Each column contains:

A zodiac sign; the name of the month; the number of days in that month; the date on which the ***nonae*** *fell (the fifth or seventh day depending on the month); the number of hours of light and darkness on the days of that month; the astrological house crossed by the Sun; the tutelary deity of the month; the activities to be carried out in agriculture; the religious holidays that a farmer was required to observe.*



The villas in agricultural land often showed mosaics and wall paintings depicting seasonal or monthly agricultural activities, to some extent representations of rustic Menologia.
These were agricultural almanacs, a type of Roman calendar that provided information on agricultural conditions and activities on a monthly basis.

Van L. Johnson hypothesized that the four-sided form of the menologia retained an original cycle of the Roman "year" or holidays based on **the four months.**

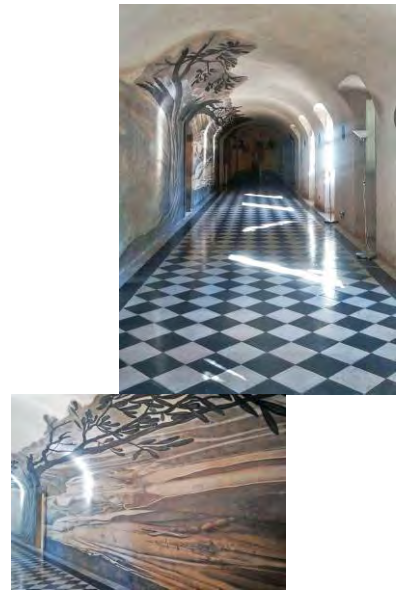
The Codex Calendar of 354



Four examples:
1 Januarius, 2 Februarius, 3 Aprilis, 4 November

To create the Codex-Calendar of 354, more than a dozen diverse texts were brought together and united into one codex. These texts were already in circulation and readily available in Rome when work began on this deluxe edition in A.D. 353.[2] Each text, therefore, has an independent existence, can be located within its tradition, and is of interest in its own right; indeed, the background and sources for these diverse texts have been much discussed. Little analyzed or appreciated, however, is the fact that each of these texts was chosen for this particular codex.
Although the illustrations of the months in the Calendar have been much studied, they continue to be misinterpreted. According to one view, the illustrations of the months were merely decorative, added to the Calendar for nostalgic effect; a second interpretation suggests that they were created for a completely different object and were simply reused for the Calendar of 354. Both of these views and the consequent identification of iconographic features of the individual months are untenable.

Time *in space*:
an anamorphic vision, following the rays of the sun for an instant







Discovers at the micro/macro scale in an instant.
The S. Francis from Paola is a long fresco of around six meters, painted at Trinità dei Monti in Rome by Emmanuel Maignan in 1642.
Frontally seen, the image is a whole of lines with the horizontal course that doesn't apparently represent anything if we're not for the small details of boats, little towns, and more, inserted really to force the reading inducing who looks at to discover them inside the landscape. Therefore, the miracle happens if we move there along the corridor, estranging us from the fresco for about ten meters. More we get far more the lines, seen of foreshortening, recompose themselves in an image, this time legible, of the knelt St. Francis from Paola and the small countries with their boats disappear to the sight, overpowered by the Saint great figure.[9]

Score in silence, Schumann



Sweet and holy Nature let me walk in your arms.
Lead me by your hand like an infant.

He lived in a time when being an artist, moreover, German, meant first of all being a romantic artist. Like the poet Friedrich Hölderlin, forty years older, whom Schumann loved and whose cursed fate he shared.
The composer's mind was strongly similar to the big pain that Hölderlin had for more than 34 years in his life. The musician was an avid reader of his poetry, like that of Novalis, but also for the habit of signing himself sometimes with Italian names, which cannot be accidental. Hölderlin had chosen Salvator Rosa, Buonarroti, Scardanelli; Schumann

Eusebio, and Florestano, two Carnaval masks, op. 9. One is a reflective type, the other a handsome madman, a sparkling romantic hero. An Ugo Foscolo type, if we want to continue the references to Italy.
Schumann was very cultured, at the top of his preferences were Goethe, Schelling, and Schiller; in his way he was also a bit of a philosopher, he believed in a pantheistic god and cradled a strong feeling of Nature. He liked to walk and pick wildflowers.
He noted in his diary on September 21, 1853, that he started composing **"a piece for violin"** (*ein Stück für Violine*), and that he finished it on October 3 of the same year.
Certainly, ***the Concerto for violin and orchestra in D minor*** does not result in evidently affected by the psychic crisis of the composer and was elaborated in one of the rare lucid moments of his mind, before mental disorders became serious and led to madness and death. Schumann defined the main theme as "***Geister-Thema",*** that is, *spiritual theme,* for the absorbed contemplative poetry that emanates from it. **For eighty-four years** the Violin Concerto remains **unpublished** and, except for some scholars, practically unknown.[10]
The Violin Concerto in D minor only emerged from the past when it was performed in Berlin in 1937 and shortly afterward in the United States. All against the wishes of the widow Clara Schumann, and friends Joseph Joachim and Johannes Brahms, who had buried the score in the Berlin State Library and decided that it would only be possible to see it again a hundred years later. An incomprehensible decision, while its author, in the rare moments of lucidity, asked what had become of its music.

In ending: ***Expectation***

An "Image" is that which presents an intellectual and emotional complex in an instant of time…
It is the presentation of such a "complex" instantaneously, which gives that sense of sudden liberation; that sense of freedom from time limits and space limits; that sense of sudden growth, which we experience in the presence of the greatest works of art.
Ezra Pound, A few don't [11]

In GA investigations, each experiment gains indications and descriptions for a new possible experience in very different projects too. How and why?
A careful critique of the chronicle of the event establishes a dynamic relationship between past and future by generating indications and descriptions as operability sequences. Although our current time draws in every way to destroy any connection with our past by continually simplifying our creative expressions, reducing them only in tools for users, we try to actualize ancient complex patterns of mathematical expression by translating them into new digital tools.
This is GA's primary task: to translate the complex ancient structures of knowledge into art, poetry, music, and expression of the body with dance using digital language.
The temporality of the generative structure is non-linear. For example, between the sequence of a poetic text read live or recorded there is a completely different perception by the part of the spectator. This is not less if we use digital devices following visionary imprinting open to the art of expectation.
"Memory took on a prophetic sound. Her life seemed like a life expected and not yet lived." [12].

At the core of this story is the sense that expectation, not stability or predictability, is what characters live for.

The expectation is a way of stepping out of time:

"*The girl wondered if she was outstripping time, with her long stride and her empathic soles, and if her expectation of love and other pleasures served the same purpose."*

In our without breath pandemic time, the walking girl expectation the silent land of our cities with a sunshine ray illuminates.

Main References:

[1]https://giulianoantonello.wordpress.com/2016/04/06/la-condanna-platonica-dellarte-6-3/

[2]https://www.youtube.com/watch?v=CcCqo22PcEE

[3] Søren Kierkegaard," *The Concept of Anxiety: A Simple Psychologically Oriented Deliberation in View of the Dogmatic Problem of Hereditary Sin"*

[4]http://www.raiscuola.rai.it/articoli/hans-georg-gadamer-il-parmenide-diplatone/13890/default.aspxhttps://www.youtube.com/watch?v=AGFuJLw7WP4

[5]http://www.generativeart.com/GA2016WEB/Colabella_GenerativeLine.pdf

[6]*The voice of poet:* T.S.Eliot at:https://it.video.search.yahoo.com/search/video?fr=mcafee&p=T.S.Eliot%2C+the+voice+of+poet+you+tube#id=5&vid=a4c40974746c7f7abacd9499a31e4ed4&action=view

[7] A video lecture of this artwork at: https://journals.openedition.org/etudesplatoniciennes/1717

[8] www.jstor.org/stable/2250010

[9]https://www.generativeart.com/GA2011/enrica.pdf

https://www.youtube.com/watch?v=gJqdlbRnhJ8

[10] Schumann: *Violin Concerto Frank Peter Zimmermann-* https://www.youtube.com/watch?v=YLod6Ra6f08

[11]https://www.poetryfoundation.org/poetrymagazine/articles/58900/a-few-donts-by-an-imagiste

[12]Gina Berriault'"*The Infinite Passion of Expectation"* https://openlibrary.org/works/OL549393W/The_infinite_passion_of_expectation

A SHORT ESSAY ON THE MEANING OF DIFFERENTIATION IN DESIGN

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Abstract

In all types of design processes, design becomes possible when the designer develops an unusual attitude and/or perspective in his/her approach to the problem he/she is addressing. As we go back in history, while designers develop a language that becomes identical to themselves due to the differences they reveal in their design, it is seen that in the pages of history the designers appear with the phrase “great artist” before 20. century, and then “great designer.” The knowledge and cultural capital of the designer are the foundations of his/her creativity. Prof. Margaret Ann Boden from the Department of Informatics at the University of Sussex defines “creativity”, one of the key concepts here, in two different ways: “Psychological Creativity (p- creativity)” and “Historical Creativity (h-creativity)” [1]. While in both forms creativity is a result, the questions of “How is data selected and defined?”, “How is data managed?”, “How and why is data established?” constitute three building blocks of the foundational reasoning of the adventure of creativity. It is obvious that with the answers to these questions, the designer makes his/her design different among its kind. So, could there be any approach that will create a difference in the design process and serve both forms of creativity?

In this paper, an attempt has been made to go after the above question and develop a proposal. In this study, the sample screening model was applied as a method of examination.

1. Design

It is without a doubt that designing is a significant aspect of ours, that we have designed since the first day of our civilization. The satisfaction of the needs such as economy (sheltering, dressing, food, health, etc.), security, justice has always been what is prior in design and they continue to be so.

The field of design, which continues to vary in an accelerating manner with respect to the needs, wants, the

accumulation of knowledge, and developing technologies, has reached a many-layered and complex structure. While many fields of design emerge under what we might call civilization, all fields of design (health, food, textile, education, and so on) form their order in accordance with their time and economical environment.

As the systems develop in the field of design, professionalization in the processes such as human resources, design/production, marketing, and so on, is required by the institutionalizing structure. While the industrial revolution in the 19th century and the changes in consumption and production, which followed alongside, were altering the economical system rapidly, they provided a significant phase concerning institutionalization and professionalization in the field of design. The following era of wars, the rapid scientific and technological progress that occurred between the second half of the 19th century and the first half of the 20th century has continued to affect the economical and, naturally so, design processes. In the current era the progress made both in science (along with the new fields of science) and in digital technologies have started to change the fields of economy and design, with as much force as was in the 19th century. Due to the digital technologies, the domain where the physical and the digital world overlap caused a redefinition of the concepts and processes of production and consumption as well as they brought about novel fields of design. While solutions, which generally use the systems and methods that we have developed in the physical world, for the problems of design that arise from the process we enter into are being produced, meeting the high level of consumption is also being attempted[1].

The United Nations, in its report "World Population Prospects 2019, Highlights," reports that in 2019 the world population was approximately 7.7 billion [3]. The liberal economy that has started to globalize in the 19th century and the rapid increase in human population due to the advancing technology (the population that was 1 billion in 1800 reached 1,6 billion according to the data from 1900 [4]) indicated not only the increase of consumer population but also the increase of the capacity of production. This increase has caused the diversity of design and human tastes to come to the fore in the world of design. It is necessary to briefly touch upon the issues of "diversity of design" and "human taste" at the point reached in the examination made in this paper.

However, it would be helpful to discuss John Heskett's brief definition of the concept of "design" before proceeding to the issue of diversity in design. In his "DESİGN, A Very Short Introduction" Heskett defines "design" as follows: "[d]esign is to design a design to produce a design" and he explains:

"Yet every use of the word is grammatically correct. The first is a noun indicating a general concept of a field as a whole, as in: 'Design is important to the national economy'. The second is a verb, indicating action or process: 'She is commissioned to design a new kitchen blender'. The third is also a noun,

meaning a concept or proposal: 'The design was presented to the client for approval'. The final use is again a noun, indicating a finished product of some kind, the concept made actual: 'The new VW Beetle revives a classic design.' Further confusion is caused by the wide spectrum of design practice and terminology… [5]"

Heskett's befitting definition and his elaboration of it correspond to Prof. Boden's definition of creativity and the distinction concerning the types of creativity. On the one hand, Heskett's "a new kitchen blender" refers to the expansion of the product range of an already existent product, the counterpart of this in Prof. Boden's text is what he calls "Psychological Creativity" (p-creativity). On the other hand, Heskett's "a classical design" is mirrored by Prof. Boden's "Historical Creativity" (h-creativity). While the former is directed at the development and expansion of the product range, the latter defines, what one might call with a recent expression, iconic designs[2].

Further, Pierre Bourdieu's handling of the issue of taste and consumption habits/dispositions with respect to the variables/factors of taste and aesthetics brings about a wide explanation of the relationship between production and consumption. At the same time, Bourdieu's aforementioned analysis includes the main causes of the need for diversity in design and especially product development [6].

Bourdieu, under the section "The Variants of the Dominant Taste," in his book "La Distinction, critique sociale du jugement (Distinction: A Social Critique of the Judgment of Taste)" classifies the belonging of aesthetic choices to the ethical body that establishes lifestyles in terms of cultural capital. He classifies these classes as teachers (primary and secondary education, high school, and university teachers), higher educated ones (public sector administrators), aristocrats, and lastly the self-employed ones.

In accordance with their cultural capital, these classes' attaining and accumulation of their likes can only be parallel to their financial capital. To give an example from the same book, on the one hand, the first group chooses rural museums which are the cheapest and earnest ones, on the other hand, the group which consists of liberal professions chooses greater museums and galleries both in and out of the country. The collections that are exhibited in those museums, in turn, generally consist of the funds of the aristocratic class. The classification Bourdieu specifies shows that diversity and difference is a crucial criterion, which is also crucial to the field of design.

Thus, if we turn to the fundamental question of this piece, how can differentiation be rendered in design?

2. Differentiation

Generally, we might state that differentiation is "the action or process of differentiating or distinguishing between two or more things or people [7]." And differentiation figures in today's

understanding of design as a crucial criterion.

The desire of a designer to differentiate in his/her designs (maybe we should say the obligation to do so) is evident in the change of the quantitative and qualitative representation (repraesentare) of painters and sculptors in the 19th century. It was when French innovator Joseph Nicéphore Niépce (1826 or 1827) took the first enduring photograph the fields especially painters occupied until that day, changed forever [8]. Until the camera was invented, the primary doing of the painters and sculptors was to document and record. While painting was showing the power and position of the emperors, kings, ambassadors, generals, ministers, princesses, aristocratic-bourgeois families, countries, and the power holders, they are now being photographed.

Painters left their position in the constitutions to photographers, and governments and palaces have started to hire photographers. With these changes, painters and sculptors were obliged to find a way to make a living and produce in the liberal economy of their time. This obligation quickly brought about art dealership and art brokerage.

The industrial revolution and the following capitalist system globalizing with an England becoming an empire in all respects as its center brought about the rise and spread of Victorian eclecticism in the fields of art and design. All kinds of precious goods, metals, and high art products were flowing to Great Britain from dozens of colonies all over the world ranging from British Honduras, Bahamas, Canada, Egypt, Kenya, South Africa, New Zealand, Fuji, Australia, Burma, or India. Different household items, furniture, fabrics, clothes, paintings, sculptures, plants, animals, etc. were offering a rich selection. For the artist, architect, designer of that day (interior decorators, fashion designers and industrial product designers), this diversity and richness provided a vast opportunity for differentiation in basic concepts such as color, texture, composition, form, or function. In this period when modern life practices started to emerge, people started to become free, make decisions about their lives, exist, and trust themselves in the institutionalized system. Thanks to the developing and spreading rail systems, public transportation, sea transportation, the ease of transportation and people's going to lands far from where they live have expanded their experiences. For architects, artists, designers who take these trips, this has greatly affected the potential to offer different products to their target audience that expand and vary through galleries, architectural offices, and similar brokerage institutions.

By and large, impressionism, the characteristic art movement of the 19th century, turned from closed areas and limited regions to open areas and distinct regions and communities in its narration or depiction. In the same century, quickly developing science and technic resulted in the changing economy and, closely related to this, compelled people to rethink almost everything in depth. This, in turn, posed a great deal of pressure on people (in gothic, horror, and fiction literature this pressure and anxiety can be traced). It can be said that the Little

Ice Age in the Northern Hemisphere ending in the middle of the century, was a positive event that developed outside of human decisions in this depressed century.

The Little Ice Age[3] (LIA), between 535 and 536, started with the earth entering into a severe cooling period that would last for a long time, following a great natural disaster called the "Dust Veil Event" that affected Anatolia and Europe. In the continuation of earth events, as the inhabitants of the Northern Globe, we experienced the LIA between 1300-1850. Besides, with the Sunspot[4] (within 11 years, the sun completes a solar cycle of calm and stormy activity) and the natural events that occurred between 1755 and 66, the LIA period was experienced from time to time with gradations[5]. These severe natural events that continued until the mid-19th century gave rise to cold weather, sicknesses, famine, migrations, and so on.

With the calming of the natural events, warming weather, and development of certain artifacts people started to go outdoors and nature more easily and spent longer time there. From music to architecture, fashion to interior design, it was impossible for designs in many fields not to include the character of impressionism. Designed or not designed natural environment, daily practices in exterior, open spaces, cities, and human communities have become the necessary elements of the stories that impressionists tell in their making sense of what they see in the physical world. Thus, the artworks they created were compared to neither classical painting nor to the photograph, which we can define as the first technical image.

Their style was completely different. In the impressionists, form had lost its importance. The light and color (which are the continuation of each other. The change in the intensity and speed of sunlight falling on the Northern Hemisphere changes the quality of the natural light seen by the human being, and also changes the quality of color) they used was a representation of the light and color of open spaces of nature[6]. The free, light brush strokes that can be seen one by one were trying to express the time-varying light, shadow, and reflections.

While the brush marks become points in pointillists, who are among the impressionists, they expand and elongate in Cézanne. Artists, living the speed of the age, have tried to express the flow of time in their paintings and sculptures in opposition to the classical understanding that portrays a moment or the photograph that captures a moment.

Hence, the impressionists and the pointillists have differentiated from the artists, architects, and designers who came before them with the stylistic details tried to be expressed above. In addition, this differentiation process should be read as an important phase of modern art.

2.1 The Differentiated One

Among the many artists who contributed to post-impressionism, Paul Gauguin is especially significant due to the stories he tells. It is evident that what

differentiates the art of Gauguin is not only his painting style but also the geography, different people, and their lives that are being depicted. Gauguin, with a radical decision, leaves Paris in 1887 and travels to Panama and Martinique, a Caribbean Island. At the November of the same year, he then returns to Paris. Later, between 1891 and 1893 he makes his first visit to Tahiti. His second visit to Tahiti happens between 1895 and 1901, and in August 1901 he travels to Atuona (on the island of Hiva Oa, or La Dominica in the Marquesas group) and stays there until his death in 1903. The reason for such extraordinary choices in terms of the geographies he wants to visit is perhaps due to his father's decision to move to Peru when Gauguin was an infant, for his mother was from the Inca aristocratic family, and the Peruvian memories from his childhood. Regardless of the reason, Gauguin depicted all the diversity of the geography he entered during his travels to the South Seas, including the vegetation and animals he saw, the lives he witnessed and shared and the life practices he accompanied. Thus, he produced the most divergent pieces of European painting, which include a great differentiation in the understanding of color, lighting, stain, and composition. His letter to Andre Fontainas in 1899, who reviewed his "Whence do we come? What are we? Where are we going?", contains remarkable explanations about his divergent status [14].

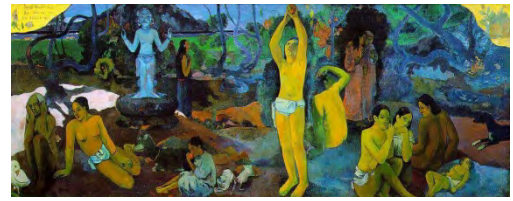


Image 1: P.Gauguin, “Where Do We Come From? What Are We Going?”, 1897

Another artist who experienced something similar to Gauguin, with respect to travels, is Paul Klee.

Klee, unlike Gaugin, has chosen North Africa as his travel route. Among Klee's travels, which include a one month visit to Egypt in 1928, his two weeks in Tunisia with August Macke and painter Louis Moilliet in 1914 had a profound effect on his work. Differences in the living culture, art, architecture, geographical structure, and light that allows us to see, the geological structure of Tunisia, the speed of the light falling here, the quality of the material used for production, and so on, would have serious effects on an artist's opinion [15]. This, in turn, revealed a significant differentiation in Klee's post-travel studies concerning his understanding of abstraction (simplification), form language (regular quadrilaterals and triangles stand out), and in his applications of color as well as theoretical studies [16].



Image 2: P. Klee, "Red and White Domes", 1914

On the other hand, pattern is an important tool in the forms designed by Klee. Pattern is an essential element of modular design, structures composed of complex or simple symmetrical pattern systems (structural solutions of Sinan's architecture are a unique example of modular design). Klee's modular patterns that are influenced by the art of architecture and ornamentation of Tunisia and its surroundings are tools for the artist to produce form and texture, as well as rhythm in his abstraction. Moreover, he used paper, glass, polished wood, or plastic and similar artificial materials in his search for materials for collage works so as to obtain the light and hence the colors of Tunisia that affected Klee. His use of artificial material alongside classical materials shows that he was following the novelties the industrial age has brought forth [15]. In brief, while Klee was interpreting both the differences he saw and experienced (such as light, geography color, etc.) in the places he traveled and the opportunities produced by the science of his day with an artistic eye, he has succeeded in making a big difference in his works.



Image 3: P. Klee, "Static- Dynamic Gradation", 1923

It would not be wrong to say that Art and Craft, which overflowed from the borders of England and influenced Europe and North America for about 40 years (1880-1920), was a movement against the unqualified mass production of the Victorian Period. Accompanied by this movement, modern works, which bear the visual aesthetic values and other qualities of the handicrafts of the previous periods, were made. Adhering not only to artistic aesthetics but also to the principle of functionality in designs, has made an important contribution to the development of industrial design. They differentiated in their understanding of design, as if acting with the approach of both an artist and a craftsman and led to the formation of the concept of 'designer'. William Morris, who stands out with his discourse against the production

criteria in the economy of his period and one of the leading names of the Art and Craft movement, is a designer who has blended the approaches of these two professions well in his own design approach. On the other hand, one of the features of William Morris is his technical approach to design, which distinguishes his work from other studies. In addition to his own extraordinary understanding of design, another feature that makes a difference in Morris's work is the products he created by analyzing the elements of the movements he influenced such as Victorian eclecticism, Art Nouveau, ArtDeco style and medievalism and his own cultural romanticism. Here, besides the technical difference of Morris, he made a second difference by reinterpreting the elements he selected from the distant history of the geography to which he belongs [17].



Image 4: W. Morris, "Adjustable- Black Chair", 1870- 1890

At this point, it would be appropriate to refer to Alev Ebuzziya Siesbye, a ceramic artist and product designer who came after William Morris and resembles him in some ways.

Ceramic artist and glass designer A. Ebuzziya Siesbye is an artist who did not renounce the craftsmanship stage of ceramic art because she hand-builds ceramic pots.

The impact of his design language which he created by sifting out the values of the history of Istanbul, where he was born, can be seen in the form, pattern, and different color preferences of Ebuzziya Siesbye's designs.

The design language he developed still preserves its identity in industrial product designs. On the other hand, the balance, resistance, and speed Ebuzziya Siesbye's bowls have seem to be in motion according to Einstein's gravitational force rather than Newton's law of gravity. Among many other aspects of his design, this illusion created by the bowls contributes to the differentiation of designs of Ebuzziya Siesbye [18-19].

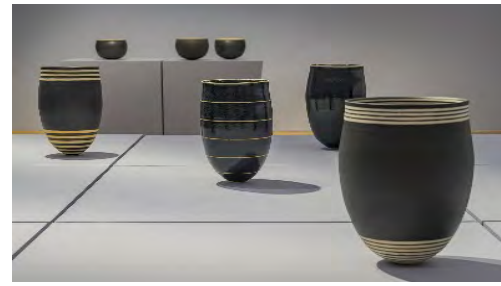


Image 5: A. Ebüzziya Siesbye, "Repetition", 2020

There are many designs that pertaining to architecture and interior design that show what type of approaches result in differentiation. In order to make the examples within the scope of this paper

richer, it will be useful to mention a few architects notable for their architectural as well as interior and product designs.

Antoni Gaudi (Antoni Plàcid Guillem Gaudí i Cornet, 1852-1926), who can be considered as one of the first architects of modern architecture, is a Spanish architect who contributed to Catalan Modernism[7] and became the pioneer of the Art Nouveau movement in Spain. All works of Gaudi, who bear the traces of the cultural roots of Spain and Catalonia in his architectural understanding, are worthy of attention. In addition to the architectural projects that come to mind primarily, such as Park Güell, the Palau Güell, the Casa Milà, the Casa Batlló or the Colònia Güell, with the orientalist, naturalist, neo-gothic lines, his furniture and interior designs, which bear the same lines, are also important works in terms of the history of design.

Gaudi's magnum opus Basilica de la Sagrada Familia (Templo Expiatorio de la Sagrada Familia), dominated by the styles of neo-gothic and Art Nouveau, is one of the works of Gaudi that portrays all the aspects of his different understanding of architecture. His tragic death during the design and construction processes of the Basílica de la Sagrada Familia was the beginning of the tragic story of the building and the discussions that have come to the present day. Basilica de la Sagrada, a Roman Catholic cathedral, bears all the architectural aspects of the Catholic cathedrals, especially the ones that develop since the Middle Ages. The difference of the structure, which carries the traces of the late 19th century - early 20th century styles (John Ruskin, who influenced Antoni Gaudi, is an intellectual who also influenced the Art and Craft movement), lies in Gaudi's reinterpretation of the gothic style with his modern architectural understanding (Dali named this style as Mediterranean Gothic [20]).

In this interpretation, one should take his use of colored mosaic and terracotta into account while considering his facade design. Here, the geometrical approach Gaudi puts, when designing the form, is the most important factor that results in the major difference of his works. The architect, who studied geometry and engineering in his youth, provided the differentiation in the forms of his work with his non-Euclidean geometrical approach [21]. Instead of using the classically used Euclidean geometry to define the basic elements of the structure of Basílica de la Sagrada Familia, he used hyperbolic and Fractal geometries[8]. Euclidean geometry, which is central in the design of the architectural form, was a pattern of shapes that usually occur in human-made objects until Gaudi.

When he designed this pattern as a non-Euclidean pattern of geometric shapes, he brought about a different perspective to the form also for the designers who come after him.



Image 6: A. Gaudi, "La Sagrada Familia", (1882-…)

When we look at the history of architecture, after Antoni Gaudi, who put forward his works with a naturalist approach bearing the Art Nouveau and Art Deco style, it would be appropriate to look at the architecture of Frank Lloyd Wright (1867- 1959).

Gaudi's naturalist approach to architecture can easily be associated with the organic architectural approach of Frank Lloyd Wright, whose understanding of architecture being influenced by the same styles.

In his education that included some irregularities, Wright, who realized his mother's dream as an architect, received his Engineering education at the University of Wisconsin (Madison), being a regular student approximately for the first three years, and later as a visiting student for a year. He has completed some of the technical requirements for architecture with the music and painting lessons his family prompted, his engineering education, and especially with the technical drawing and geometry lessons [22]. What constitutes the backbone of the architect's, one might call, self-taught architectural education are Silsbee Architectural Firm and later Adler & Sullivan Architectural Firm. Especially, the design styles of the period he was born into and the Art Deco approaches adopted by Adler & Sullivan Architectural Firm have had sharp influences on Wright's architectural style. In addition to these, we must add Wright's different geometrical approach in his architectural style. Further his travels to Japan for both business and traveling purposes had a great impact on Wright's understanding of architecture. He spent most of his time in Japan during the construction process of the project between 1915 and 1922, followed by a 5-week journey in 1905, then a short-term journey in 1913 for the preliminary study of the Imperial Hotel project.

The knowledge he attained in this period on Japanese culture and architecture has shown its effects on a wide range of designs, from his architectural designs to interior and furniture designs [23-24-25]. The Far East's approach to nature and its solutions in harmony with nature, as well as Wright's studies of classical Turkish architecture, with Mimar Sinan at its focus, have been highly synthesized in Wright's architectural understanding [26-27-28].

Horizontally spreading building masses in Japanese architecture are an important difference with the eaves seen on the graded roofs, as in Sinan's architecture. This makes a difference with the modular partitions created in the building blocks, the organization of interior-exterior spaces between the masses, the

Japanese influence in the environmental design, the interpretation of the fine details in the interior design in Japanese and Turkish architecture in interior designs. At the same time, these differences revealed by the rhythm created by the exterior light in the interior thanks to the arrangements of the windows opening to the exterior, and the design details and interpretations that point to a typical Mimar Sinan's design are also important. On the other hand, in the S. C. Johnson and Son Company Administration Building project carried out between 1936 and 1939, the scaled, intersecting, rectangular and circular volumes in the main mass, the semi-permeable pattern system formed on the ceiling due to the geometry and form of the carrier columns in the open office, are notable differences for an architectural design. The Solomon R. Guggenheim Museum project, which was carried out between 1943 and 1946, is an iconic design example in museum design with the radical geometry seen in its main body and its intelligent solutions for interior and exterior organization with this geometry. As a final example, in the Ralph Jester House project that took place between 1971-1972, it appears that he solved the main mass on the basis of a series of vertical cylinders (construct of structure and space in Sinan's architecture) [29].



Image 7: F. L. Wright, "Avery Coonley House", (1908- 1912)

In brief, what first catches the eye in Wright's understanding of architecture is his differentiated language of design that is generally developed through his analysis and synthesis of the modern or past elements taken from distant and different geographies. On the other hand, while until the 1930s Wright's designs are generally dominated by Euclidean lines and volumes (modernism), in his project S. C. Johnston and Son Company Administration Building his language of the form shows a slight tendency toward non-Euclidean geometry. The use of a different geometry in Wright's approach to form reaches its summit in his Solomon R. Guggenheim Museum.

A second name that cannot be dismissed in the issue of geometrical differentiation in design is Frank Owen Gehry (1929-…). In Gehry's architecture, one can observe influences of the cultural codes of the family he was born into, the traces of the local characteristics of the geographies he lived in, his childhood habits, his aesthetic sense developed due to the artworks he saw in the museums he visited since his childhood, and the way in which the silk, velvet and similar fabrics he admired were painted. When L. A. comes to mind, what contributes to the development of the peculiar language of the city is Gehry's architecture, which can be seen as "Urban Junkyard." The use of residue and junk material in the Rauschenberg and Johns have been inspirational for Gehry [30-31]. In addition to his use of corrugated sheet, asbestos, artificial materials, galvanized sheet, poultry wire, and similar materials in his early works, including his own house, he has been

successful in giving surprising meanings to ordinary materials due to his highly developed style concerning the relationship between material and form. Another aspect of the architect's relation to the material has been his use of interesting materials such as titanium and limestone as building materials due to the growth of projects and fundings [32]. For this reason, we can say that the difference in Gehry's architectural understanding first emerged from the materials he chose as building materials. Further, Gehry's zoological interest is present in the bulk of his designs. In Gaudi's architecture Gargoyles, an ornamental element of the gothic style, turn into ordinary animals such as pelicans, chickens, turtles, chameleons, and so on. In Gehry's architecture, however, while his Barcelona Fish is a carp that has deep affinities to his culture, the BP Bridge is completely a snake. Further, one can deeply observe the influences of his interest in the sea and sea culture in Walt Disney Concert Hall (2003) or IAC/InterActiveCorp West Coast Headquarters (2005), from the projects' main structure to the interior design. Gehry also utilizes the elements he has taken from classical Greek and Roman architecture by synthesizing them in his works such as Walt Disney Concert Hall, Dancing House (Nationale-Nederlanden Building), and Guggenheim Museum Bilbao.

On the other hand, the knowledge he has gained and the researches he has conducted[10] on Classical Turkish architecture, especially Topkapı Palace and Sinan architecture, may have shown their first effect (in his own words) in his Loyola Law School (1978) project [32].

In purchasing the CATIA 3D modeling software developed by Dassault Systemes for the French aviation industry in 1992 and turning to interactive designing programs, Gehry took his difference in the texture and form of his designs, which he accomplished by his use of material and ready-made approach, to a new level. The first project he designed with this software was his El Pez (the Fish) with a height of 45 meters. The development of the CATIA modeling program, which was purchased jointly with an Italian company called Permasteelisa, was initiated by the responsible unit in the office with the project "Der Neue Zollhof" - Dusseldorf (1998-1999). The digital design capacity offered by digital technologies such as visualization, simulation, calculation, and similar possibilities has provided a great difference in Gehry's understanding of design, especially in his form language. In addition, Gehry opened a field of digital design in architecture, with the CAD program developed in his office taking the CATIA as its example [32].



Image 8: F. O. Gehry, "Walt Disney Concert Hall", 2003

Gehry's approach to form in the problem of design is generally shaped on the basis of Euclidean polyhedra, volumes

such as cylinders, cones, spheres with different bases and planes, which we can call basic volumes. In the creation of form, Gehry's interventions to basic volumes are non-Euclidean[9]. In these interventions, the volumes obtained by turning the edges of the polyhedra into concave and convex curves, rotating around a chosen axis, bending, stretching, contracting, or simply cutting and shifting after the general intervention were used with great balance. The sources of inspiration in his planar interventions are Bellini's impressive fabric folds and drapes, Clause Sluter's sculptures, or a sail filled with the wind. While he constructs these movements as horizontal large pieces in his titanium structures, his projects such as Der Neue Zollhof (1999) or 8 Spruce Street (2011) are interpreted vertically to define the volume of the building completely.

Zahar Hadid (1950-2016), who stands out among deconstructivist architects with his formal approach, differs greatly with his approach to geometry in terms of architecture, interior architecture, and product design. The architect of Iraqi descent graduated from the American University of Beirut with a degree in Mathematics before studying architecture at the London Architectural Association. The advanced knowledge of mathematics and geometry she acquired before architecture is the main reason why Hadid was able to approach form using a non-Euclidean logic. In general, basic geometry elements such as point, line, and surface have formed the starting point of form designs (one of the factors that have an effect on this is digital technologies and CAD programs). Hadid established a topological relationship in a formal (geometric) sense between the basic elements she chose as the beginning of the design problem. As a result, Hadid achieved fluid volumes that are distinctive of her design. These volumes she reached are within the scope of Topological geometry. In short, Hadid started designing form/volume from scratch in her designs and took Topological geometry as the main generator of most of her designs. On the other hand, the difference in pattern systems she develops as a function or ornament in her designs bears the traces of the culture of the land she was born in, as well as her capabilities in mathematics and geometry.

2.2 The Differentiations

Luis Kahn (1901-1974), an American architect, interviews the students from Rice University School of Architecture in 1968 Spring. In this interview, he narrates the experiences of General Electric Company in their studies of designing a spacecraft within the scope of space studies. In stating "Mr. Kahn, we want to Show you what a spacecraft will look like fifty years from now," the project manager and a group of scientists show sketches that contain precise details to Kahn and explain them. Impressed by the sketches that are composed with a precision befitting for an architect, Kahn shares his conviction: "It will not look like that." The officials approach the table and look at Kahn with full attention, "How do you know?" they ask. The answer of Kahn is clear:

"I said it was simple… If you know what a thing will look like fifty years from now,

you can do it now. But you don't know, because the way that a thing will be fifty years from now is what it will be [33]."
Something that is unknown cannot be designed, design can only be possible with knowledge. That which is concrete, the knowledge that does not vary with respect to time and geography turns into design in being analyzed and synthesized with respect to the intellectual accumulation of the designer and the values he/she has. Thus, new knowledge paves the way for new fields of design. It is for this reason, by and large, that the novelties in science and technology bring forth the possibilities for "historical creativity." The designs that are the first instances of their kind are examples of historical creativity, and they occupy their place in history with their great differentiation.

Boden divides creativity into three forms. In these three forms, it contains an element of astonishment. The three forms Boden refers to can be listed as follows: to design something unfamiliar by combining what is familiar, to discover something, or to transform something into something else [1]. These forms Boden specifies for creativity are also applicable in the field of design. When the question of what kind of approaches lead to these forms is being asked, the question concerning how differentiation in design is achieved also arises.

In the 1970s, German industrial designer Dieter Rams had been answered the question of what is good design by 10 principles. Rams listed his principles as follows:

1. Good design is innovative
2. Good design makes a product useful
3. Good design is aesthetic
4. Good design makes a product understandable
5. Good design is unobtrusive
6. Good design is honest
7. Good design is long-lasting
8. Good design is thorough down to the last detail
9. Good design is environmentally friendly
10. Good design is a little design as possible [34].

These criteria Rams has spoken of as an industrial designer are applicable to all the fields of design. The word "innovative" in the first criterion has the same meaning with Boden's three forms of creativity: impressive, surprising, unexpected, in brief, different. Hence, the answer to the question of "What choices result in differentiation in design?" also gives a proposal as to the origins of and reasons for differentiation in design. When we analyze the differences of these works we have considered in the examples given above, it is apparent that these sources can be collected under a few items:

Knowledge: Knowledge-based selection and knowledge-based processing of the items chosen to be used while developing a solution to the problem of design, and the proposal the designer puts forward by the synthesis between his/her knowledge and experience would enable the designer to be differentiated from his/her peers.

Geometry: Everything has a shape or can be represented with a shape in both the physical world and the imaginary one.

In defining the function, the set of shapes designed to solve a design problem defines the form visually. For this reason, the difference of geometric approaches in a design appears as an important source of differentiation of the design.

Going back in history: Every branch of human history is interwoven with cultural values produced for millennia, and it is natural for a designer to benefit from these values in his work. The interpretation of the designer, which is given on the values, knowledge and technology of the time of the designer, and on the elements one takes from the history of the field that is being studied, would also make the design different.

Geography: In a design process, a designer can utilize the former elements of his/her geography or the elements from the history of distant geographies. The stronger the designer synthesizes these elements and defines a clear relationship between them, the more different can his/her solution be.

It is clear that combining one or more of the four items above, and reinterpreting and synthesizing them as a solution to the design problem would have a strong effect on the differentiation of the design.

3. Conclusion

Design can only be possible with knowledge. Halil İnalcık and İlber Ortaylı[11], two prominent historians, both state that a professional should be knowledgeable in language, history, and geography whatever one's profession is. To reach the origin of the knowledge that is to be used, to be knowledgeable about the state of the world that knowledge belongs to, and to know the geography it flourished would highly affect the success of a study.

Aktan Acar, an assistant professor in architecture, is outstanding in his work on Vitruvius and knowledge in the discipline of architecture.

"Contemporary architectural theories are not subordinated to the hierarchical articulation of human learning and knowledge that were used to be classified as seven liberal and mechanical arts until the scientific and intellectual revolutions of the 17th and 18th centuries. Before that, the origin and knowledge of architecture were being derived from metaphysics, in the form of cosmology, which was covering mythology, philosophy, theology, proto-scientific observations, and experiments. At the eve of the 18th century, the former metaphysical paradigm of architectural theory has been replaced by the scientific doctrines. This change cannot be abstracted from the gradual transformation of western thought until the emergence of modern scientific thinking and the separation of arts, science, and philosophy [35].”

As can be understood from the excerpt above, in his "A Genuine Origin and Language for the Universal Principles of Architecture" he takes up the issues of knowledge, the origin of knowledge, the meaning knowledge bears, and its alterations or transformations.

In brief, while knowledge provides variation and richness for thought and

design, it brings along differentiation in thought and design. In parallel to this, all kinds of technology, tool, and knowledge we use in the process of design change over time, and even concepts take on different meanings. This change has considerably accelerated with the change of paradigms and epochs we are now witnessing. And, as proof of this, the new digital environment is being incited by different changes every day, the concepts of time, space and speed are evolving faster than ever before.

On the other hand, while information serves the period we live in and is instrumental in the production of new designs (regardless of the environment, school, continent, or hegemony) the quality, timeliness, and accuracy of the information are now much more important.

Much as the means of production of information, as well as the speed of it, are remarkable due to the communication speed of the digital age, they can lose their validity. Thus, in producing his/her designs, the designer should be able to form his/her differentiation on the values that he/she updates and verifies with regard to the knowledge of past and present values.

4. Notes

1. The capacity reached by global capitalism with the help of digital technologies is discussed exhaustively in Shoshana Zuboff's book "The Age of Surveillance Capitalism" [2]. It would also be appropriate to scrutinize this process we are in with the new practices (new design areas, new products, new consumption patterns) that we have begun to adopt due to the pandemic.

2. "What you might do – and what I think you should do in this situation - is make a distinction between 'psychological' creativity and 'historical' creativity (P-creativity and H-creativity, for short). P–creativity involves coming up with a surprising, valuable idea that's new to the person who comes up with it. It doesn't matter how many people have had that idea before. But if a new idea is H–creative, that means that (so far as we know) no one else has had it before: it has arisen for the first time in human history. Clearly, H-creativity is a special case of P-creativity [1]."

3. The following resources can be looked at to obtain general information about the Little Ice Age (LIA): https://en.wikipedia.org/wiki/Little_Ice_Age, https://www.thoughtco.com/dust-veil-environmental-disaster-in-europe-171628, https://www.nature.com/articles/s41598-018-19760-w, https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2007GL032450 .

4. The following resources can be looked at to obtain general information about the sunspot and solar cycle: Wikipedia.org-Sunspots (https://en.wikipedia.org/wiki/Sunspot), NASA- The Sunspot Cycle (https://solarscience.msfc.nasa.gov/SunspotCycle.shtml), Climate NASA- What Is the Sun's Role in Climate Change? (https://climate.nasa.gov/blog/2910/what-is-the-suns-role-in-climate-change/) , Springer- Ilya G. Usoskin, A History of

Solar Activity Over Millennia (https://link.springer.com/article/10.1007/s41116-017-0006-9), NCBI- David H. Hathaway, The Solar Cycle (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4841188/).

5. The works of the artists of the Romantic Period may contain visual data that necessarily follow the traces of natural events experienced during the LIA-Sunspot period. Among the early impressionists, J.M. William Turner (The Eruption of Vesuvius, 1817), J. Christian Dahl (Eruption of Vesuvius, 1826), Francisco Goya (The Third of May, 1808), and other Romantic Period artists painted the dramatic events and places of history. William Turner's "Buttermere Lake, with Part of Cromackwater, a Shower, 1798", C. David Friedrich's "Monk by the Sea, 1809" and other paintings that contain similar elements can be reviewed by considering the natural events that took place in the period in which they lived.

6. Paintings such as "Rain, Steam and Speed, 1844", "Slavers throwing overboard the Dead and Dying, 1840" by J. M. William Turner, who is known as the painter of light, are good examples in terms of explaining the ambiguity of form while painting light [10-11]. Also, Russian impressionists such as K. F. Yuon, S. E. Lednev-Schukin, uncle and nephew Shchedrins, S. Y. Zhukovsky and I. Y. Repin (Leo Tolstoy Takes a Rest in the Woods,
1891, https://www.wikiart.org/en/ilya-repin/leo-tolstoy-in-the-forest-1891), with depictions of the forest containing all seasons at the same time, or Nordic impressionists such as Dahl, L. A. Ring (Diset vinterdag i Vinderød, 1901, https://da.wikipedia.org/wiki/Fil:Diset_vinterdag_i_Vinder%C3%B8d,_1901,_olie_p%C3%A5_l%C3%A6rred,_77_x_118,5_cm,_Fuglsang_Kunstmuseum.jpg) and Hans Gude (Winter Afternoon, 1847, https://tr.m.wikipedia.org/wiki/Dosya:Hans_Gude--Vinterettermiddag--1847.jpg) depicting numerous varieties of white made remarkable differences.

7. For this subject, David Mackay's "Modern Architecture in Barcelona (1854-1939), 1985" and Salvador Gincr's "The Social Structure of Catalonia" 1980 (reprinted 1984) can be found in the publications of The Anglo-Catalan Society.

8. Hyperbolic geometry is also called Lobachevskian or Bolyai- Lobachevskian geometry. It is a non- Euclidean geometry (M. Jay Greenberg, "Euclidean and Non- Euclidean Geometry; Development and History", 1960/ M. I. Dillon, "Geometry Through History: Euclidean, Hyperbolic and Projective Geometries", 2018). In 1975, a complete definition for Fractal Geometry was given by Benoît B. Mandelbrot (B. B. Mandelbrot, "The Fractal Geometry of Nature", 1982).

9. The largest list of Euclidean interventions in architectural basic volumes is included in *"Architecture, Form and Geometry*," written by architect Esen Onat in 1991.

10. It is known that Frank Gehry often came to Istanbul alone or with his students to study Classical Turkish Architecture and Mimar Sinan's architectural works. After 1999, Changa

Restaurant, opened by Tarık Bayazıt and Savaş Ertunç as Turkey's first Fusion cuisine, becomes a haunt for Gehry. Another haunter of Bayazıt and Ertunç's restaurant, who contributed greatly to modern Turkish cuisine with their intellectual knowledge, was architect Zahar Hadid.

11. Prof. Halil İnalcık (https://en.wikipedia.org/wiki/Halil_%C4%B0nalc%C4%B1k), Prof. İlber Ortaylı (https://en.wikipedia.org/wiki/%C4%B0lber_Ortayl%C4%B1)

5. References

[1] Margaret A., Boden, “The Creative Mind: Myths and Mechanisms”, Routledge, London, 2004

[2] S. Zuboff, “The Age of Surveillance Capitalism”, PublicAffairs, New York, 2019.

[3] https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf, retrieved November 3, 2020.

[4] https://en.wikipedia.org/wiki/World_population, retrieved November 3, 2020.

[5] J. Heskett, “DESIGN A Very Short Introduction”, Oxford University Press, New York, 2002.

[6] P. Bourdieu, “Distinction: A Social Critique of the Judgement of Taste (La Distinction, Critique Sociale du Jugement)”, (R. Nice, Trans.), Harvard University Press, Cambridge/ Massachusetts, 1984.

[7] Oxford LEXICO, https://www.lexico.com/definition/differentiation, retrieved November 11, 2020.

[8] G. Clarke, “The Photograph”, Oxford History of Art, Oxford University Press, New York, 1997.

[9] British Empire and map, Wikipedia.org, https://en.wikipedia.org/wiki/British_Empire, retrieved November 11, 2020.

[10] A. Bailey, “Standing in the Sun; A Life of J. M. W. Turner”, Tate Publishing, London, 2003.

[11] E. Shanes, “The Life and Masterworks of J.M.W. Turner”, Parkstone International Press, New York, 2008.

[12] A. Bowness, “Gauguin”, Phaidon Press, London, 1971.

[13] B. Salvesen, “Gauguin”, The Publication Department of the Art Institute of Chicago, Verona, 2001.

[14] P. Gauguin, “Letter to Fontainas”, Art in Theory: 1900- 200, Ed. C. Harrison & P. Wood, Blackwell Publishing, Oxford, 2003.

[15] Ş. Aslan & F. Kızıltepe, “Bauhaus Ekolünün Değişen Paradigmaları: Tasarım Eğitimini Yeniden Düşünmek (Changing Paradigms of Bauhaus Ecole: Rethinking Design Training)”, A. Derin İnan, Ali Cengizkan, In Bauhaus_100+TR

(pp.300-319), TED University, Faculty of Architecture Publication, Ankara, 2020.

[16] P. Klee, “From on Modern Art”, Art in Theory: 1900- 200, Ed. C. Harrison & P. Wood, Blackwell Publishing, Oxford, 2003.

[17] A. Clutton-Brock, “William Morris”, Parkstone Press, Ho Chi Minh City, 2007.

[18] G. Clark, “Alev Ebüzziya Siesbye”, Kale Seramik Sanat Yayınları, İstanbul, 1999.

[19] F. Kızıltepe & A. Kızıltepe, “A Brief Essay on Semantical Analaysis of Space Time and Speed in Drawing and Painting”, XXI Generative Art Conference 2018, Ed. C. Soddu, & E. Colabella, Domus Argenia Publisher, Verona, 2018.

[20] J. Roe, “Antoni Gaudí”, Parkstone International, New York, 2012.

[21] J. B. Nonell, “Antonio Gaudí: Master Architecture”, Abbeville Press Inc., New York, 2000.

[22] C.River Editors, “Frank Lloyd Wright: The Life and Buildings of America’s Most Famous Architect”, Create Space Independent Publishing Platform, Kindle Edition, 2016.

[23] K. Nute, “Frank Lloyd Wright and Japan”, Chapman & Hall, London, 1993.

[24] R. Cleary, N. Levine, M. Marefat, B. B. Pfeiffer, J.M. Siry & M. Stipe, “Frank Lloyd Wright From Within Outward”, Skira Rizzoli Publications Inc., New York, 2009.

[25] T. Heinz, “Frank Lloyd Wright Interiors and Furniture”, Academy Editions, Great Britain, 1994.

[26] J. Needham, “Doğunun Bilgisi Batının Bilimi”, A. N. Acar, Trans., MAB-TMMOB, Ankara, 1983.

[27] J. N. Erzen, “Sinan Ottoman Architect an Aesthetic Analysis”, METU, Ankara, 2004.

[28] D. Kuban & A. Ertuğ, “Sinan: An Architectural Genius”, Ertuğ & Kocabıyık, Bern, 1993.

[29] B.B. Pfeiffer, “Frank Lloyd Wright”, Taschen, New York, 2003.

[30] El Cropuis, “Frank Gehry 1987-2003”, El Cropuis, Madrid, 2006.

[31] Rizzoli International Publication Inc., “Gehry Taalks: Architecture + Process”, Universe Publishing, New York,2002.

[32] F. Kızıltepe, “Reflections of the Concept of Mathematical Symmetry as a Method in the Field of Visual and Plastic Arts”, Yıldız Technical University, The Institute of Social Sciences, M.A. Dessertation in Art and Design Programme, İstanbul, 2011.

[33] The rice University School of Architecture, “Louıs I. Kahan; Conversation with Students”, Princeton Architectural Press, Houston, 1969.

[34] S. Lovell, “A genuine Origin and Language for the Universal Principles of Architecture”, Phaidon Press, London, 2011.

[35] A. Acar, “Dieter Rams: As Little Design as Possible”, Çankaya University, The Institute of Science, M.A. Dessertation in Architecture, Ankara, 2015.

5.1 List of Images

Image 1: https://www.gauguin.org/where-do-we-come-from-what-are-we.jsp, retrieved November 24, 2020.

Image 2: https://www.wikiart.org/en/paul-klee/red-and-white-domes-1914, retrieved November 24, 2020.

Image 3: https://www.metmuseum.org/art/collection/search/484862, retrieved November 24, 2020.

Image 4: A. Clutton-Brock, “*William Morris*”, Parkstone Press, Ho Chi Minh City, 2007.

Image 5: http://www.arter.org.tr/en/on_repetition, retrieved November 24, 2020.

Image 6: http://en.wikipedia.org/wiki/File:Sagfampassion.jpg, retrieved November 24, 2020.

Image 7: https://franklloydwright.org/frank-lloyd-wrights-avery-coonley-house-for-sale/, retrieved November 30, 2020.

Image 8: https://www.getty.edu/visit/cal/events/ev_1806.html, retrieved November 30, 2020.

Entangled? Frieder Nake's Probabilities Versus Quantum Computing Artistic Research

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Abstract

Frieder Nake is one of the most prominent pioneer artists in computer art. Both carefully constructed and intertwined in a complex manner, his works are mainly based on the programming of drawing processes and the use of abstract geometrical forms. In the programs that he conceives, each visual character corresponds to variable parameters. The selection of these parameters uses random variables selected by computation of mathematical probability densities. Through statistical calculation, the artistic gesture becomes both open and determinant. The generative image is the realization of one of the many possible results. It is contingent – it belongs to an infinite class of probable images.

Quantum Computing is a relatively new field in informatics. It began in the early 1980s, when physicist Paul Benioff proposed a quantum mechanical model of the Turing machine. Richard Feynman and Yuri Manin later suggested that a quantum computer could perform simulations that are out of reach for regular computers. Quantum computing is the use of quantum-mechanical phenomena such as superposition and entanglement to perform computation. The essential difference with classical computing is the nature of information itself. Instead of a 0 or a 1, the unit of quantum computing, called the qubit, is based on the oscillation of its state between the two values.

In this paper, we are discussing the relations that can be traced between the generative probabilistic approach of Frieder Nake and few principles that are found in quantum computing, such as superposition of states and probabilistic operations on quantum information. At the beginning of computer art in the

sixties, the mathematical use of randomness played an essential role. If Frieder Nake found in classical computing and in such methods a new field for artistic research, what can we expect from investigating quantum computation with an aesthetic purpose? The paper explores this question moving from the present to the past and going back. It finally discusses the potentials of artistic research in the field of quantum computing.

1. Quantum Computing in visual art and creativity

Quantum physics has revolutionized our worldview for just over a century. Often misunderstood, and sometimes misused, quantum physics has led us in particular to quantum computing. It was in the 1980s that Richard Feynman [17] and a few other scientists [24][10] started talking about the quantum computer.

Now, 40 years later, slowly but surely, quantum computing is emerging. Beyond the advent of the quantum computer, new algorithms and new working methods are developed. The transition from bits to qubits is the important evolution, which above all enables an extraordinary creative capacity. Quantum physics is not to be confused with the resulting quantum computation. Today, as soon as the word quantum appears, it is fashionable to be wary.

However, quantum computing is indeed becoming real in our technological environments. Beyond all the extraordinary announced potentials, it is important to understand that this is a set of totally innovative methods for Information Technology. It is also important to understand that its value increases in the field of creativity. Quantum computing technology should not be considered superior to classical computing in the realm of computational creativity, but just different, with new types of algorithms.

Quantum computing is therefore gradually developing in several sectors, including the very important ones of cryptography, artificial intelligence, banking, biology and the army, of course. Quantum computing progresses both as a new digital machine and as a field of new algorithms and computer languages working on this machine.

We are interested here in the algorithmic part. Much has grown since its beginning, in particular the famous algorithms of Shor and Grover [26]. At the beginning of the 21st century, some interesting attempts were proposed by researchers for developing quantum algorithms in computer graphics and in 3D renderings especially. This is how Andrew Glassner [18][19][20], Marco Lanzagorta [21] and then Simona Caraiman [14][15] proposed the first quantum algorithms for 3D creation. These works are experimental. To our knowledge, outcomes are unsatisfactory. However, the idea of creating images with quantum computing was born.

Simultaneously, the first quantum artists or “researcher-artists” began to create the first quantum works. It is difficult to say who the first really was, because some are only using the concept to produce works while others really are starting to use quantum languages

(mostly in Python, with librairies offered by Sympy, QuTip, and Qiskit – a module based on IBM computers, Rigetti Forest, etc.).

Among noticeable pioneer artists of quantum computer art, we can list Julian Voss-Andreae [35], Lynden Stone [33], Alain Lioret [4] [23] (Figure 1), Paul Thomas [34], and Libby Heaney [40]. Through their artworks or their papers, attempts to define a quantum culture [16] or a quantum aesthetic [25] are proposed.

All of these artists work with the inherently probabilistic aspect of quantum physics. It is not a question here of speaking of randomness, but of probabilities. Thus our world would be much less deterministic than we thought. And artistic creation can also make use of this profound property of our universe.

Quantum representation of the world has dramatically changed views for more than a century. Among great physicists and inventors of this new physics, we can mention the major works of Erwin Schrödinger, who beyond his famous cat, was one of the first to describe life as determined by quantum physics [30][31]. In *Mind and Matter* and then *What is Life?*, Schrödinger opens doors to a creativity model that would be quantum.

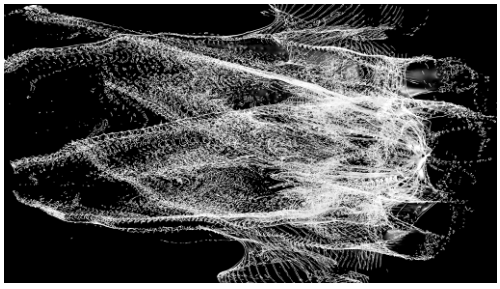


Figure 1, Alain Lioret, Galateia*, Quantum Image Creation.*

His work has inspired many authors and scientists who will go even further, including David Bohm who does not hesitate to relate particle physics to ways of thinking and therefore to creativity work [12][13] .

The emergence of a new form of art in relation to the evolution of science and computer technology has already a history. In the sixties, while first computers were introduced in university laboratories in Europe, young mathematicians saw an opportunity to pioneer new types of artwork. Already at that time, radical changes in the science, especially in the statistical physics of particles, gave an impulse for rethinking research in aesthetics. Randomness became both a scientific instrument and an artistic endeavor.

2. Randomness and probability in Frieder Nake's artwork

Computer art was made public in Stuttgart in 1965. Much influenced by cybernetician Norbert Wiener and the shift in statistical science [41], Max Bense, a physicist, a poet and a philosopher, founded the generative aesthetic with an exhibition in the Technical University of Stuttgart and a publication in the experimental *Rot* edition [42]. Influenced by Max Bense's theories, the computer graphic works of Georg Nees and Frieder Nake were shown together in 1965 in the Wendelin gallery in Stuttgart. For the first time, computers were involved in a process resulting in the making of artistic images. The detailed analysis of these early

works enables a critical understanding in the relations between algorithms, randomness and art.

As a student in mathematics in the early sixties, Frieder Nake attended many lectures by Max Bense. From 1965 and on, Nake became an acclaimed artist in the emergent field of computer art. His works were shown in Germany and abroad, in important exhibitions such as *Cybernetic Serendipity* in London, or *Tendencies 4: Computers and Visual Research* at the New Tendencies Biennial in Zagreb. Both exhibitions were happening in 1968. In 1970 his works were then exhibited in the Venice Biennial. Later in 1971, Nake criticized computer art in a short essay: *There Should be no Computer Art* [43]. His critique focused on the commodification of computer art and the lack of perspective in this field of creation. He nevertheless remains one of the most prolific early computer artists.

Nake's work is based on the programming of drawing processes resulting in abstract geometrical forms. Using lines, squares, hatchings, his works usually present two dimensional spaces that are both constructed and intertwined. The use of color is also a significant element in Nake's work considering limitations of the time. During his early period, the programming of the drawing is usually followed by the use of a high-precision pen plotter. Within the programs conceived by the artist, the visual characters correspond to variable parameters. Played with probability distribution, randomness is at the heart of the program [2].

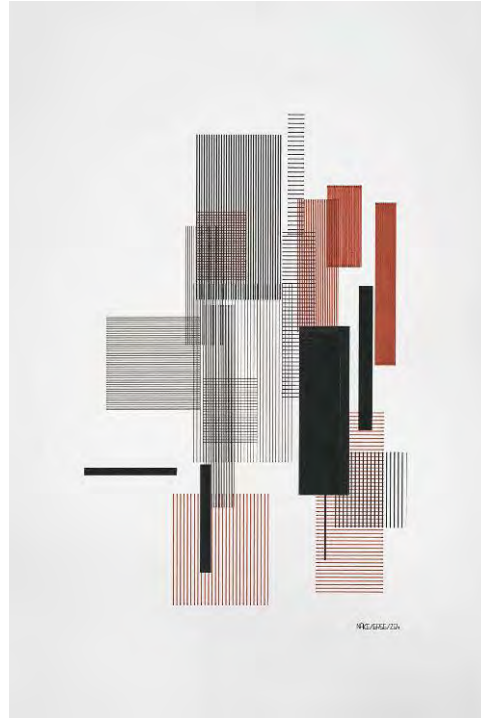


Figure 2. Frieder Nake, Rechteckschraffuren n° 3*, 1965, colored computer graphic, pne plotter with ink (black, brown) on paper, 19.2 x 29 cm, Bremen, *Kunsthalle*, Herbert W. Franke. Software : COMPART ER56 ; Hardware : Standard Elektrik Lorenz ER56 ; Plotter : ZUSE-Graphomat Z64.*

Rechteckschraffuren No. 3 [Rectangular Hatchings] (Figure 2) is an abstract and geometrical work in small format, based on the distribution of random values according to defined mathematical laws. It consists of a set of twenty areas of rectangular hatching that overlap or juxtapose each other. Densities of visual order: hatching density, positioning, dimensions and superimpositions of geometries – correspond to the calculation of probability densities. The resulting variations of visual densities create contrasts, depth and movement.

Although the image already offers to perceive certain programming issues, the non-visible part of the work cannot be approached solely from the visual description. Publications by Frieder Nake [1][2] and interviews with him provided necessary material for analyzing the algorithmic work contained in the software COMPART ER56, a program that Nake designed for various work of the same period.

With the exception of the size of the image, which is itself a variable that is determined randomly, all the values of the parameters of the work are obtained from a probability distribution function. In mathematical terms, a random value obtained with such function is an elementary event among a set of possible events. In the software COMPART ER56, a sub-program assigns the probability density for each of these events. A random generator is then used to select numbers that meet the densities devised by the user. Our study led to the programming of a simple algorithm using probability distribution for determining gray values (Figure 3).

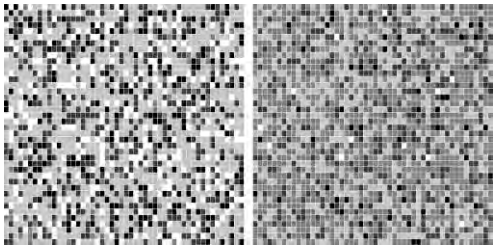


Figure 3. Probability distribution using a discrete approach: generation of a grid of rectangles of which gray value corresponds to the distribution. Five gray values are defined from black to white: black, dark gray, average gray, bright gray, white. For such a scale of gray, the right image probability distribution follows 10, 20, 5, 50, 15, and the left image probability distribution follows 3, 17, 50, 29.5, 0.1 (in %).

In his descriptions of the program, Frieder Nake does not specify the function that defines the probability distribution, nor how it affects precisely the visual results. But it is understood that each of the random variables responds to a probability distribution in which the distribution of densities can be of any type: “uniform, exponential, Gaussian, Poisson, and arbitrary discrete probability distribution functions” [46]. In our interview, Frieder Nake also testified to the use of probability distributions based on continuous functions [44].

In spite of its arbitrary appearance, the work presents a composition based on contrasts between various types of visual densities. Through statistical calculation, the artistic gesture becomes both determinant and opened. Many more works of Frieder Nake are programmed using randomness and probability distribution. As stated by the artist in recent publications [45], this algorithmic framework has strong conceptual implications. The image that has an experimental character is suspended; it is contingent – it belongs to an infinite class of image. It is a question whether such implications were followed in the later ages of computer art. The recent advances of research in quantum computing seem to renew interest in randomness and probability distribution in artistic research.

3. Randomness and probability in Quantum Computing and Quantum Images

Quantum mechanics is a theory which describes the nature of particles on the subatomic scale. It says that as we observe the world at a smaller and smaller scale, classical descriptions of particles and forces like those defined by Isaac Newton in the 18th century become less accurate and we must switch to different quantum descriptions driven by statistics and probability. For example the exact position of an electron around an atom cannot be predicted, we can only predict the probability of finding an electron in a given area around the atom at a given time [6].

To make things even more complex, the Copenhagen Interpretation of quantum mechanics devised by Niels Bohr and Werner Heisenberg states that quantum systems do not have definite properties prior to being measured, but exist in all possible states simultaneously in a principle known as superposition. It is only when the system is observed that the superposition collapses and the system exists in a single definite state. This is known as the observer effect. Taking the example of the position of an electron, we can predict a probability that an electron will be present in a particular location at a particular time, but before that measurement the electron exists in all possible positions around the atom. During the measurement the electron will reveal itself to be in one place, but by observing and measuring the electron we have altered its state and cannot determine other properties like momentum due to the uncertainty principle [7].

This interpretation of the quantum world understandably shook the physics community at the time, and is debated to this day. Albert Einstein refused to believe that reality is governed by probability and famously said "I, at any rate, am convinced that He (God) does not throw dice".

Like it or not, Quantum theory remains our best understanding of the subatomic world and has been developed into the heart of an all new type information processor. Quantum computers rely on the ability for quantum particles to exist in a superposition of multiple states at once to perform calculations. Since quantum computers can manipulate the superposition of particles which are governed by probability, we can use them as a tool to harness the nature of the quantum world and build a true random number generator (i.e. a random generator based on subatomic properties of matter).

Randomness and other properties in probability distribution found in quantum computing bears strong implications in the field of quantum algorithmic images.

Quantum image processing methods, such as that proposed by Yao et al. [38], are emerging in the field of quantum computing. We do not include here works illustrating the quantum phenomena, which are quite numerous, but rather those using quantum algorithms, with

quantum gates and entanglement effects, superposition of states, etc.

In his image processing work, Alain Lioret uses representations of qubits on Bloch spheres to create 3D structures (Figure 4). The representation of qubits on Bloch spheres thus enables a very interesting creative potential, which can be edited using rotations in 3D space with quantum gates.

The images of *Galateia* (Figure 1) and *Quantum Swan* (Figure 4) presented in this article were produced from the probabilistic representation of qubits, which can be formalized in Bloch spheres. Starting from basic 3D objects (a sphere or a cube in particular), each vertex of these objects has been represented by a qubit. Once the qubit is randomly initialized, a photograph taken at a time *t* of all the qubits gives the result obtained on these images. This is a probabilistic randomness as it really works at the subatomic level.

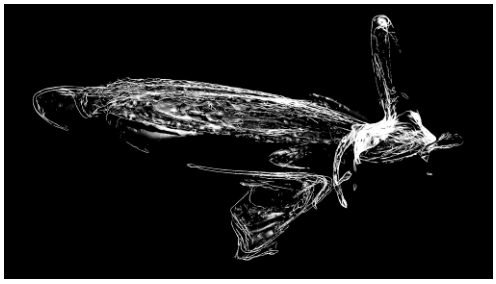


Figure 4. Alain Lioret, Quantum Swan*, Quantum Image Creation.*

This article cannot describe in detail the operations leading to these image creations. However, these images and the majority of what is found in the literature relies on the use of the following:

- Qubits which are the basis of all quantum computation. Qubits having the great peculiarity of being able to be in multiple states at the same time (superposition of possibilities, factoring creativity).

- Quantum gates, which are used to apply probabilistic operations on sets of qubits. These quantum gates (notably the most famous, those of Pauli, Hadamard, Toffoli, Cnot, etc.) make it possible to produce computer calculations in a whole new way, breaking away from the computational methods of classical computing [26].

4. Artistic research in the field of quantum computing

Are the efforts in creative quantum computing entangled with the work of Frieder Nake? As a prominent pioneer in computer art, Frieder Nake based an important part, if not the entirety, of his work – on randomness. More specifically, his exploration of probability distribution gave birth to a new conceptual framework envisioning the artwork as a class of images. The visible work is only an instance of an infinite set of possibilities. As he states it:

> A class of objects can never itself, as a class, appear physically. In other words, it cannot be perceived sensually. It is a mental construct: the description of processes and objects. The work of art has moved from the world of corporeality to the world of options and possibilities. Reality now exists in two modes, as actuality and virtuality. [45]

Because the artwork virtually exists in multiple states, Nake's theory seems to echo the principle of superposition property found in quantum computing and used in quantum image processing. It also tells that the reception of the artwork doesn't only rely on actual aspects. This argument might parallel the role of measurement in quantum computing, where measurement terminates states superposition. In a way, Frieder Nake has not only pioneered computer art, he also has prepared sustainable concepts for artistic research in the current technological epoch. Nevertheless it is necessary to underline that although in continuity with prior approaches, the computability of the artwork in quantum computing radically changes in nature. If Frieder Nake found in classical computing a new field for artistic research, what can we expect from investigating quantum computation with an aesthetic purpose? What are the potentials?

Quantum computing gives us a great opportunity: to put into form what were until now only theories. It is quite easy to summarize in one sentence the potential of this new computational creativity:

> We are moving from bit-based computer systems (2 possibilities, 0 or 1) to systems working with qubits (quantum bits) (an infinite number of theoretical possibilities)! [36]

A priori this tenfold principle results in an exponential field to explore, that is if artistic research in the field considers itself informational only, something we hope to discuss in a later research. Conceiving creative systems as the exploration of a space of possibilities, Geraint A. Wiggins asserts that creative behavior might not be described and captured by just classic Artificial Intelligence search:

> In standard state space search, we normally operate on one mode (which might indeed represent a partial solution) at a time. In my formalization, at least, traversal of the space may arise through simultaneous consideration of (and hence consideration of the relationship between) more than one of the modes in it which have already been discovered. Thus the search pattern produced is not a tree, but a lattice. [36]

At an epistemological level, the renewal of searching methods opens to new considerations in the way artistic research could be conducted, more specifically in generative art. The artistic field that remains to pioneer in quantum computing also calls for thinking and visualizing computing in new ways.

Cellular automata have been powerful tools of computational creativity since their creation (Conway, Langton). In recent years, several authors have developed quantum cellular automata. We can notably mention those proposed by Arrighi and Grattage [9], Bleh [11] or Lioret [23] (Figure 5). These operate on the basis of quantum gates and no longer on binary logic gates, which increases their potential tenfold, using probability with true random numbers .

Quantum Cellular Automata, for instance, is a project developed in collaboration with students from Université Gustave Eiffel, IMAC engineer program. The idea here is to use the probabilistic capacities of each qubit and to combine them with the use of quantum gates in order to create quantum circuits. While offering a

ground for training, this process also provides the user with new creative tools.

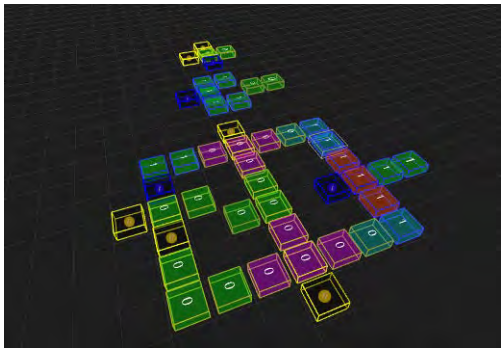


Figure 5. Alain Lioret, Maximilien Pluchard, Baptiste Montovani, Pierre Gabory, Valérian Daul, Quantum Cellular Automata*, 2019. Project developed with students from Université Gustave Eiffel, IMAC engineer program.*

Quantum cellular automata give shape to new types of algorithms in the quantum computing field, enabling the user to grasp the complexity of such algorithms. It is also worth to notice that large efforts are made in the developments of libraries like Qskit to trace the circuits involved in the programming of qubits. In itself, the logical circulation of information and its behavior also seems to lead to a new type of aesthetic, neighboring the aesthetic of code. Moreover the field of video games is very prolific in terms of quantum creation. Many quantum video games have been developed in recent years, a history of which is proposed by James Wooton [37].

Quantum computing seems to be synonymous with a new technological age. It is an opportunity to critically reflect both on computer art historicity and the relation between artistic research and computability. With his modern approach in art, Paul Klee also opened a way for *Exact Experiments* that is useful to remind: “We construct and keep on constructing, yet intuition is still a good thing. You can do a good deal without it, but not everything.” [47]

References

[1] Nake, F. (1974). Ästhetik Als Informationsverarbeitung: Grundlagen Und Anwendungen Der Informatik Im Bereich Ästhetischer Produktion Und Kritik.

[2] Nake, F. (1968). Notes on the Programming of Computer Graphics. In Cybernetic Serendipidity: The Computer and the Arts, Jasia Reichardt.

[3] Lioret, A. (2016). Quantum Art. In Expressive ’16: Proceedings of the Joint Symposium on Computational Aesthetics and Sketch Based Interfaces and Modeling and Non-Photorealistic Animation and Rendering.

[4] Lioret, A. (2014). Quantum Computing for Art Exploration and Creation. In SIGGRAPH ’14: ACM SIGGRAPH 2014 Studio.

[6] Tony Hey, Patrick Walters, Cambridge University Press (1987), The Quantum Universe.

[7] Alastair I. M. Rae, Taylor & Francis Group (2008), Quantum Mechanics (5th Ed).

[5] Aaronson, S. (2013). Quantum computing since Democritus. Cambridge University Press.

[8] Abbott, D., Davies, P. C., & Pati, A. K. (2008). Quantum aspects of life. World Scientific.

[9] Arrighi, P., & Grattage, J. (2009). Intrinsically universal n-dimensional quantum cellular automata. arXiv preprint arXiv:0907.3827.

[10] Benioff, P. (1982). Quantum mechanical models of Turing machines that dissipate no energy. Physical Review Letters, 48(23), 1581.

[11] Bleh, D., Calarco, T., & Montangero, S. (2012). Quantum game of life. EPL (Europhysics Letters), 97(2), 20012.

[12] Bohm, D. (2004). On creativity. Routledge.

[13] Bohm, D., & Peat, F. D. (2010). Science, order and creativity. Routledge.

[14] Caraiman, S., & Manta, V. I. (2009, May). New applications of quantum algorithms to computer graphics: the quantum random sample consensus algorithm. In Proceedings of the 6th ACM conference on Computing frontiers (pp. 81-88).

[15] Caraiman, Simona (2012). Quantum computer graphics algorithms. Buletinul Institutului Politehnic din Iasi, Sectia Automatica si Calculatoare, 62(4), 21-38.

[16] Caro, M. J., & Murphy, J. W. (2002). The world of quantum culture. Greenwood Publishing Group.

[17] Feynman, R. P. (1999). Simulating physics with computers. Int. J. Theor. Phys, 21(6/7).

[18] Glassner, A. (2001). Quantum computing. I. IEEE Computer Graphics and Applications, 21(4), 84-92.

[19] Glassner, A. (2001). Quantum computing. 2. IEEE Computer Graphics and Applications, 21(5), 86-95.

[20] Glassner, A. (2001). Quantum computing. 3. IEEE Computer Graphics and Applications, 21(6), 72-82.

[21] Lanzagorta, M. O., Gomez, R. B., & Uhlmann, J. K. (2003, August). Quantum rendering. In Quantum Information and Computation (Vol. 5105, pp. 128-136). International Society for Optics and Photonics.

[23] Lioret, A. (2016, May). Quantum art. In Proceedings of the Joint Symposium on Computational Aesthetics and Sketch Based Interfaces and Modeling and Non-Photorealistic Animation and Rendering (pp. 135-139).

[24] Manin, Y. (1980). Computable and uncomputable. Sovetskoye Radio, Moscow, 128.

[25] Martinez, M. C. E. M. (2013). L'esthétique Quantique: Un Regard Croise Arts Et Sciences Michel Caffarel Et Monique Martinez. Science, Fables and Chimeras: Cultural Encounters, 257.

[26] Nielsen, M. A., & Chuang, I. (2002). Quantum computation and quantum information.

[27] Parkinson, G. (2008). Surrealism, art, and modern science: relativity, quantum mechanics, epistemology. yale university Press.

[28] Pylkkänen, P. (2019). Henry Stapp Vs. David Bohm on Mind, Matter, and Quantum Mechanics. Activitas Nervosa Superior, 61(1-2), 48-50.

[29] Pylkkänen, P. (2014). Can quantum analogies help us to understand the process of thought? Mind Matter 12 (1), 61e92. URL.

[30] Schrödinger, E. (1958). Mind and matter. Cambridge: University Press.

[31] Schrodinger, R., & Schrödinger, E. (1992). What is life?: With mind and matter and autobiographical sketches. Cambridge University Press.

[32] Stapp, H. P. (2017, May). Retrocausation in quantum mechanics and the effects of minds on the creation of physical reality. In AIP Conference Proceedings (Vol. 1841, No. 1, p. 040001). AIP Publishing LLC.

[33] Stone, L. (2013). Re-visioning reality: Quantum superposition in visual art. Leonardo, 46(5), 449-454.

[34] Thomas, P. (2018). Quantum Art & Uncertainty. Intellect Books.

[35] Voss-Andreae, J. (2011). Quantum sculpture: Art inspired by the deeper nature of reality. Leonardo, 44(1), 14-20.

[36] Wiggins G.A (2019) A Framework for Description, Analysis and Comparison of Creative Systems, in Computational Creativity. The Philosophy and Engineering of Autonomously Creative Systems, Springer.

[37] Wooton, J. (2018).The History of Games for Quantum Computers. https://medium.com/@decodoku/the-history-of-games-for-quantum-computers-a1de98859b5a.

[38] Yao, X. W., Wang, H., Liao, Z., Chen, M. C., Pan, J., Li, J., ... & Zheng, W. (2017). Quantum image processing and its application to edge detection: theory and experiment. Physical Review X, 7(3), 031041.

[39] Zhang, G. (2011). Quantum-inspired evolutionary algorithms: a survey and empirical study. Journal of Heuristics, 17(3), 303-351.

[40] Heaney, L. (2019). Quantum Computing and Complexity in Art. Leonardo, MIT Press, 52(3), 230–235.

[41] Wiener, N. (1989). Cybernetics and Society: The Human Use of Human Beings. Free Association Books.

[42] Nees, G., & Bense, M. (1965). Computer-grafik, Rot n°19. Max Bense, Elisabeth Walther.

[43] Nake, F. (1971). There Should be no Computer Art. Bulletin of the Computer Arts Society, 18–19.

[44] Interview with Frieder Nake, 26th April 2019.

[45] Nake, F. (2012). Construction and Intuition: Creativity in Early Computer Art. In Computers and Creativity (J. McCormack, M. d'Inverno). Springer.

[46] Nake, F. (2005). Computer Art: A Personal Recollection. C&C '05: Proceedings of the 5th Conference on Creativity & Cognition, 54–62.

[47] Klee, P. (1928). Exakte versuche im bereich der kunst (Exact Experiments in

the Realm of Art). Bauhaus, Zeitschrift für Bau und Gestaltung.

Patterns of Home: Religious Art and Traditional Design in Pnjabi and American Truck Decoration

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Abstract
This paper seeks to examine a specific set of cultural and religious artifacts and patterns used in the visual transformation of the underlying tractor/trailer body of Pnjabi and Sikh American truck drivers. These transformations are used to create a home space on the road as well as feelings of nostalgia and pride for home and religion. There is a specific set of artifacts that are repeatedly used to produce a consistent and recognizable outcome for each individual truck.

It is a long-standing tradition for truck drivers in the Pnjab region of India to decorate their tractor/tractor trailers with religious phrases, patterns of flowers, geometric patterns, religious figures. In recent years, tens of thousands of Sikhs and people of Pnjabi origin have taken to the roads of the US as skilled professional truck drivers. These drivers often carry with them the traditions of decorating their trucks and cabs, but in the US, there are different styles of trucks as well as different DOT regulations for truck modifications. How do these differences change the decoration styles, and what traditions are kept alive on the American roadways?

This paper will answer those questions through exploring the use of a defined decorative procedure that is applied as a rule set that can consistently produce a recognizable emotional and cultural experience for both the driver as well as the highway audience.

Premise

Trucks (tractor/trailers) are the canvas for art in this research. The trucks themselves act as the starting parameters for the transformative process. The applicable modifications are variable based on the rules and availability of materials in each country discussed.

1. Trucks in Pnjab

In Pnjab, truck drivers and/or owners spend a great amount of time and care to

decorate their trucks with a set of standard, yet individualized decorations. Trucks are often just like a second home; therefore, drivers take along with them sacred words, talismans, and decorations which are reminiscent of home. As Jason Torchinsky writes, "One of the most striking things an American will notice on India's highways is how almost all…cargo seems to be transported by these lavishly decorated…trucks… The trucks tend to be owned by individual families and are lavished with decorations and attention because the truck makes possible the entire family's livelihood. They're very loved machines." [1]. Definitions of home space include home as a reflection of the self, any space in which the occupant feels safe, or a place where one can perceive a separation between outer and inner sections of space, be it by traditional brick and mortar, metal siding, or even tin and cardboard, as is often found in impermanent housing. Regardless, the perception of home is a construct which is reinforced by the individual through personalization of the space. Trucks are a second home for many drivers, and as such are often personalized for the purpose of feeling safe and comfortable therein. A set of common aesthetic features found in Pnjab will now be discussed.

1.1 Sacred Iconography

Pnjab, in Northern India is predominantly Sikh. Phrases and words from Sikh sacred text, Gurbani, are often painted on the front and sides of trucks. These phrases are most often written in Pnjabi but are sometimes written in Hindi (Devanagari) or English. The most common words and phrases are "SatNam WaheGuru," "Ek Onkar," "WaheGuru," and "Guru Rakah." Along with sacred text, the Khanda, symbol for Sikhi, is often displayed. Finally, pictures and names of historical Sikh figures and Gurus are placed upon the trucks. Common examples seen are "Guru Nanak" and "Dhan Dhan Baba Deep Singh Ji." As ideas of domesticity are often a metaphor for or symbol of the ego, displaying such religious iconography allows the driver to both project his or her ideological fascinations as well as gain a sense of spatial familiarity on the road, thereby fully realizing the home space of the truck.

1.2 Superstitious Décor

Although Sikhi teaches against superstitions, the cultural traditions of India, at times, permeate into the realm of Pnjab trucking. Along with the previously mentioned Sikh iconography, many trucks in Pnjab feature black yarn or rope tassels as well as the mask depicting the black grinning face of Mahakal as Nazar Battu, or a symbol to ward off the evil eye. By adding these items to the trucks, the drivers can reinforce a sense of security and safety that is parallel to the sense of safety found in an immobile home.

1.3 Ornate Decorations

Floral and geometric patterns have been used to decorate everything from home exteriors and interiors, book pages and covers, clothing, dishes, and even food for centuries. This style of decoration is also a common feature on trucks in Pnjab. One internationally acclaimed truck artist uses his creations to "expresses everyone's desire for peace and unity" [2]. Traditional decorations of home such as floral and geometric motifs

seem universally appealing, regardless religion, socioeconomic status, or location. The peace and unity expressed through this art, again appeals to a sense of home on the road. Many trucks in Pnjab are completely covered in colourful and welcoming patterns of flowers, swirls, plants, and organized abstract designs. Bachelard explains the importance of images and a sense of home in the following, “For the house furnishes us dispersed images and a body of images at the same time. In both cases…imagination augments the values of reality. A sort of attraction for images concentrates them about the house” [3]. In other words, what we consider home is based on images and an imagination into what those images provide for a sense of safety, familiarity, and defined border of outside versus inside.

2. Migration to the USA

Driving along I-10 or I-40 in the US, you can find more Khandas than in any Gurdwara (Sikh place of worship). Sikhs are beginning to dominate the logistics industry along the coasts, and in the West and Southwest areas of the US, particularly in California. A story from the *Los Angeles Times reports, “*There are 3.5 million truckers in the United States…But as drivers age toward retirement…and a shortage grows, Sikh immigrants and their kids are increasingly taking up the job…In California alone, tens of thousands of truckers trace their heritage to India. The state is home to half of the Sikhs in the U.S…At Sikh temples in Sacramento, Fresno, Bakersfield and Riverside, the majority of worshipers are truck drivers and their families” [4]. So, when Sikh drivers come to the US, or when Sikhs come to the US and start a career in driving, do they, and how do they continue the same traditions of truck decorations that are omni-present in Pnjab?

3. Differences in Starting Parameters

The form factor of the canvas differs between trucks in Pnjab and trucks in the US. According to one journalist, “The trucks [in Pnjab] are a bit smaller than an American-type 18-wheeler, and unlike common US cargo trucks, the cab and cargo areas are an integrated unit. Most seemed to be made by Tata, though there are some other makes in there” [1].

4. Differences in Applicable Modifications

There are several differences between trucks, rules, and available materials/crafts in Pnjab and the US that account for the more subdued accoutrement seen on and in trucks in the US. Aside from the form factor of the tractor/trailer, each state in the US also has specific restrictions for what a truck can look like. For example, blue lights are allowed in some states and not others, and windows and mirrors must be free of accessories and anything which might obstruct the driver’s view.

4.1 Sacred Text in the US

Many trucks in the US which are driven by Sikhs feature a Khanda decal or metal figure, while some have decals of Baba Deep Singh Ji, Sant Jarnail Singh Bhindranwale. Sacred text is rarely seen, and Pnjabi script is also not common. The tools for creating the same sacred texts are not as common as print shops often print only in Latin characters. Text in the US for Sikh drivers often consists

of the driver's last name or the company name which is often a word borrowed from Sikh ideology such as "Khalsa" or "SatGuru."

4.2 Superstitious Décor in the US

While black tassels do adorn the mirrors of a few trucks in the US, it is exceedingly rare. Often the drivers of these trucks are Hindu, as that tradition is predominantly Hindu. The black smiling mask is nowhere to be found. These tools of décor are generally only available in India and therefore are an artifact of the superstitious past.

4.3 Ornate Decorations in the US

To paint a 53-foot trailer in the same style as the intricate and ornate florals in the US would be a great task and would not necessarily be allowed. There are few if any working truck artists in the US who would paint a trailer. Also, as opposed to the higher ownership statistics for Pnjabi drivers, US drivers often do not own their trailers, therefore personalizing a trailer with such intricate and expensive artistic detail would be out of the question.

5. Conclusions

Regardless the country of domicile, there is a strong desire and long tradition of many Sikh drivers to transform their trucks into works of art representing the Sikh religion. In Pnjab, Sikh iconography is ever present in homes, businesses, and eateries. A longing for a sense of home is fulfilled by mirroring this iconography. Be it on trucks on the highways in Pnjab and the larger India, or on the US highways, seeing familiar Khandas, Babas, and vocabulary is comforting and point of pride for Sikhs everywhere. Starting parameters and transformations my differ between each country, but the transformative process always has, at its roots, a desire for home.

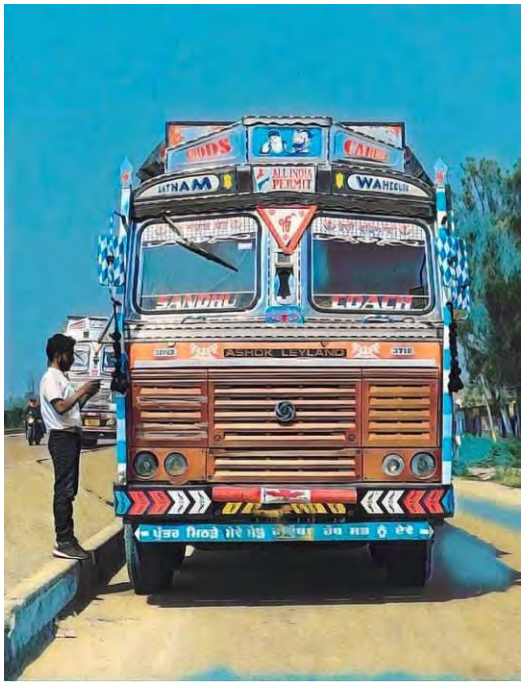
6. References

1. Jason Torchinsky, "*The Amazing Decorated Trucks of India*", Jalopnik, Web, 2013

2. Lauren Weston, "*Dover Rug & Home Presents Truck Artist, Haider Ali*", Wellesley and Weston, Web, 2015

3. Gaston Bachelard, "*The Poetics of Space",* Beacon Press paperback, 1969

4. Jaweed Kaleem, "Sikh drivers are transforming U.S. trucking. Take a ride along the Punjabi American highway", *Las Angeles Times,* Web, 2019


ALL INDIA PERMIT
ASHOK LEYLAND


GOODS







A Diagram-Based Interactive Interface Design for Art Exhibitions

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Abstract

This paper presents design phases of a Diagram-Based Interactive Interface Design (DBIID) for art exhibitions. To develop DBIID, the information visualization model presented by Card, Mackinlay and Schneiderman in 1999 was foundational. In the design process of DBIID, first data is collected from various sources and then transformed to be interpreted in the *Processing* coding environment. Before visualizing each data type in the interface, visual structures are designed. Diagrams are created by different arrangements of visual structures. Last, the interface is interactively experienced by the users and new features are added to the interface based on user feedback. In this study, the DBIID is developed for the "Artist in Their Time" exhibition of İstanbul Modern. Initial findings of the experiments show that DBIID can be used to visualize both abstract and concrete data of an artwork or exhibition by using diagrams. Also, these diagrams can help exhibition visitors to gain a deeper understanding of the artworks and exhibition.

1. Introduction

In the present day, with increasing amounts of data, technology has undertaken a significant role in refining and transforming data to make it more understandable for the user. In this context, many research disciplines use various data visualization techniques. The data visualization process includes a series of operations such as: collecting data, transforming it into visual structures, and presenting them through an interface. Data visualization is widely used in the education field. Visualizations as a graphical display of data can be used to reveal or teach ideas, concepts, and relationships between phenomena. Through the visualizations, learners are expected to synthesize information and construct their knowledge related to the presented content.

Another education-related field is museology. Since the 18th century, museums as institutions have undertaken the mission of educating societies. Until today, museums have developed different formal, informal and interactive learning models for transforming the data into a more useful format (information). Specifically, museums concerned with history, nature, and space, information are presented to the visitors with systematic interactive displays (maps, timelines, holograms etc.). The interaction between exhibitions and visitors are experiential. However, art museums do not adopt this kind of approach. Visitors in art museums are generally passive observers without any digital or physical interaction. In art museums, exhibited artworks are also presented to the visitors through labels, audio guides, and QR codes that provide written information limited to well-known features of the artworks. Besides these, art museums have developed their own mobile applications. However, these applications do not convey more information to the visitor than was obtained during the museum visit (Figure 1).



Figure 1. *(a) Mobile Application of Guggenheim Museum [1]; (b) Mobile Application of MOMA [2]*

In addition, visitors visit the art museum in a limited time within the scenario developed and route defined by the curator. However, this situation makes it difficult for visitors to gain in-depth understanding about the exhibitions and artworks and to perceive the embedded patterns such as transitions from one theme to another, distribution of artworks by time periods, grouping of artworks etc.

Based on these problems, in the scope of this study, a diagram based interactive interface was designed that invites the visitor of art museums to learn actively by doing visualizations based on various data belonging to artworks. The main purpose of this study is to enable the visitor of the art museum to seek new information and construct their knowledge about exhibition and artworks through interactively created diagrams. Another purpose is to give the visitor the chance to visit the exhibition without any temporal or spatial restrictions through the interface.

Within the scope of the study, the "Artists in Their Time" exhibition opened by the İstanbul Modern (art museum) in 2015 was selected as a case to design the interface. The interface has been designed in *Processing* coding environment and tested with a group of respondents consisting of people who have visited or not visited the museum. As an initial finding, it is observed that the respondents who used the interface are able to synthesize information, discover new relationships between the artworks that are not explicitly presented during the museum visit.

2. The Role of Interactive Systems in Museums

Data visualization tools have been designed to present and make inferences from the data. Concepts, techniques, and theories associated with the design of these data visualization tools are adopted from fields of psychology, computer science, statistics, graphical design, and

multimedia design [3]. Since the artworks in the museum have many features and each feature corresponds to a different data type, exhibition can be considered as a large data source. Through using different filtering techniques, visualizations support the human's cognitive skills to handle complexity and find patterns in this large data set [4].

The learning experience in the museum is often supported by interactivity and this experience is enhanced by the use of various data visualization tools. Adams and Moussouri [5] classified museums as interactive and traditional, and then asked adult and child visitors to express their thoughts on museums in their own words. Statements describing the interactive museums are listed as: exciting, enjoyable, colorful, participatory, memorable, and insightful. Statements describing the non-interactive museums are listed as: boring, passive, adult-centered and physically and behaviorally constraining.

In the art museums, data of the artworks is not explicitly presented. However, by reading related text from exhibition catalogues and other sources provided by the artist or the museum, visitors may gain a better understanding of the artwork. The main reason why visitors further investigate artworks (even artworks previously seen in the exhibition) is because the artwork contains some abstract (implicit) data.

Diagram as a type of visualization and representation aims to make abstract (implicit) data visible (explicit) and investigate their embedded relationships. According to Allen [6], diagrams describe possible relationships between elements, rather than being a "thing" itself. Diagrams as schematic representations also help to reduce complexity, enhance the cognitive limits, and question the relationships [7,8]. Diagram is an expression of an abstracted entity, concept, or event. However, this abstraction should not mean a reduction of phenomenon. Beyond supporting the representation of a production process in mind, diagrams play an important role in the externalization of abstract concepts such as design ideas through visuals [6,9,10]. Diagrams also undertake many tasks such as establishing relationships of abstracted concepts, ideas, and raw data, presenting their relationships, synthesizing information from these relationships, and transferring the synthesized information [9].

In this study, an interface has been designed to visualize a comprehensive exhibition and a large number of artworks of an art museum by considering visible (explicit) and invisible (implicit) information belonging to them. In this context, to visualize both concrete and abstract data together, the interactive visualization interface was decided to be diagram-based. In Section 3, the general framework of interface design and its design phases are explained in detail.

3. Framework of the Interface Design

İstanbul Modern was founded in 2004 as Turkey's first private modern and contemporary art museum. In its first permanent space (Antrepo #4, a former customs warehouse in Karaköy), İstanbul Modern continued its activities for 14 years. Due to the new "Galata Port" master plan, Antrepo #4 was demolished and İstanbul Modern moved to its temporary space in Beyoğlu, as of 2018.

In this study, the exhibition titled as “Artists in Their Time” which took place as a temporary and themed exhibition in İstanbul Modern between August 2015 and June 2017, was selected as a case. This exhibition includes 183 artworks belonging to 109 artists. Figure 2 shows interior space of the İstanbul Modern at Antrepo #4 before moving and different types of artworks including painting, sculpture, video, and installation exhibited in “Artists in Their Time” exhibition [11].



Figure 2. *Photos from İstanbul Modern at Antrepo #4, “Artists in Their Time” Exhibition, 2017 (Photos by Author)*

The reasons for choosing this exhibition for the interface design are as follows:

- The exhibition's content in terms of type of art works, number of artists and variety of themes.
- The exhibition has been visited by the vast majority of people living in İstanbul and is likely to be revisited before or after using the designed interface; the popularity of İstanbul Modern provides this study an opportunity to collect feedback.

While designing the Diagram Based Interactive Interface Design (DBIID), *Processing* coding environment was used for visualizing and externalizing the links between different kinds of data of the artwork. As a foundation to DBIID, the information visualization model presented by Card, Mackinlay and Schneiderman [12] was taken.

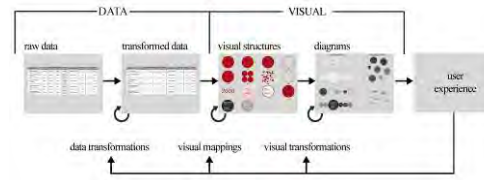


Figure 3. *Flowchart of the DBIID developed based on Card, Mackinlay and Schneiderman’s [12] model*

The phases of the design process of DBIID can be listed as: the collecting raw data obtained from the sources, the transformation of raw data to be used in the computer environment, the creation of visual structures for each data type, the diagrams created by the visual structures, and the experiencing the interface by the users (Figure 3). In the following subsections, design phases of the DBIID are explained in detail.

3.1 Collecting and Refining Data

In the scope of this study, the data of the exhibition is obtained from written sources such as boards and labels in the exhibition space, exhibition catalogues prepared by the museum and information from the museum’s official website (Figure 4).



Figure 4. *(a) Data from Exhibition Catalogue [11]; (b) Data from Labels (Photo by Author)*

To refine the obtained data, the main categories of the CDWA (Categories for the Description of Works of Art) classification system developed by the Getty Center is used [13]. In the scope of this study, the categories (storage number, cataloging style, etc.) of the CDWA that are essential only for museum experts are not included in the classification.

First, the dataset consisting of 183 pieces of artwork from the exhibition were classified as textual and numerical. Some of the textual data has been converted to numerical data to ease the interpretation of data by the computer. Figure 5 illustrates the textual (T) and numerical (N) data types, also transformation of data types from T to N. For example, while “1” in the data table represents installations, “2” represents photographs, “5” represents painting. Alternatively, in another dataset, including 14 different countries; while artworks created in Germany are represented with “1”, Netherlands with “8” and “Turkey" with "13”. In this step, all data related to the artworks are stored in the Excel sheets. These Excel sheets then imported to *Processing* to create diagrams.

ID	Title	Catalog Level	Object/Work Type	Classification Level	Creator Description
1	cehennemim	item	painting	painting	painter
N	T	T	T	T	T
N	T	N	N	N	T

Creator Identity	Nationality of Creator	Creator Role	Creation Date	Size 1	Size 2
fahrelnissa zeid	turkiye	painter	1951	205	528
T	T	T	N	N	N
T	N	N	N	N	N

Size 3	Duration	Dimension Description	Color Code (R)	Color Code (G)	Color Code (B)	Materials/Techniques Description
0	0	2 dimension	119	95	61	oil on canvas
N	N	T	N	N	N	T
N	N	N	N	N	N	T

Theme	Owner/ Agent	Provenance Description	Collection Status
personal issues	Istanbul museum of modern art collection	unknown	Sirin devrim and prince Raad donation
T	T	T	T
N	N	N	N

Figure 5. *22 Data Types and their transformations*

3.2 Transforming Data into Visual Structures

The refined data of artworks are transformed to two-dimensional visual structures so that the data belongs to artworks can be easily understood by visitors. While transforming the raw data of artworks into visual structures, basic design elements such as point, line, plane, and color are used.

In the first stage, each artwork is represented with a point (Figure 6a). Points are selected because of their characteristics such as not defining any direction (x,y,z) and possibility to form clusters. In the DBIID the size of the points is dependent on the size of the artwork in the physical environment. The sizes of the artworks are obtained from exhibition catalogues and labels located next to artworks. Since size vastly differs between artworks, the sizes of the artworks are remapped between minimum and maximum radius defined by the designer. Moreover, the colors of the points are derived from the average color of the artwork calculated in the *Processing* environment based on actual photos of the artwork. Therefore, representation of each artwork differs in terms of size and color (Figure 6b).

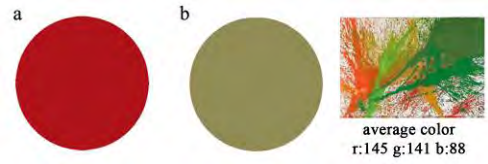


Figure 6. *(a) Representation of an artwork with a point; (b) Calculating the average color of an artwork*

Another parameter used in the DBID is the dimensions (2D, 3D, 4D) of the artworks. In DBIID classification and representation is done as follow:

- Paintings and gravures are considered as 2-dimensional artworks and represented with simple circles filled with color (Figure 7a).
- Sculptures are considered as 3-dimensional artworks and represented with circles filled with color with a thicker contour line (Figure 7b).
- Videos and installations are considered as 4-dimensional artworks and represented only with contour without any color fill (Figure 7c).

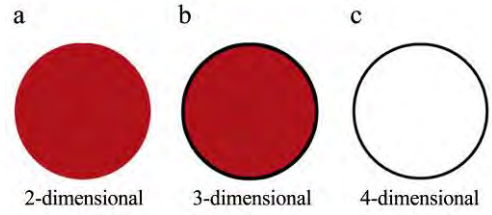


Figure 7. *Representation of (a) 2-dimensional (b) 3-dimensional (c) 4-dimensional artworks*

Another important feature considered to create visual structures is the “category of the artworks”. According to CDWA artwork can be classified as item (a single artwork), set of artworks, group of artworks, and series of artworks. These features are assigned to each artwork and illustrated as shown in Figure 8.

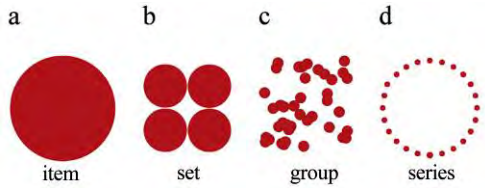


Figure 8. *Representation of categories of artworks (a) item (b) set (c) group (d) series*

In addition to transformation of certain data into visual structures by using basic design elements, data such as the title of the artwork, the creator of the artwork, the role of the creator, the technique of the artwork, the owner (name) of the artwork, and the status (owned/borrowed) of artwork for is presented in text format by superimposing with the previous created visual structures (Figure 9a). As an exception, the creation date of the artwork is presented directly as a 4-digit date (year) without any transformation (Figure 9b).

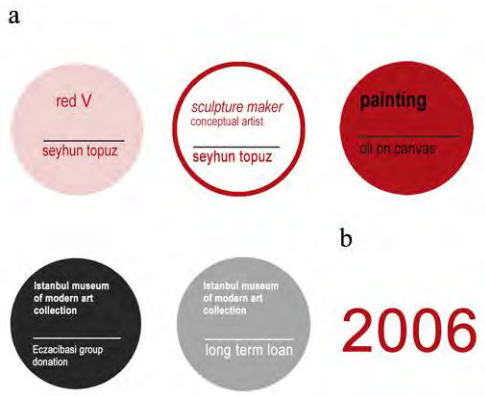


Figure 9. *(a) Superimposition of textual data on points; (b) Representation of creation dates*

3.3 Creating Diagrams

The interactive visualization techniques can be used to reconstruct and visually review large quantities of data. Burkhard [8] listed the main characteristics of the visualization-based applications as: being interactive, being dynamic and containing embedded details. To design DBIID for the "Artists in Their Time" exhibition, the *Processing* coding environment, which provides flexibility in establishing the relational networks of complex data and allows interactive inputs by mouse and keyboards, was used. The designed interface is compatible with both Windows and macOS operating systems. Due to the interactive characteristic of the applications, changes can be made by using filtering buttons in the interface and diagrams are produced. The dynamic feature of the interface allows the changes in the visuals to be shown to the user instantly. To reach the embedded details, the expected details can be highlighted by zooming in and clicking on the visual structures.

On the main screen of the interface, there is a sidebar (Figure 10a) to display or associate the select data types and a number slider (Figure 10b) to define the number of artworks that will be included in the diagram.



Figure 10. *Opening Screen of the Interface (a) Sidebar (b) Number Slider*

The buttons of the sidebar are grouped under 3 menus. The top and the middle group buttons are used to make

visualizations with “main categories” of data. The buttons on the top group create "clustered" diagrams based on the following data types: random, nations, theme, collection, classification (Figure 11a) The buttons on the middle group create “sequential” diagrams to visualize the artworks according to order of artworks in the catalogue, order of artworks in the exhibition space, and chronological order of the artworks (Figure 11b). The lower group of buttons is used to superimpose a data type from “main categories” and another data from “sub categories”. Superimposition enables the overlap of two or more visual structures in a single view. In such visualizations, all visual structures can be visible by using the transparency of a visual structure [14,15]. Subcategories of the data types are listed as: size of the artwork, category of the artwork, name of the artwork and its creator, artist and their proficiencies, creation date of the artwork, material & technique, and owner and status (Figure 11c).

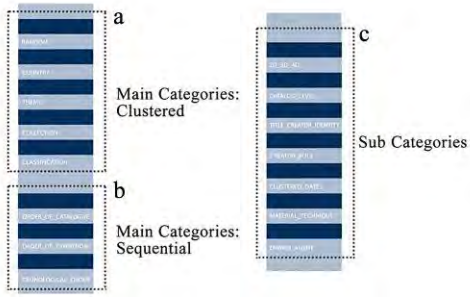


Figure 11. *Buttons (a) Clustered Categories (b) Sequential Categories (c) Sub Categories*

The bar at the bottom of the screen is designed as a "number slider". The range of this number slider is from 0 to 183. These numbers refer to the index numbers (order) of the 183 works in the exhibition catalog. In this case, the artworks up to the index number determined by the number slider are included in the diagrams (Figure 12).

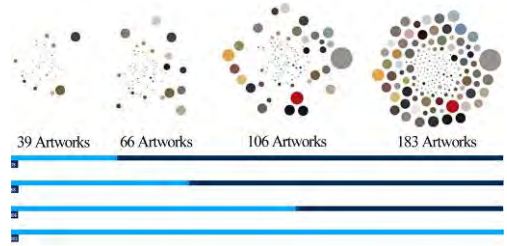


Figure 12. *Determining the number of artworks in the interface by the number slider*

Briefly, the created diagrams are grouped as clustered diagrams and sequential diagrams. The basic principle of “clustered diagrams” is that the artworks come together to form a cluster around a center point without touching each other. For example, when the main category of "nation of origin" is activated from the interface, the points representing the works of artists from the same nation merge to form clusters. The data under the “main category” of “nation of origin” creates a diagram that all artworks are clustered around 14 center points as "Germany", "USA", "Argentina", "Austria", "Bulgaria", "Denmark", "South Africa", "Netherlands", "England", "Italy", "Northern Cyprus", "Puerto Rico", "Turkey" and "Samoa". Produced from this diagram, where the majority of the works are from Turkey while other countries reached a maximum of 4 works except the United States of America (Figure 13).

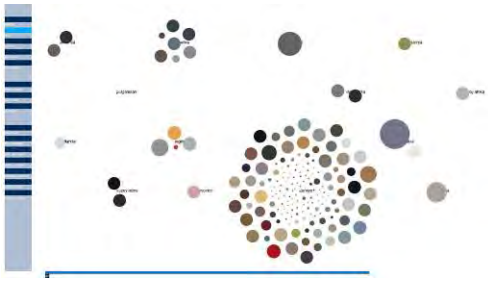


Figure 13. *Clustered diagram created with the activation of the "Country" button*

If a subcategory is activated along with a clustered main category, diagrams that consist of more information are created. For example, when Theme and Dimension (2D, 3D, 4D) buttons are turned on, two different data are superimposed. For example, it has been determined that the works in the theme of "artworks for women" are mostly 4-dimensional and pieces in the "Cinema" theme are 2-dimensional instead of 4-dimensional as expected (Figure 14).

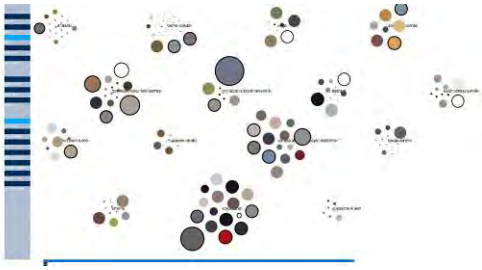


Figure 14. *Clustered diagram created with the activation of the "Theme" and "2D, 3D, 4D" buttons*

Juxtaposition is a flexible and easy-to-apply technique that is useful for bringing a huge number of visual structures in a single view. The principle to form a sequential diagram is the juxtaposition of the artworks on the interface (display). Since the visual structures that represent artworks are arranged side-by-side in the sequential diagrams, the diagrams are formed as three rows to fit all artworks to the interface (Figure 15).

The user of the interface can create the strings of artworks gradually by increasing and decreasing the number of artworks by using the cursor to manipulate the number slider. Sequenced diagrams deal with three different types of exhibition data: order of artworks in the catalogue, order of artworks in the exhibition space, and chronological order of the artworks. Through these diagrams, it was observed that the artworks were not arranged in the exhibition space as in the catalogue or chronologically in the exhibition space. In addition, it is obvious that small works are side by side, while there is no certain rhythm in the arrangement of large and small works in the diagram expressing the exhibition sequence. On the other hand, it is seen that the colors of the work are homogeneously distributed throughout the exhibition and there is no zoning in the exhibition in relation to the color of artworks (Figure 15).

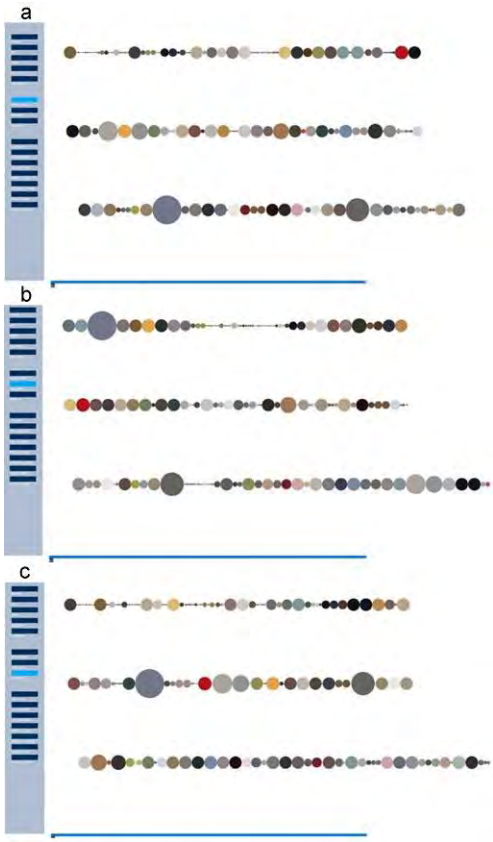


Figure 15. *Sequential diagrams (a) Catalog Order (b) Exhibition Sequence (c) Chronological Order*

When the “Exhibition Order” and the “Date of Creation” of the artwork are superimposed, it is observed that there is no chronological order while arranging the artworks in the exhibition space (Figure 16).



Figure 16. *Sequential diagram created with the activation of the “Exhibition Order” and “Date of Creation” buttons*

3.4 Improvements after User Experiments

Based on the feedback obtained as a result of the user experience, the interface has been developed by adding new features. In the design of interface where the abstraction feature of the diagrams is adopted, the visitors stated that the lack of actual images of the artworks has a negative effect in the retaining of memory of the exhibition. For this reason, the visuals of the works have been added to the interface so that they can be turned on and off depending on the user's request by right clicking on the representation of the artwork (basic design element) in the interface (Figure 17).



Figure 17. *Displaying the actual image of a clicked artwork on the interface*

Similarly, due to the use of the zoom in command that causes complexity and difficulties to perceive the text representation of data in the categories (work name, artist name, artist description and role) during the user's experience of the interface, with the left click of the mouse, an informative pop-up window containing the artworks title, artist name, year, collection name, material technique can be displayed on the interface (Figure 18).



Figure 18. *Displaying the textual data of a clicked artwork on the interface*

4. Discussion

The interface is designed to enable visitors of museums to make a computer-aided, interactive visualization and gain a deeper understanding of the exhibition and the artworks in the museum space. The reason for the interface to reach the visitor through visualizations is that visuals support the cognitive system and reduce the cognitive load in the process of learning, producing and transferring the generated information. The visualization model developed in the study aims to transform the interface user into an active and participatory visitor by dynamically filtering the large amount of implicit and explicit data of the art exhibitions with interaction.

With DBIID diagrams were created using simple forms and elements such as point, line, plane, and color, based on the abstraction feature of the diagram, instead of directly presenting the data related to exhibitions and artworks. In other words, abstract diagrams were created from the abstract data of non-abstract (concrete) artworks.

As a result of the use of the interface, the positive features of the interface are listed as follows:

- Revealing invisible data networks and patterns with clustered and sequential diagrams
- Refining the complexity of relationships between data and visualizing them in an understandable way
- Enabling visitors to take an experiential role by encouraging them to ask new questions about exhibitions and artworks through discovered patterns
- Having a different perspective on exhibitions and artworks with the combination of the experience and knowledge gained from the interface in the digital environment and the museum visit
- Providing exhibition experience without temporal and spatial restrictions
- Presenting data that is not available in the exhibition space or the exhibition catalogue
- Providing the opportunity to experience the exhibition in different arrangements other than the order determined by the curator (catalog sequential, chronological)

Another important point to mention is that the "Artist in Their Time" exhibition and the Istanbul Modern exhibition space do not exist at the moment. In this context, the interface and the database behind it have a digital heritage feature.

The interface design provides some flexibility as stated. The CDWA standards, which were used in this study and developed with the purpose of creating a database of artworks, can be used to refine obtained data of any other art exhibition.

To use the same interface for different art exhibitions, visualizations can be made by changing the basic qualities such as shapes, colors, sizes representing the works of art, while the algorithm scheme and data conversion principles remain constant.

References

1. **Url-1.** <https://www.guggenheim.org/plan-your-visit/guggenheim-app>, accessed 6th November 2020.

2. **Url-2.** <http://www.theculturelp.com/wp-content/uploads/2015/10/MOMA-mash-museum.jpg>, accessed 6th November 2020.

3. **Aparicio, M., & Costa, C. J. (2015).** Data visualization. Communication Design Quarterly Review, *3*(1), 7-11.

4. **Keller, T., & Tergan, S. O. (2005).** Visualizing knowledge and information: An introduction. In T. Keller, S. O. Tergan (Eds.), *Knowledge and Information Visualization* (pp.1-23). Berlin: Springer-Verlag.

5. **Adams, M. & Moussouri, T. (2002).** The interactive experience: Linking research and practice. In *Proceedings of International Conference on Interactive Learning in Museums of Art and Design* (pp.1-24). London: Victoria and Albert Museum. UK.

6. **Allen, S. (1998).** Diagrams Matter. *ANY: Architecture New York, 23*, 16-19.

7. **Eppler, M., & Burkhard, R. (2004).** Knowledge Visualization. Towards a New Discipline and its Fields of Application. Retrieved November 3, 2020 from <https://www.researchgate.net/publication/33682085_Knowledge_Visualisation_Towards_a_New_Discipline_and_its_Fields_of_Application>

8. **Burkhard, R. (2005).** *Knowledge Visualization: The Use of Complementary Visual Representations for the Transfer of Knowledge: a Model, a Framework, and Four New Approaches* (Doctoral dissertation). Swiss Federal Institute of Technology - ETH Zurich, Zurich.

9. **Ceylan, E. (2010).** *Modern Bir Mimari Temsil ve Performans Aracı ya da Mimarlıkta Diyagram* (Doctoral dissertation), Mimar Sinan Güzel Sanatlar

Üniversitesi, Fen Bilimleri Enstitüsü, İstanbul.

10. **Garcia, M. (2009).** Prologue for a history, theory and future of patterns of architecture and spatial design. *Architectural Design, 79*(6), 6–17. doi:10.1002/ad.974

11. **Kantarcı, N. C (2015).** *Sanatçı ve Zamanı / Artists in Their Time.* İstanbul: İstanbul Modern.

12. **Card, S. K., Mackinlay, J. D., & Shneiderman, B. (1999).** *Readings in information visualization: using vision to think*. San Francisco, CA: Morgan Kaufmann Publishers.

13. **Url-3.** <http://www.getty.edu/research/publications/electronic_publications/cdwa/> accessed 6th November 2020.

14. **Javed, W., & Elmqvist, N. (2012).** Exploring the design space of composite visualization. In *2012 IEEE Pacific Visualization Symposium* (pp. 1-8). IEEE.

15. **Beck, F., Burch, M., Diehl, S., & Weiskopf, D. (2014).** The state of the art in visualizing dynamic graphs. In *Eurographics Conference on Visualization Conference*. Swansea, Wales, UK.

Generative Art and Design for Re-rendering the Handicrafts industry

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Abstract

Both, handcrafted art and generative art, find a common basis in the idea that they are non-repeatable, one-of-a-kind objects in time and space – one carefully crafted and curated by human hands, the latter carefully crafted by algorithms which are in turn tuned by humans. This dichotomy is nothing but inspirational. These two very distinct forms of 'crafting' lie on two opposite extremes of the product design timescale – handicrafts are losing importance every passing day and indigenous artisans are suffering more than ever; generative art is gaining momentum each passing day and slowly infiltrating our daily lives. There is immense potential in combining these two methods of artistic product design – handcrafting techniques can present an exceptionally unique and ingenuous way for generative artists to potentially realise their designs/art in a physical form while generative art and design tools can help facelift the handicrafts industry by breathing in a much needed contemporary air and providing revolutionary technical solutions to problems of economic, cultural and aesthetic sustainability of handicrafts.

This paper aims to curate methodologies to integrate generative art, AI and handicrafts to form a synergetic relationship – that of culture, technological and social advancements in the field of product design. Highlighting the potentials of both these methods and pulling attention to how they can benefit each other, the paper also identifies crucial gaps in the handicrafts industry that need immediate attention from the artists and design communities around the world – it is no longer valid to only romanticize hand made products and herald them as symbols of tradition and patriotism, but we also need to

acknowledge that they are systems of labour exploitation in today's world – attention has to be brought to this and technology has to find a way re-render the handicrafts industry.

Key words: generative art, AI, computational design, handicrafts

1. Introduction

The premise for writing this paper began with a deep dissonance – in July 2020, India dissolved the All India Handicrafts Board (AIHB). AIHB was a government advisory body and a forum to represent weavers and artisans', vocalize their issues to the authorities and advice the government in formulation of development programs in the handicrafts sectors. Even though watered down, this was the only official forum to represent a community of craftsmen, a sector which is still one of the largest employment generators in the country. Not just in India, but many other countries and numerous traditional handicrafts are now lost or have declined. There are several reasons – economic unsustainability in the face of machine production, crafting is a time taking process, present day lack of material knowledge, translation in the aesthetic choices of people, needs for rapid production and 'function' over 'form', etc. Some of these reasons will be scrutinized in the paper and methodologies to resolve them with help of generative art and design will be discussed.

Simultaneously, designers and artists are increasingly adopting generative systems for creating work across various disciplines. Software and parametric tools are readily available for everyone to use, creating a barrage of visually chaotic and abstract artefacts with little basis of design practices and thinking as we explore these various 'tech' tools of designing and visualizing [2]. In a way, generative art is changing the foundational meanings of design.

While advances are being made to make generatively designed products more functional but currently, both handicrafts and generative art are seen as 'non-essential' processes in space and time rather than viewing them as something functional – one wouldn't possibly drink coffee from a hand-crafted heirloom ceramic pot, but choose the mundane steel factory made glass. The paper seeks to explore how can both these practices of crafting be seen in a functional manner if they were to merge and form a synergetic process.

For purposes of clarity, the following definitions for the keyword terms will be used for further discussion:

Craft: It is a very contested term especially in the era of machine production but broadly, this paper refers to craft as a making approach, either by hand or machines, which is guided by tradition, is sensitive to materials and has intentions for novelty rather than mass-production.

Generative Art: Refers to any art practice where the artist cedes partial or total control to a system, such as a set of natural language rules, a computer program, a machine or other procedural invention. This system is set into motion with some degree of autonomy contributing to or resulting in a completed work of art [1]. The generative system may or may not be 'high' tech.

Digital Crafts: In the context of this paper, this term refers to machine made

objects but not those that are mass-produced. Digital tools like 3d-printing, CNC machining and laser cutting have paved the way for rapid manufacturing of objects which are unique from one to other, imparting 'personality' in the age of individualism.

A.I: Artificial intelligence, it will be used interchangeably with *neural networks*, *style transfer algorithms* and *machine learning*.

In the subsequent sections, there is a brief discussion on the post-industrial debate on machine-made goods v/s those that are handcrafted; about how digital fabrication was able to refute the most contested drawback of mass-production – lack of 'uniqueness'. After this discussion, an attempt is made to curate a list of characteristics and thus the different ways in which both these separate practices of crafting – hand-made and generative – can complement one another and create potentials for augmentation.

2. Handicrafts in the post-industrial world

It is the Arts and Crafts movement (flourished between 1880 and 1920) that demarcates a pre and a post period for handicrafts. Strongly anti-industrial in its ideologies, the movement advocated social and economic reform of the crafts sector. Originating in the British Isles, it subsequently spread to the entire British Empire, Europe and America. The reformers associated mass production and industry made goods with a decline in standard of designed objects. John Ruskin, one of the founders of the movement, argued that the separation of intellectual act of design from the manual act of physical creation was socially and aesthetically damaging [3]. Ruskin, William Morris and other co reformers attached words like "dishonest" and "alienating" to machine made goods - attempting to define the purpose of crafts as for "fulfilment" and being "true". These are a highly tangible and affectual set of words - dishonest and alienating; true and fulfilling - that have been attached to these two distinct methods of object design and production. The movement was highly radical and extremely critical of the modern ways of manufacturing and wanted to completely free away from industrial methods. But the factory had its benefits - which were multi-fold for many people - speed, reduced cost and large quantities - all of which spoke to the consumerist population. These benefits could not have been replaced by the traditional craft and hand making techniques! There was no seeming competition between them.

But with the advent of rapid prototyping it was made possible to conceive a notion of 'digital craft'. Desktop 3D printers have become more accessible than ever, people can now quickly fabricate any object that they want to use or customize. This is just on of the many examples where designers and non-designers alike are taking advantage of these newer crafting techniques. Although this shines greater light on the hand-crafting techniques and issues they are facing. Handmade went from daily need and riches to 'intellectual' diminish and then was deemed as mere 'luxury' – due to the high costs of production.

It is not this paper's aim to be critical of the modern manufacturing and mass production techniques; rather, the aim is

to find a common ground between these technologies and the hand crafts in order to create a synergetic system where in one complements the other.

3. Points of overlap and possible augmentation

There are evident overlaps that one can draw between digital craft and handicraft and there are also very visible differences between the two – and those gaps, I believe, can be filled with the help of generative art.

3.1 Novelty and Uniqueness

Artefacts resulting from both, hand-crafts and generative art processes are extremely unique. One ceramic pot is different from the very next by the same artist – uniqueness brought about by human hands. One drawing is very different from the other but both resulting from the same algorithmic system – uniqueness brought about by introducing randomness in the algorithm which lets it run wild. And the intention of novelty is what separates craft from mass-production!

Two expert interviews were conducted for research purposes. Kopal Sheth, a ceramicist who graduated from RISD and is now an artist in residence in Philadelphia, posits that there is a need for aesthetic revolution in the traditional handicrafts industry. As she puts it, people's 'tastes' have changed – for décor, for daily products as well as for art. The notion of 'contemporary' is what she feels is missing in the traditional crafting industries of India. Also, a lot of the handcrafted produce (apart from handloom and textiles) are seen as 'non-essential' items which further aggravates the problem of reduced sales and high costs. This is where generative design can step in – to create the much-required aesthetic revolution.

An interesting precedent study that I undertook was that of **the chAIr project** by Philipp Schmitt. He created the four classic, AI-designed but human manufactured chairs - thus reversing the roles of man and machine in the design process and industrial production. Though not speaking about an existing handicraft, the project infuses technology in the process of wood and metal work for furniture. The resulting chairs, manufactured by human hands, materialize contradictions of form and automation into an irony of AI solutionism [4]. This precedent is of importance to my processes and concept in order to understand how man and machine can co-step and tango together and upend our conventional understanding of handicrafts and technology. The handicrafts industry today has been reduced to a form of hobby or folk art - often bought off as souvenirs by foreigners visiting a country or as a statement and pieces of luxury - Patola sarees in India are hand woven and come at a price of 3000$ which is affordable only to about 1% of the nation's population. The commonplace occurring and functional uses of the hand produced goods has declined. They need a lot of time to be conceived; they come costly and lastly may feel "outdated".

Technologies like AI and generative design can help envision hand crafted goods with the modern aesthetic. A project prototype was undertaken wherein a neural network was trained on a dataset of 400 images of traditional Indian and Islamic tile patterns.



Fig 1 Geometric Ceramic Tile patterns

The model was running on a StyleGAN algorithm (GAN – Generative Adversarial Networks) and was pre-trained on a dataset of nature scenes and mountains. This provided an interesting cross over conceptually – fusing organic patterns of nature with this highly geometric dataset of tiles.

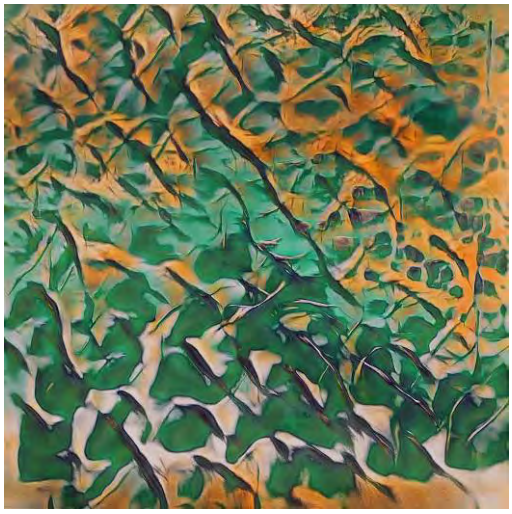




Fig 2a Tile Patterns generated by AI



Fig 2b Tile patterns generated by AI

These are just some of the patterns that the AI generated. What is extremely intriguing is the abstractness of these images and the simultaneous complexity and intricacy. How would one go about producing these tiles for real? To actually clad on walls?

Machines and digital fabrication can only do so much. Even the most advanced of robotic 6-arm machines cannot do undercuts as beautifully as human hands

can. There is a limit (at least in todays time) to how 'finished' products machines can fabricate. This is where handicrafts can augment the field – hand techniques of carving and subsequent finishing of fabricated products.

In conclusion, this section posits that generative art can infuse a breath of fresh air in the aesthetics of traditional handicrafts while hand crafting techniques can help us realize generatively designed artefacts tangibly with all the intricacy and complexity manifested in the generative designs.

3.2 Craft – A Wasteful endeavour

We humans are incredibly wasteful creatures; in order to perfect a making skill like handcrafting wood or ceramics, one would need to practice and practice and fail before eventually succeeding. In this sense, we generate a lot of 'waste' in terms of the discarded material, time and resources spent over learning a skill. Generative art as well can be extremely wasteful in terms of the effort we spend in writing and tweaking the algorithm and its results again and again until we reach a desired outcome. But this waste is not physical. Generative art does not waste 'materials.

This provides an interesting intervention point for technologies like virtual reality combined with haptics and touch sensitivity, which can be employed to 'practice' virtually until you get perfect and then start making things. In April 2010, Emi Tamaki, Takashi Miyaki and Jun Rekimoto developed a piece called Possessed Hand [5]; which was A Hand Gesture Manipulation System using Electrical Stimuli. It was posited on the fact that acquiring knowledge about the speed and timing of hand gestures is extremely important in order to learn skills like playing musical instruments, performing arts and making handicrafts. To solve these problems, they proposed PossessedHand, a device with a forearm belt, for controlling a user's hand by applying electrical stimulus to the muscles around the forearm of the user. Envisioned applications of this device were that it would help a beginner in learning musical instruments [5].

The digital waste of generative art practices can be leveraged for human learning and skill development when it comes to 'making' something.

This section hence concludes by stating a need to explore, design and leverage various technologies which can help people learn hand-crafting techniques but waste less material. The Possessed Hand is just one of the ways in which this interaction can be imagined. This section thinks about the paper concept with a different approach - one that focuses on using technology to *learn methodologies* of handcrafting rather than using technology to *make* or *design* crafted products.

3.3 Slowness and Reach

Handicrafts and generative art are both slow processes – in terms of the time it takes to master the skills. Even then, one can never know the full potential or the myriad of ways these techniques can be used. While learning a single handicraft technique starts with really knowing and understanding the material, excelling at generative art requires understanding generative systems – be it code, algorithms, sensors or simple rule sets. And both are not easy for beginners.

There is one key difference though – once you know and can make a generative system, time is not too long to produce the artwork – often it takes minutes to generate the final visual output. But most handicrafts on the other hand, take a long time to fabricate something – even though you know very well how to make a wooden chair, the process is not going to be much faster for making even the 100th one. There is an added slowness in making of handicrafts.

But in the age of efficiency, the acceptance for slow crafting is being embraced. Many artisans really enjoy the work they do as they feel 'closer to customs and their ancestors'[6]. There is also a satisfaction that is attached to making with one's hands. But a lot of novices who start learning handicraft techniques from scratch find it a little overwhelming to do so. A lot of the handicraft forms in a country like India are community based – a sect of people, a village or cultural community – are skilled in making crafts. They often pass down these techniques to new generations within the community itself. This narrows the reach of skilled crafts. Not many people in the world can hand weave Patola sarees.

This is one more difference - between the reach of generative art and that of traditional crafting techniques. Digital communities have made it possible for generative art skills to be far and wide reaching – it is not limited to a geographical area or a community. Can handicraft techniques be as wide reaching as generative art? It seems like a tough feat but isn't one that is unachievable.

Collaborative teams which comprise of artisans and generative designers can be of huge potential to achieve the above posed feat. Moreover, AI and machine learning couple with robotics and haptic electronics can enable handicrafts to reach more people. I almost conjure up a teaching machine that has learnt gesture control and skills from the most exceptional artisans all over the world and can teach complete novices – this builds up an entire generative system, where the initial rules or algorithm is provided by human artisans; codified and then being learnt by others; the output is a result *generated* due to the teaching machine.

4. Conclusion

Employing, reviving and re-rendering handicrafts has extreme significance in the contemporary culture and society.

Pre-industrial process of making relied on local procurement of raw materials, using indigenous skills and human resources and is inherently more sustainable than the current practices of machine making.

The strong rooting in tradition and culture is something that is required in the extremely impersonal societies we live in today. Craft products can help us ground in our roots.

With a world geared towards efficiency, more and more people are stressing on the need to slow down, to reflect and have moments of mental rest. Being able to 'make' or as I say, 'craft' something comes with a sense of satisfaction, a sense of belonging and to some, even as a form of meditating.

Generative art has the potential to, and should, start creating a contemporary history; artists need to learn from craft

communities about how to involve and manifest tradition in the works produced. Like handicrafts, generative art too should be building a community that is driven by a similar ethos and passion – that of making and striving for novelty.

Re-iterating above mentioned similarities and possibilities for intermingling of two forms of art, generative art has the capacity to impart a much needed aesthetic revolution to handcrafted art – which is not to say that we uproot tradition out of it. Simultaneously, handicrafts and making techniques could give generative artists very unique and novel ways of tangibly manifesting their generative artworks into materials and forms in space and time. A lot of experiments have already been done in the realm of hand-woven textiles and pattern design by infusing traditional making for algorithmically generated patterns. There is immense potential for even more types and skills of handcrafting.

5. References

[1] Philip Galanter, “What is Generative Art? Complexity Theory as a Context for Art Theory”, GA2003

[2] Lisa Marks, “Parametric craft techniques, design methodology for building on embodied cultural knowledge”, Berea College

[3] Orenco Originals LLC. 2020. *The Beginning Of The Arts And Crafts Movement And John Ruskin*. [online] Available at: <https://www.orencooriginals.net/blogs/news/73428421-the-beginning-of-the-arts-and-crafts-movement-and-john-ruskin>

[4] Philippschmitt.com. 2020. The Chair Project (Four Classics)

[5] Emi Tamaki, Takashi Miyaki, and Jun Rekimoto. 2010. PossessedHand: a hand gesture manipulation system using electrical stimuli. In Proceedings of the 1st Augmented Human International Conference (AH '10). Association for Computing Machinery, New York, NY, USA, Article 2, 1–5

[6] Comms. “Interview with an Artisan.” Community World Service Asia, 18 Mar. 2016, communityworldservice.asia/interview-with-an-artisan/.

Creative Automata
Dreaming about Art in a Post-human World

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Abstract

We know from everyday experience that technology is changing the world at great speed and in ways we cannot effectively predict or control. Each of us has different thoughts and feelings about this vertiginous journey we are all in. Art as a micro-cosmos reflects the different stances towards technology that can be found in society at large. In this context, working with generative systems becomes interesting because it is a way to engage with the complexities of technology in a way that goes beyond mere fascination or aversion. It is a way to explore what a human artist and a non-human semi-autonomous system (or automaton) can do together, in a sort of creative collaboration where productivity and agency are distributed in variable ways.

We explore some basic ways in which generative practice departs from the traditional image of the artmaking we inherited from modernity, as epitomized by the ideas of the “masterpiece” and the “genius”. Far from an ideal of perfect control of mind over matter, generative art is about setting in motion an unpredictable process and “letting go”: granting the automaton its freedom.

Since the first flint axe, humans have been shaped by the tools they make. Generative art is also a way to reckon with the agency of inanimate things, and welcome them into the process of making art. They have, of course, always been there; the paint and the brush since ever alive and rebellious in the hands of the painter, but for too long we have struggled to subordinate their autonomy to human will, like they were passive repositories of our ideas and intentions.

We inquire into the curious back-and-forth that takes place between a human mind and a rule system, machine or

algorithm as a new generative work takes shape, in a process of exploration and trial-and-error that happens in the space between the affordances of two very different agents. We also peek into the uncanny landscape that opens up as the digital automata become more complex and more autonomous, turning human participation ever smaller, raising the spectre of a future where it is eliminated from the formula altogether.

In short, we would like to imagine what art can be or become (if anything) in a post-human world, where we finally let go of the illusion of being the only active force imposing order on passive matter, to take back our place in a universe where everything happens in a complex network of interlocked agencies–and our very survival can depend on slowing down, paying attention and understanding their subtle balance.

1. Introduction

As we all know from everyday experience, technology is changing our lives in many, fundamental ways, which we can't yet fully comprehend or control. It feels like technological change is *happening* to us, and there is not much we can do beyond accepting it and trying to adapt as well as possible. We are all passengers on a train heading at full speed towards an unknown, but probably very strange destination. We don't have much of a choice about taking part in this vertiginous journey, but we do certainly have different thoughts and feelings about it.

Some people believe the machines will only bring upon us unhappiness and de-humanization, and ultimately the destruction of the natural environment, the dissolution of social bonds and the end of civilization. Some others, however, are confident our growing integration with artificial systems will take care of all our problems, release us from the need to work on things we don't like, and be the foundation of a more perfect and happy world.

The case is, we don't know yet. Technophiles may be right - or maybe it is technophobes. For the time being, the situation appears to be more complex. Many contradictory forces are at play. Let's think of an example we all know very closely: the smartphone. It confers on us what not long ago we would have called superpowers, radically increasing our ability to communicate, access information and act on the world. In many regards, we can do a lot more with one of those devices than we were able to do without one. But it is also a source of endless distraction, a sink for our time and mental energy, and it literally makes us more stupid: several studies have found that, just by being at hand, and even when silent, our smartphone exerts a subconscious demand on our attention that takes a toll on our capacity for concentration and problem-solving. [1]

In other words, it would be overly simplistic to just decide that smartphones are "good" or "bad". The fact is, they change the way we think and act and connect with our surroundings in complex and fundamental ways. They change *what we are*. Similar things could be said about the Internet, Artificial Intelligence, gene editing, and almost every other one of the technologies that are now permeating more and more the very

fabric of our lives.

The encounter with an alien species, that scenario so many times anticipated by science fiction, is happening right now, before our eyes, inside our homes. It is just that the aliens haven't climbed down from an UFO; they are not coming from outer space. We invented them: they came out of our own hands and brains. They have conquered the world under the cover of being our own creations. As such, they should be familiar, something we can easily comprehend and control. But that's certainly not the case. The situation we are going through now has all the markings of a change of epoch, a clash of civilizations. As we sit in front of our computers or pick up our phones, a close encounter of the third kind is taking place–its consequences unfathomable.

2. Automata at play

Art is a microcosm of society. Indeed, we can find in art the same stereotypical attitudes towards technology that can be seen elsewhere. There's no shortage, in particular, of critical, dark or apocalyptic visions about our future in a world dominated by machines. There are also currents in art that are based in the glorification of new technologies and the unfolding of their powers for never-ending amazement and fascination. It is also true that much of contemporary art is simply not concerned with technology at all, taking care instead of other subjects and worries.

In the varied landscape of possible relationships between art and technology, the work with generative systems occupies a particularly interesting spot. It doesn't look at machines and digital devices from a critical distance that renders them hostile and foreign. But it doesn't either succumb to the fascination of their more obvious and dazzling effects. Rather, it works closely with the device to explore the possibilities that are contained in it but not yet visible; to find out what it can do, but also to know its limitations.

It is not about falling in love with the device, but not about fearing or hating it either. A generative system is neither slave nor master, but rather a sort of colleague or playmate. The system can be software, a robotic or mechanical contraption, a chemical process, a manual procedure, a game or social dynamic, etcetera. The technology involved is not necessarily digital. How the system is materialized is important, but its soul is in the *rules* it embodies. The key lies in the fact that, at some point, it can act with *autonomy*: that is, beyond the immediate control of the artist. That's why we choose to call it an *automaton*.

The automaton can be regarded as a sort of game. A game exists because of, and is defined by, a set of rules, which we might also call an *algorithm*. All games are generative to a certain extent, even those totally unrelated to art, because their rules set up a landscape of possibilities. That abstract domain is larger or smaller, has few or many dimensions, depending on the complexity of the rules involved. A subset of those possibilities is actualized each time the game is played.

Working with generative systems is not about playing a given game, but more like

inventing new games all the time. Each match is not important, the possible variations of the rules are. It is about creating interesting automata that can make interesting things when put in action. It is about experimenting with the potentials and limits of the agency of non-human entities.

3. The idea of an artist

We can perhaps grasp with more precision what is different about this way of making art if we contrast it with other, more traditional ideas. There's a classical view of what art is and how it is made that we inherited from centuries past. It has certainly been put in question, attacked, and left for dead many times and in multiple ways since the beginning of the twentieth century, but despite every effort on the contrary, it is still the standard mindset against which we still understand and weigh every novelty and rebellion. Think, for example, about one of the great artists of early modern times, like Rembrandt or Velazquez. What was their relationship to their work? There are a few things we could probably assert with some confidence. First, there was a physical immediacy: everything that was visible in the painting was coming from the hand of the painter. Of each stroke on the canvas we could say "the artist was there", like every single one of them was a signature, conveying their particular way of giving form to matter. (The great masters had, of course, assistants, but their role was to become invisible, to pretend they were never there).

Second, the artist was thoroughly accountable for everything the work was. Everything that was right or wrong with it was their merit, or their fault. The work was an expression of their will, and of that only. If the work was bad, the reason was perhaps that the artist was not talented enough: they couldn't (yet) exert the necessary command on their media. Art was all about *control*: perhaps the most refined form of dominance of mind over matter.

Third, the work itself was unique and unrepeatable, a very special thing resulting from the confluence of the talent and inspiration of a particular person, in a particular time and place. It was a singular *event*, dated and signed. Especially in the case of the masterpiece, nothing else was quite like it. There was no meaning, therefore, on asking about any rules at play behind it, about anything like an algorithm for its production. There were certainly many norms, techniques, and traditions at play in classical art, but everything that made the work unique was precisely what went beyond all those constrictions, everything about the work that was *unexplainable*.

4. The machine that makes the art

Now, while keeping our baroque artist in the gallery of our mind, let's put a different character next to it. We can perhaps invoke a figure we might consider the patron saint of generative art: Sol LeWitt [2]. His famous lemma, "The idea is a machine that makes the art" [3], condenses in a few words many things we have said. As far as we know, LeWitt did not touch a computer in his life. He didn't need it: "the idea is a

machine" because, once defined, it can be executed "mechanically" by people other than the artist and therefore, so to say, "proceed on its own". So, "the idea" is here something quite different from the fathomless inspiration of the traditional artist. It is, on the contrary, something very explicit and concrete: a set of rules, a small program.

In the case of many LeWitt works, the idea was at once the title and the recipe for its execution. Things like "Ten thousand lines, about 10 inches long, covering the wall evenly". [4]



Fig. 1: Sol LeWitt, 1971, ***Wall Drawing #86: Ten thousand lines about 10 inches (25 cm) long, covering the wall evenly.*** *(detail)*

So, LeWitt's work gets rid of everything that was essential to the traditional way of making art we just described. He didn't paint or draw his works himself: he didn't even have to be present when they were "executed". The physical immediacy between artist and work was therefore broken. The actions of the assistants that actually made the piece introduced a degree of uncertainty in the final result. Certainly not by mistake or lack of ability, but deliberately, as a part of the plan. On the other hand, as the product of a simple, explicit rule, the work becomes repeatable. Every time the same instructions are followed, the transition from idea to materialization takes place anew, and none of those instances is more "original" than the other. There is no "unique event" to be seen.

This is, of course, just one of the many ways the paradigm of classical art got in trouble during the twentieth century. But I believe the shift in the conditions of artmaking that LeWitt represents is synchronized with other, deeper turns in occidental culture (which is nowadays worldwide). Namely, a change of focus from material objects and their production, classification, and management, to the systems as abstract informational models, accounting for many different instances of materialization, which become therefore contingent and secondary.

A whole imaginary world has been lost in the transition: the artist as a privileged being, the inspiration as a bottomless mystery, the shine of the exceptional event, the work as an auratic object, distinct from all others. For some people, the pain of so many losses is just too much to bear, and they will try to avoid it by simply denying that LeWitt, and others like him, are making anything that deserves to be called "art". But the fact of the matter is art cannot be any more what was for Rembrandt and Velasquez, not only because of the historical imperative to move on and make something different, but because we live in a very different world. The questions have changed.

5. Non-human partners

In 1968 the artist, critic and curator Jack Burnham published and essay that is an important reference for us. Its title was “System Aesthetics” [5]. Among other things, he asserted that “we are now in a transition from an *object-oriented* to a *system-oriented* culture. Here change emanates, not from *things*, but from *the way things are done*”.

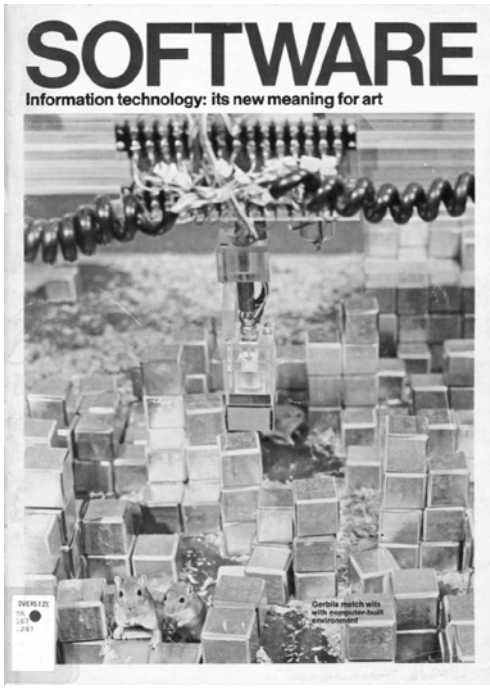


Fig.2: Catalogue cover for ***Software****, group show, Jewish Museum, New York, 1970.*

Shortly after that, in 1970, he curated a group show at the Jewish Museum in New York. It was called “Software”, and it gathered conceptual and new media artists around the idea of, precisely, software, defined in a broad sense as a program, situation or set of instructions designed by an artist and executed by a computer, a machine, or members of the public. The idea behind the show was that software had become more important than hardware, the “hidden order” in the dynamics of a system more essential than its perceptible presence as a thing in the world.

Generative art is about making a system that makes art. The automaton, as a sort of middleman, dissolves the intimate link between artist and work that was at the core of traditional art, while it also “devalues” both. The artist is demoted from their high place as a gifted creator because the work is not any more a pure manifestation of their talent. The work is not that unique thing that stands apart from all others, because it can be repeated, and in any case it is significant only as a token or visible evidence of the abstract system it comes from. It is just what remains from one time the game was played.

Something non-human infiltrates the usually all-too-human cycle of artistic production. As that happens, the very definition of “human” is altered. All along the first stretch of modern age, everything that was not a human was considered as essentially passive, an available material, in waiting to be used and formed in accordance with our will. Man (a definitely male man) was alone in the world: the relationships to everything else were asymmetrical. Animate and inanimate beings were equally subordinated to his plans and decisions. Nothing could get level with him or look him in the eye.



Fig. 3: Hans Haacke, ***Blue Sail****, 1964-1965.*

The automaton, however, is an active non-human. It might be quite simple, like the fan that moves the fabric in Hans Haacke's *Blue Sail* [6]. The artist, in any case, takes a step back to make room for the uncontrolled action of that foreign agent, and with that little movement, everything changes. What was hierarchical becomes horizontal, the active and the passive trade places, and the will to control is tempered by a very different attitude, which Brian Eno beautifully called *surrender*. It is about letting the things do their thing, lying back and just watching.

There is usually a two-time rhythm in the generative process. First, a stage of system design. Second, a moment when the automaton springs into action, like the stormy night when Doctor Frankenstein's unholy creature received the spark of life. The former is an instance of imaginary projection and careful execution, more classical in its outline. The latter is the novel scene, when the artist retreats, becomes a spectator of their own work, and watches as events unfold. One possible measure of the success of the generative process is to what extent the automaton proves capable of surprising its own creator: how rebellious or unpredictable the creature becomes when set in motion.

This two-time cycle can take place just once or go over many iterations, becoming a trial-and-error procedure. The artist and the automaton become involved in a sort of dialogue: with each run the system does things that compel the human to change some things that make the system do different things, and so on. This back-and-forth drives a process of evolution, or at least semi-random drift, in a space of possibilities, towards a destination that could not be foreseen by the artist (or the automaton) beforehand. They could only reach there together.

In short, generative art can be regarded as a creative collaboration between a human and a non-human agent. The outcome is something neither of them are capable of doing on their own: a hybrid work, which is not the mere display of the technical capabilities of a given apparatus, nor the direct exteriorization of a human intention, but something in between, in tension between the human and the non-human, like an artistic cyborg.

6. Machines and systems

We have used the word "machine" a few times to talk about the automaton. But that might be misleading: in any case, the automaton would be a very particular sort of machine. First, because the word "machine" makes us think of a concrete, heavy, complex piece of matter that is taking up space somewhere. But the essence of the automaton is in the

software, not in the hardware. Its soul is given by the rules it embodies. Second, the power of the machine is typically doing the same many times, with great speed and efficacy. But the automaton does things that are all different.

During the Industrial Revolution, machines enabled a quantitative explosion in the production of goods that transformed the world radically. We all know that. However, there is an associated fact that might be less obvious: namely, the qualitative reduction in the variety of objects around us. Suddenly, our coats and carpets and cups and chairs were all identical. The diversity and individual character that comes with crafts and handmade work was lost. The industrial machine is linear, predictable, and transparent in its operations, because its very nature lies in *repetition*. We expect from it to behave exactly the same every time, and when it doesn't, then we are in trouble: the machine is broken. Machines brought forth an age characterized by the multiplication of the identical.

On the other hand, the automata or, in Burnham's terms, the systems, are recursive, opaque, and variable. Their inner workings are often too complex for thorough explanation. When set in motion, there are feedbacks, interactions and non-linear processes that render it unpredictable. The gears and levers are not plain to see: it tends to be a *black box*. Its output is equally variable. The systems open before us a new landscape: the automated production of difference, the explosive multiplication of the unique. The "mass production" of the industrial age is converging now on the production of the particular that was typical of the artisan's shop.

The insane productivity of the automaton is a source of fascination, but it can also become a problem for the generative artist. There is often an "embarrassment of riches" that leaves us with the difficult task of *choosing* what, from an overly abundant output, are we going to actually show as a work. The work is, in a certain sense, the entire space of possibilities created by the system. But that cannot be shown. It is sometimes so vast that even we, as artists, can only explore a few trails and regions of it, descend on it in limited incursions guided by chance and instinct. We can choose to present the automaton as an interactive application that users can navigate, and thus, so to speak, pass on the problem to the public. But many times we find ourselves in the situation of having to capture and select particular instances of the countless things the system can do, and that always feels arbitrary, like an undue human intrusion on the wild freedom of the automaton. As we noted before, those captures are just samples standing as representatives for the rich world of the possibilities they come from.

7. A second nature

Of course, nature itself is "generative" in the sense we have been describing. It is indeed the epitome of generativity. No two trees are exactly alike, no two leaves of the same tree are identical. However, we don't usually speak of trees as "generative", because that's a qualification we reserve for human creations. Art is a human affair, and generative art is too. We could say the "creative collaboration" between a human

and a non-human agent is, at the end of the day, not really horizontal, not a gathering of equals. There is an essential asymmetry, because the automaton is made by a human, and it only springs to life when and for as long as the human decides. The naked truth is, the human is still in *control*.

All that is true. Generative art is, in a certain sense, still all too human. But even a short moment of *surrender*, a small space for the autonomy of the system, is enough to change everything. As we tried to show, the canonical places of the artist and the work in the traditional paradigm of artmaking are brought down by this intrusion of the agency of non-humans. All of a sudden, art is not any more about making beautiful or sublime or radical objects, but about exploring systems: going for a walk in the universe that lies beyond the limited realm of human stories, wishes and fears.

Generative art is also part of the process by which technology strives to resemble nature more and more–moving away from the rigidness and obdurate insistence on the same of industrial machines, towards the adaptability and variability of complex systems. Step by step, human inventions acquire for themselves characteristics that were the privilege of life. As this happens, the balance of power in the "creative collaboration" changes. Automata become more autonomous. Human participation becomes ever smaller. It is perhaps not so crazy anymore to think of a future when automata don't need us at all to live their lives and develop their creations. At that point, technology would become a sort of "second nature", and art would cease to be an exclusively human affair.



Fig. 4: ***Deep Dream.*** *Original image, and results after 10 and 50 iterations (Source: Wikipedia)*

These days, this trend is visible in the quick succession of amazing developments happening in the field of the so-called "Artificial Intelligence".

Neural networks and deep learning technologies are conquering territories that were, not long ago, undisputed human domain. They can now drive cars, diagnose cancers, speak and listen, beat any of us at chess and go, write texts that make sense, etcetera. A few years ago, the Deep Dream experiment by Alexander Mordvintsev [7] surprised many of us by showing they can also do something that feels intimately human. They can *hallucinate*: that is, see things that aren't actually there, but that they are trained to see and can reinforce in a feedback loop, producing images that are not a representation of anything external, but a strange visual record of the "ideas" that are somehow encoded in that digital mind.

Shortly after that we were presented with a related system, "Style Transfer", which was able to pick up typical patterns and palettes from a set of images and apply them to any other one. You could have a photo of your cat rendered in the "style" of Van Gogh or Picasso. There's something uncanny going on there because, what could be more human than style? Was not that precisely the most personal, the most unexplainable thing for classic art? The style, like a signature, was intimately tied to a particular artist, it was that which *made* them an artist, which made them unique and different from all others. And now a lowly machine has somehow grasped the van-goghism of Van Gogh in a fairly convincing fashion, and is applying it to a picture of my cat. The summit of humanness reduced to an algorithm– albeit to one we can't directly see or analyse.



Fig. 5: Style Transfer. The same image, rendered in the styles of Van Gogh, Picasso and Munch.

So, it is true that automata are made by humans, but that's not *the whole* truth. Because humans are also made by their automata, their machines, and their tools.

They are shaped and defined by them. Their affordances, their bodies, and the ideas they have about themselves are changed by the technologies they use. We should also ponder if we are really in control. We certainly like to think we are but, as we remarked at the beginning, we are all aboard the unstoppable train of technological change, and nobody seems to be guiding it. The billionaires at Silicon Valley, they have a lot of power when it comes to deciding which technologies are developed and which of them reach the market, but they don't see the future. Even they don't know what the automata will end up becoming, how will humans be transformed and what world, if any, are we going to build together.

We need to think about the complexities of the times we are living beyond both the acritical enthusiasm and the paranoid rejection of technology. Machines and digital systems are not pliable slaves, but they are not evil masters either (not yet, at least). The work with generative systems in art is a way to begin thinking about a universe where humans are not the centre and origin of everything that matters, but one more node in a complex network of human and non-human agents. It pushes open the doors of that mysterious enclosure that was artistic creation, letting chance, uncertainty and lack of control in. While doing that, it shifts the attention from the work itself to the space of possibilities defined by the generative system and its unlimited capacity for variation. It is an open experimentation that addresses at once the growing powers of automata, the very nature of that thing we call "art", and possible new ways of living, doing and being human in the ever more diverse, complex and perplexing world we are all heading to together: objects, plants, animals, people, machines and artificial intelligences.

Notes

[1] See for example https://www.theatlantic.com/technology/archive/2017/08/a-sitting-phone-gathers-brain-dross/535476/

[2] Solomon "Sol" LeWitt (1928-2007), American artist whose work has been linked to minimalism and conceptualism.

[3] Sol LeWitt, *Paragraphs on Conceptual Art*. Artforum magazine, June 1967. Available online at http://www.rednoise.org/pdal/uploads/Paragraphs.Conceptual.Lewitt.html

[4] Sol LeWitt, *Wall Drawing #86: Ten thousand lines about 10 inches (25 cm) long, covering the wall evenly*. First installation at The Bykert Gallery, New York, June 1971.

[5] Jack Burnham, *System Aesthetics*. Artforum magazine, volume 7, no. 1, September 1968.

[6] Hans Haacke, *Blue Sail*, 1964-1965. Currently at SFMOMA, San Francisco, USA.

[7] Alexander Mordvintsev, artist and researcher. Currently engineer at Google. Personal website: https://znah.net/

Grammatichetta di Pescasseroli
The Dignity of the Dialect

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My passive knowledge of the language of Pescasseroli, as treated in the "Grammatichetta di Pescasseroli" was early acquired in Rome from reciprocal language interaction of my parents, who were born and grew up in Pescasseroli in their respective neighborhoods 100m. apart. My active performance in the language began at the age of 10 with my mother's side of the family at our ancesteral home (Ca' Margiot) where we sought refuge from the bombings and the war raging around Rome. Pescasseroli is located high in the Apeninnes about 50 miles from the winter line of the 1944 WWII battle front around Monte Cassino. While there, I attended elementary school with Nicolino d'Adorne (a former mayor of Pescasseroli) and a relative, Mario Di Santo (now living in Los Angeles). To both of them, I owe my early interchanges in the language of Pescasseroli.

Following graduate school in the United States, I felt confident about writing articles on the language that were received in international linguistic journals regarding theories of phonology, morphology, and syntax of P. Theoretically, I follow Kaplan, R., 1989, on demonstratives, which explores the theory of deixis socio-linguistically distinct for men and women, which I observed in the language of Pescasseroli. Kaplan, I believe, recaptures the implications for linguistic theory of grammar along the presupposition of Croce's ' Intention-expression'. Croce's 'intuitionism' and its implications for understanding culture (crucially including 'artistic intention' beyond linguistic expression). Croce's philosophy of 'intentionism'" was furthermore recognized in Language (1921) by Edward Sapir, who commended Croce's philosophy 'intention-expression' as a wholistic conception of culture, its constructions separable and unrepeatable. In later syntax and beyond, most recently, Chomsky's introduction to Andrea Moro, The Boundaries of Babel. .
Today, in Pescasseroli, I consult with Aimone and Rosa Maria Decina, although my first intuitions about the language turn out to be generally reliable.
A synopsis of the birth and 'eternal rebirth' of culture is inconceivable in a principle/object 'always in motion'. One can try with image of an architectonic design such as of the façade of Santa Maria Novella by L.B. Alberti. It tells us today in its (apparent) immobility what the 'architect had in mind: one/unique and unrepeatable'. But, on the other side of time, I/you/he may conceive another unique paired mentality guided by our own conceptual world to which we have the right/wrong: Obama/Trump.
A consideration of choices in the 'evolution of the world,' artistic or otherwise, is up to us individually to observe and consider the consequences.

Identity and Diversity Historical Identity

On the etymology of the name of the municipality (Pescasseroli)

Benedetto Croce was one of the first scholars to research the historical-political origins of his native community of Pescasseroli [1] It was Croce who tried his philosophical hand at the knowledge then guided by the illustrious Italian historical linguist Graziadio Isaia Ascoli, on the alternative denominations Pesclum Asseroli, Pesculum ad Serulum. Croce himself proposed his own reliable etymological hypothesis. "As skeptical as I am in terms of etymological conjectures, I will turn the two just exposed with skepticism, but also the third one that I propose here: that Pesculum ad Serolum (which at least once is written Sarolum) is the narrow foot 'pass' near the Sangro (lat.Sarus), which is born not far away and flows under that mountain, still poor in water, still small (Sarolus, small Sangro). I know the objections that can be raised , but in any case this conjecture can stay with the others, with respect to which, moreover, it has the advantage of responding well to the geographical area of the "Peschio" (lat.pe[de]sculum) sul Sangro (lat.Sarolus') "[2] (cf. a similar prefix elsewhere Pescosolido, Pesco Costanzo,(v. Sabatini).

Diglossia of Gender

(men / women) in the indexicality (deixis) of the 'intuitive' communicative linguistic act, in particular the form of the definite article (a) and that of the demonstrative adjective (b). In the community of Pescasseroli, the language of women (a) varies from that of men (b) in the linguistic act of "cognitive intuition" through "linguistic expression ". The demonstrative "deictic system" indicates the 'distance' (real or presumed) between 'the speaker' and 'the one who' listens' in the act of communication [3]. Some examples and the distinction between the deictic system of language (expression) of women ('ternary') and that of men ('binary') follows. (It should be noted that this particular distinction in the deictic system of expression occurs only in Pescasseroli among the surrounding communities of the wider Marsica region, consequently excluding an indigenous origin, at least for the definite article in the 'grammar' acquired in Pescasseroli as first language of birth (L1).

Diglossia in Deixis in Pescasseroli

U men (binary) / D women (ternary)

Determinative article:
(a) a [peškə]: shepherds of transhumance (Puglia), Arbëréshë
(Men /**a/**)
(b) se [péškə]:
women from Scanno (cf. 1780: Zu Matremonio) (Women /**se/**)

Demonstrative adjective:
(a) **quiste** m.s.' this (dog) here' (near the speaker) Uomini e Donne
(b) **quíšche** m.pl. 'these dogs here'**, dèqqeta**
(around (indet.) the around speaker
quísse m.s. dog **èsse, dèsta** (indet. by the listener) D
quíšše m.pl dogs det./indet.(by the listener) UD
(those dogs (far from the speaker / listener.) UD)
dèlleta (far (indet./away from speaker /

listener) UD)
‘there (if) ‘m.s.det., away from the speaker / listener D
quísse/quéssa m/f.s.det.(far from speaker / near to those who listen)
lóche, dèsta, dèlleta (indet. far from speaker / hearer) UD
quíšche cane ècche (dendre / fore, indet…), **dècqueta** UD
‘these dogs here (inside, outside, around),indet.) UD.
(c) The origin in the classification of the Italic branch of the Indo-European language family among the languages of the world for a plausible official etymology of the municipality of Pescasseroli [4]
Italic>
* Oscan-Lucano-
* ped(iscul)um) ‘ /narrow foot passage (on the Sangro river))
pesc(u)lu /(fall of short penultimate syllable
peskju ((kl> kj semivowel)
peške / palatalization skj> škë (a /se Péšche (orthography))
(* Italico- (cf. Lat. pĭskem> It. pesce [péʃʃe]
Osco (lucano) * 'pĭʃke)

Consider, in addition, that in today’s Arbëréshë (ie /Albanian dialects, prov. Avellino. * Peshke means 'fish' and the possibility of an equivalent origin (*Indo-European) and the etymological consequences for the origin of the common name of our town , extended to 'passage' between the mountains to the Latin name river Sarus (Sangro), still small, Sarolus (see Croce’s conjecture).

‘Intuitionism’

It is of the philosophical direction of 'Italian neo-idealism' in the sense that for Croce [5] language, (like aesthetics) is a perennial creation ('intentional act') of double, unrepeatable and inseparable articulation: intuition-expression / (the spirit does not intuit except by doing). In this respect, Crocean's thought on the nature, both of art and of language, is in contrast (in its time and in principle), with philosophical positivism in the nascent 'linguistic structuralism' [6] which seeks the regularity of language only in the morpho-syntactic 'structure' of expression, independently of any 'mental act'. The immanent character of the linguistic (and artistic) act excludes ‘translation’ or exact ‘repetition’ [7]
“Every translation, in fact, either denies or fails; that is, it creates a new expression. In the first case the expression always remains one, that of the original, being the other more or less deficient, i.e. not a proper expression; otherwise, there would be two expressions, but with different content.

”This understanding of the nature of language was acclaimed by the patriarch of American anthropological linguistics, Edward Sapir, who noted the contribution of Croce’s thought, in what became the reference for the student of linguistics in America a century ago [8] :

“Croce is one of the very few who have gained an understanding of the fundamental significance of language. He has pointed out the close relation to the problem of art, the psychology of thought and in the strange cumulative drift in the life of the human spirit: that we call history or progress or evolution. The value depends chiefly on the unconscious and unrationalized nature of linguistic structure.”

Identity in the Lexicon

It was Dante [9] who experimented with

the language of use.
The question returns with the unity of Italy, as a legal state, when Cavour and D'Azeglio corresponded in French and Alessandro Manzoni in a letter to Bonghi expresses an opinion contrary to that of Dante. This is repeated today in communities where more than one linguistic identity coexists, such as the European Union or the Albanian municipalities in Italy. I know one can raise the issue of language / dialect. Such a discourse would recall aspects of political-social hegemony in Gramsci's philosophical thought [10]

The Order of the Letters

It was Leon Battista Alberti [11] who promoted Italian,, instead of the medieval Latin proposed by Flavio Biondo)' proving with his 'grammar of the 'toscano language' that the common language (Dante's *vulgaris)* is also grammatical, like Latin, a variant of the biological faculty of the human race. Recent research in bio-linguistics [12] defines human language as an organ with the dual function of the formation of thought and its expression in the diversity of representation systems. oral and / or (ortho) graphically coded. These are the linguistic systems (grammar) devised, developed, acquired and handed down from generation to generation: evidence of the universality of human language responsible for communication at the time of Caesar Augustus or Barack Obama.

Linguistic Identity

scripta manent (verba volant)
Following a similar academic and cultural interest, as a descendant (sensu lato) of Pescasseroli, this essay is proposed as the subject of a new investigation on the origins and evolution of the community of Pescasseroli: its 'identity' conceived in the sense of the ethnic-cultural relationship through the grammar of its language and kept in the rhythm of its lexicon, in the context of the diversity of expression and mutual understanding. To this end, this study aims to be a point of arrival and departure towards the codification of the innate knowledge of the present human and socio-linguistic community in Pescasseroli through a proposal of reasoned spelling to transmit to our posterity, consistent with the dialectic of Crocean intuitionism, assisted in the same direction by scientific research by recent neurological observations of the mirror neuron in the macaque phenotype. [13]

Speech and the Development of the Alphabet

"But above all stupendous inventions, what sublimity of mind it was who imagined finding a way to communicate their innermost thoughts to anyone, although distant for a mighty interval of place and time! To talk with those in India, to speak with those who are not yet born for a thousand or ten thousand years; and with what facility, by the different arrangements of twenty characters upon a page!
Let this be the seal of all the admirable inventions of mankind."
Galileo Galilei [14]

Why and How to Write in the Language

To write and document our human identity in its socio-cultural context properly expressed in the lexicon and rhythm common to Pescasseroli's language. For the identity of the bilingual contact with the language of Italy it is urgent and useful in a world of linguistic and cultural diversity, although destined

(alas!) to the globalization of identity. To this, but not least, an orthography of Pescasseroli's speech is proposed that is both descriptive and contrastively faithful to the historical phonological rhythm of that spelling of the national language that we already know to our advantage. To this, but not least, an orthography of Pescasseroli's speech is proposed that is both descriptive and contrastively faithful to the historical phonological rhythm of that spelling of the national language that we already know to our advantage.

Cultural Vocabulary

Dario Fo, Nobel Prize in Literature 1997
"I think it's a good idea to teach the child the spoken language of his/her land of origin."
de la sòa tèra, parché cognóser la propria parlada d'origen ol segnéfega rescìrsce a la granda dol lenguàz de nüng, de le svérgule del idióma e del basement de la cianciàda del parlar comün che nel caso nostràn a l'è l'italiàn. [14]
b. Free version and comment in the language and culture of Pescasseroli (A. Decina, R.M. Tullio)
Nu, pešcarùle, mbreséмbia, ne chiamáime abruzzése perché sìme nàte ì cresciùte sótte a nna cheltùra latina, ì pùre longobarda, tandà ca mmézz'a dialètte nostre se so mmešcate quàcche paróla tedešca, ma chiù mùnte latìne.
(Translation:: We people of Pescasseroli, for example, call ourselves 'abruzzans' because we were born and raised under a latin ,and also longoboard, because, in our 'dialect, you find some Germanic words, but many more Latin)

Diversity <=> Identity

It is a two-way relationship. The historical and geographical origin of the people of Pescasseroli has its roots in the transhumant society of Abruzzo, uniquely in that last variant of the large sheep track that came to frequent the pastures of the upper Sangro valley in the millennial tradition. But when, who they were, and in what language they communicated, suggests a double research thesis anchored to the socio-linguistic context of the present situation of diglossia in the community. In this regard, only in the Pescasseroli language, there is a dual system of expression of the deissi in the grammatical register of women (quíse cane) and that of men (quìa cane) (see Saltarelli 2016). This thesis aims to explore the hypothesis of an origin of our identity in a context of diversity. That is, in Pescasseroli, the language of men and that of women can be partially and permanently distinguished. The philological evidence (if <lat. Ipse) suggests the ancient deixis of the article that was used in Scanno in the eighteenth century. For the deixis of men (**a** cane **, a** café **) T**he origin is still uncertain. Who were and where did the first shepherds of the tratturo come from who traveled with their sheep to our pastures and stopped? What was the occasion that will give rise to Pescasseroli's cultural 'identity'? And which of the languages of the tratturo they spoke will be able to illuminate today's linguistic diversity, to be proved by a parallel study on the respective genetic variants of the transhumance populations. [16]

Diglossia a Pescasseroli. Two distinct (in form and function) grammatical systems of deictic reference are in coexistence a Pescasseroli identified with the adult population of men (a) (cf. above) and women (b), but still in need of

sociolinguistically identified evaluation.

Uomini	Donne	
a cane	**se** can	det..
quia	quise	distal
	quisse	prox. to interlocutor

'binary' 'ternary'

For a geometry (or mental knowledge) of the reference theorem. The double thesis in the trial in search of the origin of diglossia in Pescasseroli among the particular type of the "deixis" [17], that is the use of the demonstrative (see (1) still in use today in the speech of men 'with two terms' (quiste, quía), as opposed to that of (b) women 'with three terms' (quíste / quísse / quìse \) requires a theory of interpretation that does not seem to have anything to do, in this case, in the genetic difference between men and women, but which prescribes access to the context of the discourse. Furthermore, the recent directive in research on the evolution and development of the natural human species raises a radical question: because only us [18] Why only we of the human race possess the ability to acquire language, with the same skill of success necessary for the languages of Abruzzo, Italian, Mandarin, Bantú, Papago, Quechua, etc. The hypothesis on each language of Abruzzo claims the same capacity from each of us as a human being: that of acquiring an 'organ' (language) that allows us to think in silence or to express an 'identical' thought through a ' diversity of systematic vocal gestures or written signs. Leonardo da Vinci identified the origin of the 'voice' in the vocal folds of this in his notes on anatomy (with a syllabary of the Vocal-Consonant permutations added at the top of the page, 1510-). He, too, sought a codification of a personal linguistic expression for his anatomical discoveries. Leonardo achieved it individually in an alphabet of mirrored letters written from right to left, according to his natural neuro-biological preferences.

The Speech Act

(Croce 1908: 10-11; Sapir (1921, Austin 1955, Searle 1969).
Croce recognized the linguistic activity of the mind (spirit) as a double and inseparable intuition-expression act: "the spirit does not intuit except by doing, forming by expressing "Language is perpetual creation "and therefore the impossibility of translation (76), even if" good ones are made "). Crocean intuitionism did not at the time welcome interest in general linguistics, dedicated to historical reconstruction and the pressing Saussurian structuralism. The only exception among the linguists was E. Sapir, Language (1921, see above):
"Among contemporary writers of influence on liberal thought Croce is one of the very few who have gained an understanding of the fundamental significance on liberal thought of language. He has pointed out its relation to the problem of art. I am deeply indebted to him for this insight. [19]
"Every language I, in itself, a collective art of expression. There is concealed in it a particular set of esthetic factors: phonetic, rhythmic, symbolic, morphological, which it does not completely share with any other language. The artist's "intuition", to use Croce's term, is immediately fashioned out of a generalized human experience, thought and feeling. [20]

Sapir, the anthropologist linguist, thanks Croce, the philosopher of aesthetics, for having contributed fundamental concepts on the nature of human language, in particular the impossibility of an 'exact' translation, 'even if good ones are made'. The Crocean theory of "intuition-expression" for language returns with J. Austin, 'How to Do Things with Words' 1960, and J.R. Searle 'Speech Acts' 1969, 'Expression and Meaning' 1979. Both philosophers of language tend (in our opinion) to articulate Croce' "intuitionism", as an action (the act that the speaker 'intends' to address to the listener through the expression. An approximation of the Act-expression follows, although in practice the intention of the expression can be vague. For example, with the type (6) 'please' a passenger expresses himself politely with an 'interrogative' expression (2a): do you get off? 'request' or directive (2b) addressed to the interlocutor with the intention of having him move'. The respondent can respond in the affirmative (and does not move) or in the negative (and moves to let her pass). Thus with "perlocution" you avoid a rude imperative 'lèvat'èsse!'.

1. Assertive (as things are*) "the 'postale' arrived at two o'clock".*
2. Directive: (a) Question, (b) Request (a) "*addónna va? (b) statte zítta!*
3. Commissiver, Promissive (promise) *te dénghe na bèlla cùsa!? Se m'ajùte*
4. Expressive *how beautiful! but, I don't like it!*
5. Declaration *I declare you husband and wife!*
6. Perlocutive: (courtesy on the tramway*) 'scende'?* (Expression 2a, Intent. 2b)

Crocean intuitionism is the intended basis of the "Lemmario cum Grammaticchetta" Albertiana that we develop for Pescasseroli. For each lemma (the set of over 4000+ entries with (in spelling, phonetics, morphology, syntax, meaning in Italian and use in "(expression) - intention" in the language of Pescasseroli, according to the Act / Action (Intention- Linguistic expression (1-6). The proposal is intended to be a first cultural approach, towards "intuitionism", in the Linguistic Act (intention-expression), in the guiding light of the geniality of Benedeto Croce. along with a phonologically based orthography of the current speech of Pescasseroli.

Synoptic Table

example letter-sound (P) V. 'lemmario)

[a] a accattá ('to buy)

[e] e nétta ('clean pp fem)

[ɛ] è na fèlla de pane (it is a slice of bread)'

[ə] pelletrílle (colt)

[o] cótte, chiórte ('cooked' m.', it's crocked m.)

[ɔ] còtta, chiòrta (" coocked f. crooked f.)

[i] í, i j rítta, arrivata (streight/ppf/arrived/ppf,)

[ɨ] ì pìne, vìne spartì ("pine,wine, share)

[u] ú, u cúrte, fúnne, nù (short, deep, us)

[ʉ] ù fùne, fùte, cavùte (roap, thick, hole)

[p] p patìte, péttela, pile (clog, shirt?, hair)

[b] b buscia (pocket).(v. lemmario di Pe grammatichetta)

[t] t size. treat, twist

[d] d dècqueta, dapù, dòdda

[k] c (_a, o, u) house, thing, coat

ch (_i, e,) chi, chióve, chiàne, vàcche,

[g] g (_a, o, u) conga, angáura, *g-

gh (_i, e) lúnghe, ténghe, vínghie

[tʃ] c (i, e) cìce, cèra, ceciótte, cc (-i, e,) c (c (i, e))

[ʤ] g (__i, e) gènde, gísse, Geràrde g (g) i, e)

[ts] z zítta !, púzze, arrízzate !, jetèrza z (z)

[dz] verza, pènzace, nzìne z
[f] f the face, mbàccia f> b assim. to the N of in _ _
[v] v la vócca, mmócca v> m assim. to the N of in #
[s] s strangest ?
[z] s sderrepatùre
[ʃ] sc (i) scì 'yes' /, scígna, sciótte, càscie, càscie / càsscie, ssci (i) 'lo scì'
š (__c, ch) ščàppa / scàppa, Péšche, fíšche, mescíšca, ščùma, mmešcà, ščàffe,
[ɾ] [r] r rr morre/more, core/corre
[l] [l] l ll call, calle
[ʎ] gli vóglie, píglie, glie, fíglie
[m] more, morre, dies, flocs of sheep
[n] n mónna, remonna
[ɲ] gn cúgne, gnótta / gnútte
[ŋg] ng (<nc) ngàpe, ngànna
[ɲʤ] ngiànguela, me ngènne
[nd ndènne,
[nʣ] nz (<ns) nzìne, nzèmbra, nzàcca, nzómma
[mb] mb (<nf) mbecà (fàuche), mbàccia (face), mbrónde (frónde)
[mm] mm (<nv, nm) mmócca (in the mouth), mmàne (in the hand)

the graphic accent mark on the tonic vowel of the word

magnà, màgna, màgnala!
magnà, magna, magnala)
v. Sabatini-Coletti, De Mauro

The Historical Spelling Alphabet and the Phonetic Alphabet

For an orthographic encoding of the variants of the spoken language of Pescasseroli in their origin, evolution and differentiation in today's use.
Vocalism: the duration and the gesture
-metric, 'reinforcement (commutative realignment (a + b) = (b + a))
It. The coffee # fòrte V # C:
P. a cafè # fòrte V: #C
-vowel harmony (metaphonesis and syllabic rhythm: equivalence)
-reduction of the auditory gesture (the vocal folds)
- restrictions on constricting (the oral cavity) Chapter 1: Sounds, words, phrases, and the speech act
from thinking <=> to encoding a speech spelling

Sounds, words and phrases: identity and linguistic diversity
The sounds and the letters: the two alphabets
Words and phrases: from idea to speech
Sounds and letters: two alphabets (equal but distinct):

(a) (i) Phonemes. The minimum units of rhythm and speech articulation.
(ii) Allophones. Real sounds: their production and perception of the phonemes
(b) (i) The letters. The symbols and signs of writing: how to write in the alphabet.
ii) The alphabet. A reasoned coding (an orthography) to write in the language of Pescasseroli in accordance with other languages.

Articulatory reduction: the inarticulate vowel (letter e-mute) (inactivity of the articulatory gesture in the vocal cord)
Glottis strike, absence of "vocal gesture"
Context: un / in-stressed syllables, except / a / Saltarelli: [salta'rel]

fortis / lenis : vì.ne / vín.ne, fù.te / fútte
Context: closed / open syllable mì.te / mít.te

Reduction of 'tension' in open syllables (for high vowels í / ì, ú / ù)

(for Pugliese and San Valentino / á / à /: cà.sa, cánde
metafonesi / syllabic harmony: bél.le bèl.la), for n <n bù.ne bó.na

Context: Root <Suffix. The vowels

The origins and evolution:

Diachronic vocalism
ī ĭ ē ĕ ā ă ō ŏ ŭ ū Classical Latin (as an example)
I iː i eː e aː a o oː u uː phonetic alphabet: long / short (duration) (IPA)
| | | | \ / | | | | Aː / a FUSION, from quantity to quality
II i ɨ e ɛ a o ɔ o ʉ * proto-novel: i / ɨ, e / ɛ, o / ɔ, / (mid vowels: open/closed
| \ / | | | \ / | FUSION of the phonemes i , u/ ɨ, ʉ / high V (tense/lax)
III i e ɛ a o ɔ u Italian and Marsicano (fucense)

Note. Pescasseroli's tonic vocalism corresponds to stage II, a system
pronunciation closer to that of Latin (= * Italic, * IE) and older than that
of the Italian and of the Fucense Marsican, as there persists the distinction between the ī / ĭ, ū / ŭ.

This aspect of the pronunciation of Pescasseroli can be considered positive and hitherto unpublished evidence
in favor of the reconstruction of the system II. On this diachronic theme see Devoto (1974: 174 with reference in note to Lausberg, 1961).
(4) Latin reflexes (I) in the lexicon of P (II) in contrast with Italian (III):
fīcus / cĭcer, mūrum / nŭcem I ī ĭ ē ĕ ā ă ō ŏ ŭ ū Latin
| | | | \ / | | | |
fjícuera / cìce, mùre / nùce II i ɨ e ɛ a ɔ o ʉ u * Pescasseroli
| \ / | | | | \ /
figs / chickpeas, wall / walnut III i and ɛ a ɔ o u Italian

Thus, from the historical outcomes of the lexical vocalism of the Romance language in the neo-Italic variant (of the Indo-European language family) still in use in Pescasseroli, we can observe a system of nine phonological entities, corresponding to the diachronic system (II). They are divided into two complementary prosodic contexts, synthesizing the synchronic system of 'distinctive sounds in the seven-phoneme Pescasseroli lexicon, equivalent to that of Italian
(5) Semi-open pronunciation of vowels / i u /
/ a ɛ and i u ɔ /
/ \ / \ vì.ne / vín.ne, fù.ne / fún.ne
[a ɛ e ɨ iu ʉ ɔ]
/ i u / have an open sound (of one degree) [ɨ, ʉ] at the end of the syllable: vì.ne, fù.ne
The five distinct vowels (phonemes) in tonic syllable (6a) are systematically analogous to those of the Italian etymological lexicon. We illustrate each of them in their international [phonetic] alphabet (IPA) (6b) and in the corresponding orthographic alphabet that we propose for writing the speech of P (6c). The coding of the proposed system is conceptually consistent with the orthographic conventions of the national language, except for the variations dictated by the phonological system of P.
(6) Vowel phonemes (a) and the contextual (real) sounds [(allophones (c) le corresponding *letters* in stressed/unstressed syllable.
(a) Phonemes i u é è ó ò a/ /\
/\ /\ | | | | |

(b) i foni: [i ɨ u ʉ e ɛ o ɔ a]
| | | | | | | | i |
(c) le lettere: *í ì u ú è è ó ò à*
(7) The articulation of phonemes i tn the geometry of the oral space anterior central posterior (back)
ɪ. _____**.u** close (high)

\ | |
é._____ ____ middl (-close)
| | |
è._____ **.ò** middle (open)
\ | |
_\ **a.** ____ | low (open)

(The articulation of vowels is realized by the advanced position of the in the tip, blade, back (l front [i, é, è] in contrast with back vowels [u, ó, ò], which are characterized by lip rounding. For mid vowels [é, ó / è, ò] there is an additional distinction in the configuration in the aperture in the oral cavity advancement of 'dorsum', (the vowel [a] defined by the the position of the tongue at rest.)
Examples for each vowel: [how to pronounce, how to spell:
description: vowel [how to pronounce] how to spell (Italian)
closed vowels: [i] [ˈrit.ta] rítta 'straight'
closed vowel[e] [ˈnet.ta] nétta 'clean'
mid-v back [o] [ˈvok.ka] vócca 'mouth'
medium-open [ɛ] [ˈfɛl.la] fèlla 'slice'
[ɔ] [ˈkjɔr.ta] chiòrta f. vs .m. [o] [kjórte]
Cf. other open/closed alternation with open/closed mid-vowels
open vowel [a] [ˈspa.sa] spàsa 'flat plate'

Note: The IPA phonetic transcription is usually enclosed in square brackets. The syllabic division in the utterance is marked by the dot. The tonic accent is at the top left of the syllable of greatest prominence (v. 1.1.1). (Further on, we eliminate the point of the syllabic division in the writing and write the tonic accent on the vowel of the syllable itself, except in specific cases.)
The tonic accent and the spelling accent:
Words (lemmas or voices exponents of the lexicon) in the language of Pescasseroli, as in Italian (I), are distinguished from each other mainly on the basis of the tonal prominence of the vowel of one of their syllables. Let us observe the position of the accent at the number (2a) for Italian (I) and (2b) for P. To give an idea, the word consists of at least one syllable, whose sonorous core is the vowel (. ˆ.) [21]
For much of the basic lexicon, words in the neo-Latin and neo-Italian languages are bi-syllabic. The words of more than one syllable, one (and only one) are distinguished by their sonority compared to the others and determine the 'tonic accent' of the word. The tonic accent has a distinctive value in Neo-Italic languages, while in the mother tongue of Rome the accent (stroke) was predictable based on the duration or length of the penultimate syllable. The tonic accent fell on the penultimate, unless it was 'short', in which case the accent fell on the previous one. For the distinctive value of the tonic accent in Italian, as can be seen (a, b, c):
(a) it happens:. . ˆ. ˆ. (b) happens:. ˆ. . ˆ. (c) happen:. ˆ. ˆ. .
càpeta [ká pə ta] capìta [ka pɨ ta] capetà [ka pə tà] P

For the purposes of an orthographic alphabet faithful to the phonics of Pescasseroli's speech, the graphic accent of a word is indicated on the vowel in direct correspondence with the tonic accent (the highest peak of relative sound pitch among the syllables of a word (ˆ): càpeta, capìta, capetà (~ it.

'capita', 'capita', 'capitare') (v. (2)). Thus in the writing of Pescasseroli's lexicon) the prosodic type: proparoxitone (accent on the third last), paroxitone (penultimate) and oxytone (last) are uniformly indicated on the lemma by the graphic accent with the relative didactic needs in identifying the word, by its pronunciation and interpretation, as well as by 'how to write it'. this lexicographic decision we follow the scientific practice of dictionaries of the Italian language and with neo-Italic needs [22]

This convention on when to mark the accent on the word is not faithfully followed by the spelling alphabets used in the languages of the world. In fact, Italian by historical norm marks the accent only on the oxytone words 'understood, understood, happened', with related didactic problems. Spanish, on the other hand, marks (with an acute sign) both the truncated and the slips ánimo, animo, animó with rules for writing that are difficult in spelling learning for second language speakers, but also for native speakers. Extreme is, then, the spelling of English, which does not know the graphic accent at all, not even in the case of functional contrasts in which the spelling lemma convict with a tonic accent on the first syllable has the meaning of noun ('prisoner, convict'), while with the tonic accent on the last syllable convict is interpreted as a transitive verb ('to plead guilty (someone)').

Generally, the alphabets for writing national languages are not always faithful to the phonetics of speech, sometimes due to the phonological evolution of speech over the generations or academic institutions.

From what has been said, an optimal spelling of the distinctive tonic accent would follow the uniform application of the following rule in writing. The historical Italian alphabet marks the accent on the last syllable of 'cantò' to distinguish it from 'canto' by excluding oxytone words from bi-syllabic paroxytones. The distinction between paroxyton and proparoxytone is not implemented in the historical alphabet of Italian (see (2a / b above, understood (1ps), understood (prt. marks the accent both on the oxyton and the proparoxiton: ánimo, animo, animó.

For the lexicon of Pescasseroli it is proposed to follow either the norm of some Italian dictionaries (see Zingarelli (10a)) in which each word marks the tonic syllable, or the more rational rule of Giammarco, which does not mark the accent on the penultimate (10b), or that of the Italian, which only places the accent on the oxytone (10c).

(10) the spelling accent on the tonic vowel of the word

(a) magnà, màgna, màgnala! Zingarelli, (Sabatini Coletti, De Mauro),

(b) magnà, magna, màgnala! Giammarco

(c) magnà, magna, magnala (? see Principal of P. for the practice in our school)

The open / closed pronunciation of vowels: è, ò / è , ó:

Making use of a uniform use of the spelling accent, we will use the grave sign (`) for the tonic vowel à, which is always of maximum oral opening. We will use the grave accent to indicate the relatively more open sound quality of the middle vowels (fèlla, chiòrta) in contrast to the acute sign (´) for the more closed quality of the same vowels (nétta, vócca). The open / closed vocal phonetic trait has functional value for middle vowels, in a form similar to Italian (è / e), in whose written norm its use is not generalized. In

fact, in Italian the lemma 'pesca' / 'pɛska / "fruit" is not homophone with "fish activity" /' peska / from which it is lexically distinguished by the tonic vowel is open phonetically in contrast to the closed é. Already the grammarians of the sixteenth century considered this lack in the spelling of the Italian language at the dawn of the language question.

In short, in the representation of the language of Pescasseroli, the orthographic accent of a vowel will indicate not only the tonic prominence in the word but also the open or closed pronunciation of the letters and/or, with relevant descriptive considerations. The present orthographic coding also wants to be analogous to the French norm which indicates the greater or lesser opening of the oral cavity in the pronunciation of the middle vowel and through the normative use of the accent aigüe / grave (e.g. élève, précède in which even the absence of the graphic accent on the mute vowel and it has a phonetic function in the deaf, centralized and even 'transient' pronunciation) [23]. Following French norm, we may use the letter e for the orthographic indication of the reduced vowel [ə] in the spelling of the speech of P (see (3, ii)). The use of the grave / acute accent to indicate the open / closed middle vowel is consistent with other studies on Abruzzo dialects [24] felt the lack of the historical alphabet in the distinction between open / closed middle vowels [ɛ / e], [ɔ / o] proposing new letters based on the Greek alphabet (omicron / omega).

(11) The 'grave' and 'acute' accent mark.

the grave accent on open vowels is, ò: eg. fèlla, chiòrta (~ it. slice, crouched.

the acute accent on closed vowels is, ó: eg. nétta, vócca (~ it. clean, mouth)

Note: refer to (3) and (7) for the articulation of the vowel gesture.

A particular feature of the dialect of Pescasseroli is the 'relaxed' (lenis) or semi-open articulation of the high tonic vowels / i u / in open syllable: [ɨ ʉ]. The same vowels are pronounced 'tense' (fortis) in a closed syllable [i u], 'weak' (lenis) in an open syllable.

Note: The concept of 'closed / open syllable' for the "lenition" (fortis / lenis) of high tonic vowels / í, ì /, / ú, ù / should be reconsidered based on the following data. The condition for the lenition of tonic vowels is blocked not only by a consonant in 'syllabic tail', but also by a syllable in 'metric tail', as observed in (a), (b). Consequently, proparoxitons do not undergo lenition.

a) [»(C) VC] es. vín.ne ‘(you) sell’ (b) [»(C) V] es.fù.ce‘ Fuce ’(n.p.)

í.ve.ne ‘drink’ Fú.ce.ne ‘Fucino’

vi.ne ‘wine’ pù.ce ‘flea’

saw ‘see’ was ‘was’

ì ‘e’ ù ‘o’

(12) / a é è i u ó ò /

pronunciation of semi-open vowels in open syllable

[a e ɛ i ɨ u ʉ o ɔ]

| | | | | | | | | which we will write with the low / high accent

à é è í ì ú ù ó ò

Note: (closed syllable, forward accent) vs ` (open/closed syllable fo high V

í / ì vín-ne ‘you sell wine’ /

fúnne / fùne ‘deep /rope

see, see ‘see’ (3pp)

Fùce, Fúcene (person, place)

mùre, múrene ‘die, die’

The phonetic system of Pescasseroli, in its dynamic configuration of the oral cavit,y is represented in the trapezium (13) (14), for the vowels in tonic syllables.

Note the semi-open position of the phonemes / i u / which are pronounced [ɨ ʉ] in an open tonic syllable (see (5), (6, b).

anterior central posterior (labial)

(13) [i]. _____ _____ _. [u] \close /high

\ [ɨ] | [ʉ] | closed semi-open (and centralized) in open tonic syllable in P.

[ie]. _____ _____. [o] middle close

| |

[ɛ]. _ _____. [ɔ] middle open

\ | |

\ __ [to] _____ | open (low)

(14) Examples of short / lenis or open pronunciation [ɨ ʉ] ~ closed [i u] of high vowels (i) / i / and (ii) / u / in short / long syllables. (v.12).

(i) / i /: [ɨ] in sill. open [ˈtsɨ.na] zìna, 'womb'

['mɨ.t (ə)] mìt (e)' (you) reap '

['ɛssəsə' vɨ] èssese vì 'there, you see'

[i] in closed syllable

[ˈtsin.na] zìnna

['mit.t (ə)] mítt (e)' (you) put '

(ii) / u /: [ʉ] in sill. open [ˈfrʉ.ta] fruta 'wound (to the head)'

[ˈvʉ.t (ə)] vùt (e) 'elbow'

['mʉ.və] mùve! 'muoviti!'

['krʉ.də] crùde' raw '

[ˌKwe 'vʉ] que vù? ' What do you want?'

/ u /: [u] in sill. closed [ˈfrut.ta] frútta 'fruit'

[vut.t (ə)] vútt (e) '(you) push'

['vut.ta] vútta! 'Push!'

['vut.ta.nə] vúttane! 'Push us!'

['mu.və.tə] múvete! 'Move1'

The result of the phonetic splitting in short / long syllabic position results in a wider contextual range of sounds in the system of tonic vowels of P than in Italian, as well as in comparison with other variants of the Marsica.

This synchronic phenomenon in the speech of P recalls the pronunciation of these short vowels by nature in the etymological lexicon of Latin, eg. lat. facĭlis pronounced ['fa.kɨ.lis] (' penultimate short, tonic accent on the third last) [25] The same splitting of Latin short vowels is reconstructed as a phonemic contrast of the proto-vowel. [26] The particularity of this phenomenon also in P would suggest that it is an archaic residue in the evolution of the proto-novel), in particular that of the phonemes / ɨ ʉ / ((stage II, see 1.1.1) reduced to phonetic alternation [ɨ ʉ] in short ~ long syllable ['mɨ.t (ə)] / [' mit.t (ə)] mìte / mítte 'reap / put'.

The approximation to this etymological reflection in the dialect of P is extraneous to the novel domain and difficult to perceive from an Italian monolingual, but attested in other languages. In fact, in English meat / mit [miːt] / [mˆt] 'meat / glove from baseball' approaches the acoustics of mítte / mìte 'put / reap' in the pronunciation of Pescasseroli. The effect on closed tonic vowels / i u /, illustrated in (3), is attributed to the structure of the syllable. If the syllable is short, the vowel is also short or 'weak', otherwise the closed vowels are pronounced as in Italian. So the oxytones in ‘vù ‘? 'Do you want to come with your aunt?' Are always pronounced 'weak' being the tonic vowel at the end of the syllable and of the word. In the case of proparoxitone (where the accent is on the third to last syllable), however, the vowels / i u / are never pronounced 'weak': vúttane !, múvene (* mùvene). It was gone. The fact that the tonic vowel is always followed by two syllables (mú.ve.ne) make it in a virtually long syllabic position, thus excluding the possibility of ' weak / lenis' pronunciation in words like mú.ve.ne 'move' , fú.ce.ne 'Fucino'. lí.ce.ne 'plum tree', quíne.ce 'fifteen', ú.ne.ce 'eleven', cú.ce.ne, 'cook', e *(e)*

In conclusion, unstressed vowels (except / a /) are 'inarticulate' or 'reduced' in pronunciation, and therefore are not distinguished in hearing one or the other. Indeed, they can also be defined as 'transient' in the rapid style of speech. The landslide of the lingual-palatal joint in the oral cavity is assigned to the central middle vowel identified by the phonetic symbol [ə]. The process of phonetic reduction of the unstressed vowels in the configuration of the oral cavity can be observed in the trapezius (4 ') in contrast to the tonic vowels (3'). Examples that illustrate the reduction of each tonic vowel (v. 3 ') to the vowel of neutral lingual-palatal articulation and, consequently, indistinct to auditory perception. In sum, the 'reduced vowel' consists of the glottal stop in the absence of the vowel gesture. (v. 13, 17)

(17) Unstressed system: dynamic process; reduction from distinct vowels to indistinct [ə].

front center rear

._____ _____. closed (high)
\ | | hi
\ | |
middle
\ | I u high-close
.___ e | o____.middle-open

\ | |
\ __ [a] ___ | open (low)

(18) Examples of tonic / atonic contrast (processing of table (4))

Examples of tonic / atonic iteration:

vowel pronunciation and enunciation of closed vowels

Sounds Letters

i] / [ə] [ˈvin.nə] / [vən'nɨ.tə] í / e vínne / vennìte ‘sell / sell’

[ɨ] / [ə] ['dɨ.tə] / [də.'ta.lə] ì / d (e) tàle ‘finger / thimble

Rear/back

Sounds Letters[u] / [ə] ['frut.ta] / [frət.'ta] ú / e frútta / fr (e) ttà / fruttare’[ʉ] / [ə] ['fʉ.mə] / [fə.'ma] / fùme / f (e) mà ‘fumo / fumare

Middle vowels: Anterior

Sounds Letters

[e] / [ə] ['net.ta] / [nət.'ta] é / e nétta / nettà ‘pulita / pulire’

[ɛ] / [ə] ['prɛ.ta] / [prə.'ta.ta] / è / e prêt / pretàta ‘stone / stone blow’

Rear/back Sounds Letters

[o] / [ə] ['kjo.və] / [kjə.'vʉ.tə] ó / e chióve / chjevùt (e) ‘piove / piovuto’

[ɔ] / [ə] ['pɔr.ta] / [pər.'tʉ.nə] ò / e pòrta / p (e) rtùne ‘door / gate’

Open vowel:

Central (low)

Sounds Letters

[a] / [a] ['ka.sa] / [ka.'sar.ʧa] à / a càsa / casàrcia ‘house / shed (the shape of a house)

From a comparative point of view, the reduction of the unstressed vowels (except / a /) in the pronunciation of P precludes the acoustic perception of the basic phonemes (1-2), unlike the Italian which looks at the sound in the expression. Consequently, the interpretation of the word is less transparent in respect of the intelligibility of the spoken word in our neo-Italic variant. In some cases, the vowel reduction can lead to the restructuring of the etymological lemma. Such seems to be the specific case of the word fruta in the lexicon of P (see (2ii) and Part II, Dialectal Lexicon), which, due to the reduction and loss of the pretonic vowel, its derivative etymology of past participle in - / ut / - of the verb * fer-i-re (* fer-ù-ta /> [f (ə) rʉta]> [frʉta] ‘ head 'wound', is now hardly accessible to paradigmatic learning. The word frùta is a lemma noun non- derivative, the atavistic sense of de-verbal is relegated to the search for the

etymologist.
The effects of the condition of prosodic reduction in languages of the Marsican type (and in a more advanced form in other dialects of eastern Abruzzo, in Puglia (as well as in English) can be better understood with reference to panel (4), where the vowels at margins of the oral space, the seven vowels (3) are well distributed in the oral cavity and therefore of articulation and transparent perception.
The vowel reduction effect, as centralization in schwa (3a)> (3b)) , reduces the intelligibility of phonological oppositions (1) and consequently the comprehension in comparison with Italian, as we have observed with respect to articulatory and perceptive erosion (3 "> 4 ").
The consequence of the phonetic reduction for the writing of the unstressed vowel of the spoken word of P (with respect to Italian) is equal to its phonetic uniqueness: the use of a single sign already existing in the historical alphabet of the national language consistent with the following spelling convention .
Note: The articulation and perception of the unstressed vowel [ə] varies according to (a) the distance from the tonic vowel or the position at the end or beginning of a word where the sonority is no less perceived. The sound volume also decreases with (b) the acceleration of the phonatory process. These two prosodic-motor factors can lead to the complete disappearance of the syllabic nucleus and consequently to the restructuring of the consonant with the adjacent syllables, thus forming a new lemma.
These measures are important for writing in systems subject to vowel reduction such as Abruzzo and other dialects south of this isoglossal. The writer is subject to decide when not to write the letter and in the unstressed context.
The choice of the letter e as orthographical sign of the reduced vowel [ə] (see (4b)) responds to phonetic and practical considerations, but not only. We mentioned above (1.1.3), that the use of the letter e for the reduced or caducous vowel is consistent with the orthographic tradition of modern French: a phonological system which, like that of P, normalizes in its written convention the evolution history of unstressed vowels through the silent (indistinct) or transient e [27] In the prestigious tradition of studying the eastern Abruzzese dialects [28] makes use of the e for the indistinct vowel [ə] (nére), while in the volumes on the Abruzzese lexicon [29] Giammarco favors the phonetic symbol itself ə (nérə). It should also be noted that in the Italian linguistic tradition the vowel reduction is also represented by the sign of the dieresis nérë [30]
This essay collects the descriptive requirements of the phonetic alphabet and the accessibility of a commonly used spelling alphabet in the rigor of the Abruzzo tradition. As a practical principle and with didactic purpose, the data will be written in the two alphabets, that is, both in phonetic transcription (IPA, SIL Doulos) and in a coded spelling suitable and useful for writing and reading the Pescasseroli dialect: eg. the sound transcription according to the IPA universal phonetic alphabet ['nɨ.rə] will be written nìre' black 'in the orthographic alphabet coded for the language of Pescasseroli and, possibly, extended to the variants of the other languages of Abruzzo. (see the synoptic table at 2.2.13 (48)).
METAPHONESIS of the tonic vowel: bèlla / bélle F / M, strétta / strítte F / M
A phenomenon typical of the Italian

central-southern Italian dialects, metaphony [31] concerns variations of the medium tonic vowels / and / in the pronunciation in tonic syllable of the same lexical root: eg bèlla ~ bélle, còtta ~ cótte, etc. In Pescasseroli, metaphonesis is conditioned by the grammatical category of the gender F (emminile) / M (aschile) and is valid only for middle vowels. By metaphonesis, the following correspondences (5) are created with the relevant consequences in transparency between the phonemic system (20a) and the phonetic system (20b).
(20) (a) the phonemes: / a ɛ and i ɔ or u /
Feminine metaphonical correspondences

(b) the sounds: [a and i or u]
(21) Examples of the metaphonic effect
(a) The open vowels / ɛ ɔ / [and o] bèlla / bélle 'bella / o' còtta / cótte 'cooked / o' chiòrta / chiórte 'crooked / crooked' quatranèlla (female) / quatranélle(male) /sciòtta / sciótte
Middle vowels / e, o / / [i, u] strétta / strítte 'narrow / o' Frangésca / Frangísche (first. Name F / M)
córta / cúrte 'short ‘
(22) Metaphonesis: dynamic redistribution in the vowel trapezius
front center rear
\.u _____._|_____. u closed (high)
\ ɨ | ʉ | closed (open /’
e ._____ ə _____ meddle close
\ | | “Centralizing” effect
ɛ ._____ .ɔ medlle-open
\ | |
__ ____ - open (low)

The pronunciation of the vowel rises by one degree from the Feminine to the Masculine on the vertical axis of the trapezius (4) (iii). It should be noted that P's metaphonesis makes visible the morpho-phonetic contrast of the Male / Female category, a contrast that in Italian is found in the suffix 'bell-o / bell-a'. It is argued that the realization of the contrast F / M is a fallback constraint on the root in the dialects that favor the reduction (or absence) of the suffix. The metaphonesis of the radical is, in fact, also active in the eastern dialects of Abruzzo where it is conditioned not by Gender but by Number, which creates the contrast.
Phonetic Singular / Plural on the root, since the suffix is inaccessible by reduction to the inarticulate vowel: ['ka.nə] / [' kɛ.nə] 'dog / dogs' [32]
In the position adjacent to the tonic vowel, Lanfranco notes, the reduced vowel [ə] = e may be less perceptible ([ˈtrikkwətə]) in the tríccuete or trícquete script (remember the difficult writing of the Triqt cafe restaurant ['trikkwete]). The term could be defined as the lexicon-semantic calque of the American dance of the 60s The Shake, or coined on the deverbal of the verb trecquetà 'to shake (seismic)', thus recognizing a more faithful phonetic transcription in which the unstressed vowel is just hinted: [ə]. The degree of perception of the reduced vowels is an important fact in the speech rhythm of P, because the unstressed vowel can go so far as to disappear completely in some contexts, with consequent restructuring of the lemma. We have already mentioned above the example the fruta (<[la f ə ˈrʉta]) '(accidental) injury to the head'. We add tratùre / traˈtʉre / <* [təraˈtʉrə] 'tiretto'. It remains to solve the case of the final word schwa, where the vowel tract seems even more inaccessible to auditory perception: [ˈvakə] vàch (e) 'vago (d'uva)', [ˈvakkə] vàcch(e) 'vacche (f .pl.) '. Examples of word pairs in which the phonetic contrast is minimal (in this case in the twinning of the occlusive consonant

[k / kk]) is relevant for a phonological typology of neo-Italic languages.
We also point out that a conflict arises between the physical requirement (minimizing articulatory effort with vowel reduction (5a> 5b) and the grammatical category requirement (realizing the Feminine / Masculine lexical / morphological opposition typical of neo-Italic). The precedence of the requirement to enhance the grammatical category seems even more urgent in other Abruzzo linguistic variants where the vowel reduction (4) affects all the unstressed vowels, including [a]. In Lanciano, for example, the Italian lemma 'acqua 'is pronounced [ˈekkwə], (Finamore 1898: 9 writes écque) an Abruzzese system that generalizes the reduction of all unstressed vowels to schwa, in particular the final [a]> [ə]. In these East Abruzzo dialects of substratum frentano the metaphonesis would respond to the contrast in the category of the Singular / Plural number (e.g. péte grósse / pìte grússe) 'big foot / big feet'), while at P this metaphonic contrast Singular / Plural would not it is observed (e.g. pède jerósse, Sing & Pl).
(24) Summary of metaphonic variations in general f./m. in Pescasseroli
è ~ é bèlla (f.s.) ~ bélle (m.s.)
ò ~ ó còtta (f.s.) ~ cótte (m.s.)
ó ~ ù bóna (f.s.) ~ bùne (m.s.)
é ~ í strétta (f.s.)~ strítte (m.s.)

Semivowels and diphthongs:
The semivowels [j w] in the phonetic system of the Romance languages have different historical sources. They derive:
(a) from short vowels / i / unstressed in hiatus with another vowel: Lat. gratĭa (m) ['gra.ti.a]> [[' gra.tja]> ['gra.tsja] it. 'grace]
(b) from the reduction of the consonant link * kl, pl> kj, pj: Lat. clamare, plenum> Pescasseroli
will call [kja.'ma] 'call', chiàina ['kjai.na]' full '.
(c) common in Italian, are the semivowels of the midVowel diphthongs, a reflection of the vowels
middle lat. ĕ ŏ> * novel ɛ ɔ> it. [jè] [wò] in a tonic open syllable position.
(d) A fourth historical source is that of the 'breakings', which are the etymological reflections of Latin long middle vowels / ē ō / in tonic position. They can resolve themselves sometimes in the homorganic descending diphthong [ej] and [ow].

In the language of Pescasseroli, the only diphthongs are also etymological reflections in open syllables of the long tonic medium vowels of Latin (or of a proto- * Italic / ē ō /> [àj àw]). The most stable etymological basis in some neo- * Italic dialects (in contact with Rome) could be spoken Latin (or * proto-novel). Apparently this type suggests a phenomenon of 'early metaphonesis' that copies the feminine / a / segment from the suffix to the tonic element, reducing the middle vowel to semivocal: / s and r -ai /> [s ai j r -ai]. The hypothesis of the metaphonesis of the gender is productive in the male / female alternations: naira / nìre, spàusa / spùse. But, in other cases the diphthong [àw, àj] does not depend on the female gender: † angàura, nàune, paipe, etc.
We note that this phenomenon has an archaic connotation (†) and of less and less frequent use. Due to its rarity, this 'harmonic' diphthong between the suffix and the root would suggest a historical substratum with Peligne (Scanno), Dalmatian († veglioto), Ro /umeno, but also Apulian and in the dialects of the island of Ischia [33]

References:

[1] History of the Kingdom of Naples, Laterza, 1972, Pescasseroli, pp, 303-358)
[2] cf. Croce 1972 /, p. 309, first edition 1924)
[3] Robert Kaplan, 1989, 'Indexicality'
[4] Croce 1924- Indo-European/Italic (derivational proposal for the language of Pescasseroli)
[5] Croce 1908, 169
[6] F. de Saussure, Course de Linguistique Génénerale, 1916
[7] Croce 1908: 78
[8] *Language* Preface, Ottawa, April 8, 1921
[9] Dante Alighieri: De Vulgari Eloquentia c. 1302-1305, editio princeps in 1577, Paris: Corbinelli cf. Botterill 1996
[10] Ives, P. 2004
[11] (1404-1472; (Petote1996)
[12] (DiSciullo & Boeckx 2011)
[13] (Rizzolatti et al. 1996, U. di Pavia).
[14] (Dictionary of Spelling and Pronunciation, B. Migliorini, C. Tagliavini and B. Fiorelli. Ed. RAI. 1969
[15] From the Corriere della Sera 22 Cronache 22, Sunday 31 May 2009
[16] Cavalli-Sforza, About Us: The History of Human Diversity About. 1993. Mondadori Editore, Milan; Piazza, A., et al. 1988. The Genetic History of Italy. U. of Turin. Ann. Hum. Gen. 52 (Pt 3) 203-13
[17] Svenonius 2006
[18] R. Berwick and N. Chomsky: *Why only Us*. *Language and Evolution*. (M.I.T. Press, 2016)
[19] Sapir 1921, Preface
[20] Croce 1921, 224-225
[21] Albano Leoni et al. 1998: 69
[22] Zingarelli1970: xiii, Sabatini Coletti, De Mauro, Giammarco, Finamore
[23] Grevisse 1969: 8
[24] Finamore 1892, Giammarco 1987, 2008 For Italian, GG Trissino Grammatichetta, 1529
[25] Sturtevant 1940 on the pronunciation of Latin
[26] Hall 1976: 18, v. 1.1.1
[27] Grevisse 1969
28] Finamore 1893: 10
[29] Giannmarco 2008: 221
[30] Devoto 1974: 180,185
[31] Devoto1974: 183
[32] Finamore 1893
[33] Lausberg 141, Tekavčić 70

General Bibliographical References

Albano Leoni, F. e P. Maturi. 1998. *Manuale di Fonetica.* Roma: Carocci
Alberti, Leon Battista, Grammatica della lingua toscana.
Avolio, F. 1996. *Il "neutro di materia" nei dialetti centro-meridionali: fonti, dati aperti.*
Contributi di Filologia dell'Italia Moderna X. 291-337.
Cavalli-Sforza, Piazza A., Menozzi P, and Mountain J 1988. Reconstruction of human evolution: bringing together genetic, archeological and linguistic data. Proc. of the Nat. Acad. of Sci. USA 85:6002-6006.
Cianciusi, W. 1988 .*Profilo di Storia Linguistica della Marsica.* Istituto Dialettologico D'Abruzzo e Molise. Università degli Studi dell'Aquila
Croce, B. 1908. *Estetica come scienza dell'espressione e linguistica generale*. Bari Laterza
Devoto, G. 1974. *Il Linguaggio D'Italia.* Milano: Rizzoli
Devoto G. e Giacomelli I diletti delle regioni d'Italia, Firenze: Sansoni
Dumitrescu, D. & M. Saltarelli, 1998. Two types of predicate modification. Theoretical Analysis of the Romance

Languges. LSRL XXVI, Mexico City, John Benjamins Publishing Company
Finamore, G. 1893. *Vocabolario dell'Uso Abruzzese* .Città di Castello: Arnaldo Forni
Giammarco, E. 2008. *Lessico Italiano-Abruzzese.* Vol. VII del Dizionario Abruzzese e Molisano (DAM). Pescara: Tracce
LEA lessico etimologico abruzzese
DAM dizionario abruzzese molisano toponomastica abruzzese
Hall, R. A. Jr. 1976. *Proto-Romance Phonology.* New York: Elsevier.
Lausberg, H. 1971. *Linguistica romanza. Fonetica.* Milano: Feltrinelli. Pellegrini
Parente, R. 1765. *Zu Matrimonio A Z'USO*. A cura di E. Giammarco, Scanno 1971.
Rohlfs, G 1968. Grammatichetta… Torino: Einaudi
Saltarelli, M. 1968. Marsian vocalism. *Orbis 17, p88-96*
1976. The Marsian Verb Paradigm. *Studia gratularia dedicados a Robert A. Hall Jr.* Madrid: Playor. 245-253.
1987 Genitives in Marsican and Romanian.Tokyo, Japan
1999. Sull'identità linguistica dei Marsi. *Argomenti 19.*
2000. The alternating adjectives of Romance
2001. A constraint interaction theory of Italian *raddoppiamento sintattico*
2007 (?). Count/Mass Nouns in Marsican (?). CIDSM3(?). Cambridge, UK,
2008. Marsican genitives, CIDSM4(?)Pescara
2009. A uniform hypothesis of count/mass expressions: New syntactic evidence.
Proceeding of CIL 18, Seoul, S. Korea
2010 Countability. Bochum, Germania
2011 Spatial Demonstratives, CIDSM6. Cambridge, UK
(appear) Marsican deixis and the nature context-sensitivity in syntax
Tekavčić, P. 1972. *Grammatica storica dell'italiano.Fonetica.* Bologna: Il Mulino.
Trissino, G. G. 1529. *Grammatichetta.* Vicenza: Tolomeo Janiculo.
Vico
Zingarelli, N. 1970. *Vocabolario della lingua italiana*. Bologna: Zanichelli

AdNaan by Jacek Grudzień: An Intermedia Performance

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Abstract

The musical piece *AdNaan* by the contemporary Polish composer Jacek Grudzień was written in 2002 for solo cello and tape, specially commissioned by the accomplished cellist Andrzej Bauer.

The composer's intent was to create a work that would be a certain reflection on the sound landscape surrounding us. *AdNAAN* thus belongs in the so-called ecological music and related concept of *soundscape* formulated by Raymond Murray Schafer. Besides the sound signal, the main musical information carrier, an essential role in this work is fulfilled by the space from which the sounds come. The elements of the soundscape (a recited excerpt from Prospero's monologue from Shakespeare's *Tempest* and passages from Lenten songs recorded in a church in Warsaw) and cello sounds have been recorded on audio tape and digitally manipulated. The piece received a recommendation by the UNESCO International Composers' Tribune in Vienna, gaining world renown as a result.

Currently, new interpretations of this piece are being made, e.g. with solo accordion. The accordion variant of this composition is recorded in the 5.1 surround sound system. To create this version of the work, the tape part was processed by a sound engineer in a recording studio. The instrumentalist recorded the accordion part, to which the sound engineer added several layers of live electronics. The sound engineer used special sound effects that caused the accordion tone colour to blend with tape for a uniform sound of the whole.

The subject of studies and analyses will be the electro-acoustic work *AdNaan* in both its versions.
The composition in its original version, in turn, has become the inspiration for an intermedia performance art.

Key words: intermediality, polish contemporary art and music, body

movement, music choreography, virtual reality, generative music, electroacoustic music

1. The object of study. Jacek Grudzień and *AdNaan*

A Polish composer born in 1961, he collaborates with the Polish Radio Experimental Studio and is mainly associated with theatre and film music.

Grudzień learned composition under the direction of Włodzimierz Kotoński and piano improvisation under Szabolcs Eszténi at the Academy of Music in Warsaw (currently the Fryderyk Chopin University of Music in Warsaw). Though his family had musical traditions, it was thanks to the distinguished improviser that Jacek Grudzień decided to study composition. The moment of meeting Eszténi may be considered, to borrow Mieczysław Tomaszewski's concept of nodal points in the life of the composer, as 'the moment of the first crucial meeting' [9, 10]. Between 1986 and 1987, as part of the scholarship funded by Witold Lutosławski, Grudzień studied electronic music in Barry Anderson's studio. His compositions are inspired by minimal music, repetitive technique, electronics and new digital technologies (including virtual synthesizers). The composer points to Gagliarde (1996) as the pivotal point in his work, his first composition written for a string quartet, one of the more difficult ensembles. The premiere was given by Kwartet Wilanowski during Warszawskie Spotkania Muzyczne (Warsaw Musical Meetings).

The subject of analysis is the electro-acoustic work *AdNaan* that received the UNESCO Composer's Tribune recommendation in Vienna and gained world renown. The solo cello and tape version of this composition, commissioned by the excellent cellist Andrzej Bauer, was created in the summer of 2002. Apart from this version, others with viola and accordion were created, the tape part being unchanged. The composer suggests the use of amplified instruments during the performance, which will fully convey his artistic idea. The composition, in its original version, provided inspiration to create intermedia performance art.

AdNaan, as the composer revealed, is a name of one of the angels. The title does not carry any underlying message of the content of this work. It is, however, an essential element in choreographing the work.

2. Methodology

While attempting to analyse and interpret the ambiguous work by Jacek Grudzień, one may refer to the concept of literary stylization formulated by Stanisław Balbus. 'Stylization', according to the author, 'best and most vividly emphasizes […] the character of any intertextual phenomena, i.e. intertextual and inter-stylistic relationships' [1]. Translatable to this composition are certain Balbus's intertextual strategies related to intertextual passivity, such as 'overt imitation', where 'intertextual relationships are subordinated to the subject-informative functions present and, as inter-semiotic gestures, neutralized' [1]. In his *AdNaan*, the composer alluded to old styles, genre principles and excerpts from works by other composers, at the same time revealing the evocation of his own pattern and original style.

The composition is also a certain reflection on the soundscape that surrounds us. *AdNaan* thus belongs to the so-called ecological music and the related concept of soundscape by Raymond Murray Schafer. Besides the sound signal that is the main transmitter of musical information, the space whence the sounds come fulfils an essential role in the work. The elements of the soundscape (a recited excerpt from Prospero's monologue from Act 4, excerpts from Lenten songs recorded in a church in Warsaw) and the sounds of the cello were recorded on tape and digitally manipulated.

3. Projection of tape and sound source

The tape part that accompanies the soloist (regardless of instrument) in this piece is unchangeable and is notated only as an audio track. The sound sources for creating the tape part were regular cello sounds performed and recorded by Andrzej Bauer, who selected the excerpts (ranging from one note to whole motifs) located in the score intended for the soloist [4]. Besides the sounds of the cello, the composer used excerpts from Lenten songs heard and recorded in a church in Warsaw as well as an excerpt from Prospero's monologue from Shakespeare's The Tempest: 'We are such stuff as dreams are made on, and our life is rounded with a sleep', recited by the composer's friend Owen Leech.

The audio samples used as building blocks were then processed by the composer using the *Cubase* computer software and compiled into a patchwork whole. Due to these manipulations, despite the use of only one sound generator, the final result is a polygenic material and thus an intermedia work. This intermedia artefact is created by different media, such as the electronic medium (tape part) and amplified acoustic instrument. As a result of media hybridization, a composition is created in which the process itself is viewed as a basic medium for creative expression. It is worth noting at this point that 'Intermediality does not mean either the sum of various media concessions or the placement of particular works among the media, but the integration of aesthetic concepts of particular media in the form of a new media context' [7].

The projection of the tape is straightforward. When playing the tape, one needs to set the temporal ratios, sound level and, if need be, the reverb effect. The composer, wanting to achieve the desired effect of strict, canonic imitation, used various effects offered by a virtual synthesizer.

4. From a conductus to an intermedia song

Both the piece and its music material were created intuitively. The composer did not give this work any specific musical form or genre in advance, yet he mentions alluding to the medieval conductus. One may presume that the material recorded on tape functions as a cantus firmus typical of conductus. As a result, a framework is created with juxtaposed various – in terms of material and style – structural ideas that mark the phases of the piece. Particular phases are separated by a section that returns in altered variants, fulfilling the role of a refrain like in a rondo.

AdNaan takes the form of an intermedia multi-part verse-refrain song, where in

each verse the composer presents a different type of music material. The composer achieved multi-part texture through multi-track recording. The composition thus resembles a palimpsest structure and may be based on 'comparing poetics which are based on semiological criteria characteristic of a given medium' [8].

Refrain (A) – a fast, motive passage employing repetitive technique. It includes four different – melodically-rhythmically and metrically – sections which become the basis for the structure of individual variants of the refrain (A_1, A_2, A_3, A_4; see Photo 1). Each of them uses, however, a distinctive ostinato figure and its variants. The final refrain (A4) takes the form of a coda. In the electronic layer that accompanies the soloist's repetitive motifs, the composer introduces sound effects to imitate the sound of a folk band.
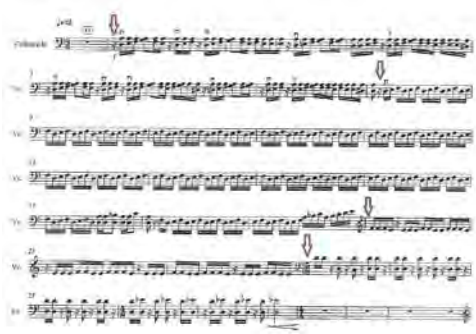


Photo 1. J. Grudzień, AdNaan, Refrain (A) by kind permission of Jacek Grudzień

The first verse (B) is based on a melodious, cantilena-style theme in the solo part, transformed with the use of the technique of imitation. The tape part imitates the excerpts from the theme played by the soloist, producing an echo effect. The theme, due to its original rhythmic pattern, resembles the tango rhythm (see Photo 2).
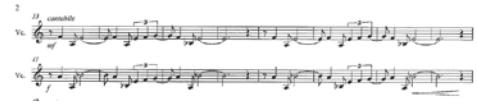


Photo 2. J. Grudzień, AdNaan, Verse (B) by kind permission of Jacek Grudzień

The second verse (C) includes exclusively electronic sounds from the tape part. In terms of style, this verse alludes to electronic sound generation techniques used in actively developed popular music genres such as hip hop or rap. A detailed analysis of the sound effects and technologies used for this verse shows an example of intra-compositional, covert intermediality, as defined by Werner Wolf's typology of intermedia relations [12]. One of the media used is obvious (the electronic medium, the tape part), while the other is alleged in 'signalling in the artefact a potential presence of imitation of outside media structures and techniques' [11]. In this case, the alleged medium will be the imitating on the cello (electronically modified) of the sound generating techniques used by hip hop performers and DJs, such as looping, sampling or scratching. This explicit reference to modern techniques in popular music provided the basis for a metaphorical intermedia discourse in this phase of the piece.

The third verse (B_1) alludes, in terms of music material, to verse B. In the tape part, the composer used a texture reminiscent of the pointillism of the 1950s. This audio track is the background that accompanies the cello

theme played first in the form of improvised 'out of tune' glissando intervals, then in its original form like in verse B (see Photo 3).
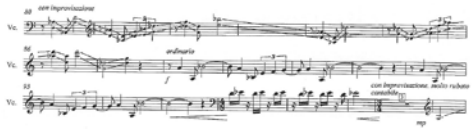


Photo 3. J. Grudzień, AdNaan, Verse (B_1) by kind permission of Jacek Grudzień

The fourth verse (D) uses new material to be improvised on and performed rubato. In this phase Jacek Grudzień alludes to folk music, quoting original and electronically modified motifs of a Lenten song. In addition, the ending of this phase features a playback of an excerpt from Prospero's monologue from Shakespeare's The Tempest. With this ending, the composition reaches its culmination, which is then resolved in the final phase of the refrain. Grudzień achieves this culmination in both parts by a progressive increase in the level of dynamics, rhythmic diminution and acceleration of musical action in the electronic medium, as well as by the upward glissandos performed by the soloist (see Photo 4).



Photo 4. J. Grudzień, AdNaan, Verse (D) by kind permission of Jacek Grudzień

The following is the large-scale structure of the piece:

a (bars 1-14) tape introduction [time: 0'00'' – 0'33'']

A (bars 15-28) [time: 0'34'' – 1'30'']
B (bars 29-48) [time: 1'31'' – 2'17'']
A_1 (bars 49-57) [time: 2'18'' – 2'32'']
C (bars 58-69) tape part [time: 2'33'' – 2'59'']
A_2 (bars 70-77) [time: 3'00'' – 3'19'']
$\mathbf{B_1}$ (bars 78-95) [time: 3'20'' – 4'02'']
A_3 (bars 96-98) [time: 4'03'' – 4'06'']
D (bars 99-138) [time: 4'07'' – 5'19'']
A_4 (bars 139-164) [time: 5'20'' – 6'30'']

5. From generative art to live performance art

Jacek Grudzień's *AdNaan*, due to the sources of sound used, belongs to generative art which, according to Philip Galanter, 'refers to any art practice where the artist uses a system, such as a set of natural language rules, a computer program, a machine, or other procedural invention, which is set into motion with some degree of autonomy contributing to or resulting in a completed work of art' [3].

The version for accordion, created in a recording studio, uses additional sound generators and latest studio technologies. The audio track of the tape was spatially processed using compression and psychoacoustic processors by a professional sound engineer, Dariusz Mazurowski, to adapt the electronic sound to the one of the accordion. In this way, amplification, better clarity and spatiality of sound were achieved. Mazurowski added several layers of live electronics to the audio tracks of tape and accordion, the task of the former being to blend the soloist's timbre with the sounds recorded on tape. The accordion part was recorded in the studio using a special array of six microphones and mixed to the 5.1 standard (the placement of the speakers being front, centre, sides and top). The recordings, as reported by Mazurowski, 'were being manipulated and saturated by means of a series of

special processors and, finally, each track was placed in a virtual sound space in accordance with the positioning of the microphones, with the use of a state-of-the-art spherical diffusion processor' [6]. The final version of this work, containing all the audio layers, was recorded in a stereo CD version [2].

Comparing the time-dynamics representation of the phonographic recording of both versions of the work (sonogram) and its time-frequency representation (spectrogram) one may notice that the caesuras of individual phases are accurately reproduced in the accordion variant (see Figure 1, 2).

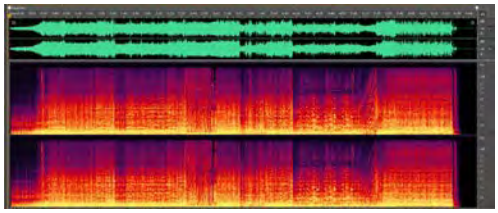


Figure 1. J. Grudzień, AdNaan (Andrzej Bauer, cello), sonogram and spectrogram

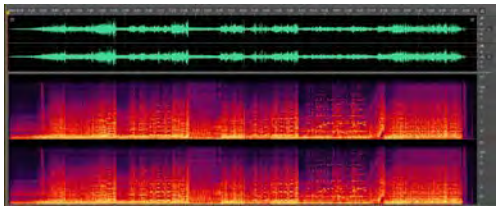


Figure 2. J. Grudzień, AdNaan (Paweł Zagańczyk, accordion), [2], sonogram and spectrogram

Technical interference in the tape layer on the sound engineer's part, based on specialist compression, besides creating a different interpretation of the work, additionally helps the listener to particulate the form into distinct phases.

As a composition, *AdNaan* also became an inspiration and a starting point for creating a collaborative, multi-layer audio-visual work produced by a composer, a choreographer, a visual artist and a music theoretician.

6. Conclusion

Jacek Grudzień's *AdNaan* is undoubtedly a work of acousmatic art in which the process of perception of an invisible source of sound emitted by a computer in real time, transmitted by a multi-channel speaker system, being, by analogy, twentieth-century *musique concrète*, is an element of a broadly defined soundscape. The two versions of the composition, the original one and the accordion one created by the sound engineer, demonstrate that an intermedia work may be open to interpretation by the performer. The original version of the piece became an inspiration for creating an interdisciplinary work, an interactive project. During this performance art the audience may follow the live animation, i.e. visual music in which synchronization of audio signals and lighting with body movement is present.

References

[1] Stanisław Balbus, *Między stylami* (Cracow: Universitas, 1993), 19, 112–13

[2] *Fall of Icarus – Mazurowski, Zagańczyk*, Requiem Records Opus Series 42/2019

[3] Philip Galanter, 'What is generative art? Complexity theory as a context for art theory', *Proceedings of the Sixth International Conference, Exhibition and Performances on Generative Art and Design*, ed. Celestino Soddu (Milan 2003), <https://generativeart.com> (accessed 23 October 2020), 4

[4] Jacek Grudzień, *AdNaan* (unpublished, 2002)

[5] Monika Karwaszewska, Beata Oryl, authorized conversation with Jacek Grudzień from 20 September 2020 (Gdańsk, unpublished)

[6] unpublished correspondence with Dariusz Mazurowski of 12 September 2020

[7] J.E. Müller, 'Intermedialność jako prowokacja nauki o mediach' *Od projektora do komputera. Współczesna niemiecka myśl filmowa. Antologia*, ed. trans. A. Gwóźdź (Katowice, 1999), 152

[8] Adam Regiewicz, 'Komparatystyka jako sposób badania nowych mediów', Teksty Drugie 2 (2014), 57–8

[9] Mieczysław Tomaszewski, 'Droga twórcza, jej progi i fazy, przemiany i fiksacje', *Dzieło muzyczne i jego konteksty* 5 (Bydgoszcz, 2009), 9-20

[10] Mieczysław Tomaszewski, *Muzyka w dialogu ze słowem. Próby, szkice, interpretacje* (Kraków, 2003) 35–47

[11] Magdalena Wasilewska-Chmura, *Przestrzeń intermedialna literatury i muzyki* (Kraków, 2011), 36

[12] Werner Wolf, 'Intermediality Revisited Reflections on Word and Music Relations in the Context of a General Typology of Intermediality', *Word and Music Studies: Essays in Honour of Steven Paul Scher and on Cultural Identity and the Musical Stage* (Amsterdam, New York, 2002), 28

Measuring the Entropy of Mass Housing Projects Through Spatial Relations

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Abstract

Buildings as architectural design products include a high level of organized complexity and can be considered as a source of information. Previous studies looking into the relationship between entropy and architecture, calculations are performed on modular, repeating, distinct, and unambiguous components of buildings. In this context, entropy calculations can be performed for mass housing (MH) projects which consist of standardized repeating housing units. MH projects include many factors such as shape, color, height, material to make entropy calculations. Another important issue to be addressed in MH projects is the spatial relations between housing units. In the calculations where only the shape of the housing units is considered, entropy values of MHP will be relatively low because of repeating parts. On the other hand, the two same housing units can create numerous combinations and neighborhood conditions. The main objective of this study is to test a method previously developed by authors to calculate spatial relation entropy of a different context such as MH projects. In this study, Silodam MH Block (built in Amsterdam) that includes 157 individual units on 11 floors is selected for spatial relationship entropy calculations. As a result of spatial relation entropy calculation, it is concluded that a set of simple and repeating units in a MH can create a high level of entropy in terms of spatial relation. It has also been concluded that spatial relationships are an important instrument of architects in achieving organized complexity.

1. Introduction

Built environments, buildings, and artifacts as products of humans include a high level of organized complexity and can be considered as a source of information. The information embedded in these human products can be measured by using an objective method such as entropy which is propounded by

Shannon as a key concept of information theory [1]. Entropy measurements of built environments, buildings, and artifacts can be conducted through a variety of physical features. In the literature, these physical features are named as factors and the factors cannot be limited to solid-void ratio, size, scale, shape, color, and spatial relations.

In the scope of this study, a previously developed spatial relationship entropy calculation method is applied in a new context. Previously this method developed by the authors applied to measure the entropy of man-made historical architectural elements called muqarnas [2]. However, in this study, a similar method is utilized in the building (MH) scale. In the scope of this study, Silodam MH Block designed by MVRDV in Amsterdam is selected as a case.

Previous studies looking into the relationship between entropy and architecture, calculations are performed on modular, repeating, non-intersecting, and unambiguous components of buildings [3,4,5,6]. The reasons to select mass housing (MH) projects are their characteristics such as repeating distinct parts (housing units) and the number of possible spatial relationships between these parts.

The possibility to create a large number of spatial relationships have been tested previously with Froebel Blocks and LEGOs. Based on the findings of Stiny's [7] experiments with Froebel Blocks and Durhuus and Eilers's [8] calculations with LEGO blocks, 2 identical 3-dimensional forms can create a large number of spatial relations. The research question answered in this study is:

- Is it possible to achieve a certain level of entropy value from the spatial relationships between subparts of a single MH building?
- Is there a difference between spatial relationship entropy values calculated based on floor plans and sections?

2. Complexity and Entropy

The term 'complex' as a noun refers to "a whole composed of interconnected or interwoven parts" [9]. In the adjective form of the term, there is an emphasis on becoming "combination of simple things or elements" [10]. Boeing's [11] definition of complexity indicates the rich behaviors that arise from the interaction of many connected parts and subunits of a system.

Salingaros [12] and Klinger and Salingaros [13] classified complexity as "organized" and "disorganized". In cases of organized complexity, the system contains internal organizations and the order resulting from these organizations ensures the sustainability of the system. On the contrary, disorganized complexity has no organization; and in the absence of internal organization randomness occurs and any kind of order cannot be mentioned [12,14]. The absence of any pattern makes perceptibility difficult and reveals randomness. While ordered complexity contains a large amount of information in an organized way, random information stored in disorganized patterns does not support establishing relationships. Due to the lack of internal organization, the information processing capacity of the human mind is overwhelmed, in other words, patterns with a mathematically simple definition are more easily perceptible, patterns that

cannot be defined simply are random [13,14].

Beyond natural systems and social structures, complexity is also seen in man-made systems. Built environments, buildings, and artifacts have a highly organized complexity. In built environments, the order is achieved by creating a structure or organization. As a result of extreme order, excessive repetition and monotony occur. On the contrary, the lack of order creates a high level of complexity that leads to chaos.

There are methods used from past to present to organize the complexity of built environments, buildings, and artifacts. It is possible to obtain a complex architectural product from repeating parts by using basic operations. These operations can be listed as but not limited to: translation, symmetry, reflection, rotation, scaling. All these methods have been invented and used in the past during the development of architectural products including organized complexity. The built environments, buildings, or artifacts without the mentioned organization mechanisms show random and disorganized characteristics. The use of symmetries randomly when producing large-scale forms may lead to the collapse of information [12,14].

The concept of entropy remained limited to the discipline of physics until the late 1940s and rediscovered by Shannon in information theory. Since Shannon propounded information entropy to solve communication problems; his entropy concept was adopted by other disciplines such as psychology, art, urban design, and architecture. Bailey [15] emphasized that the concept of information entropy can be applied to any information content that contains multiple data types.

As concepts of complexity have different definitions and classifications, entropy has been also defined in different ways. Berlyne [16] defined entropy as a method to measure the disorder physically. Similarly, Shaw and Davis [17] used entropy synonymous with disorder and diversity. In this study, the entropy concept in information theory is used to measure the level of complexity of artifacts.

In cases where complexity is considered as a quantity, entropy is a convenient method to calculate complexity. According to the basic entropy equation, the entropy value can be calculated through finding the frequency of the repeating parts in a whole. In this study, the basic entropy equation is used to calculate the spatial relationship entropy in both plan and section planes.

Detailed explanation for the basic entropy equation and sample calculations can be found in previous studies published by the authors [2,6,18,19,20].

3. Spatial Relationship Entropy Calculation Method and Its Implementation

To do spatial relationship entropy calculations, measurable features of the MH project has to be defined clearly. In this study, spatial relationship entropy calculations are conducted over two types of spatial relation. Horizontal relationship entropy (HRE) is calculated over the side-by-side neighborhood relations of the discrete housing units (polygons) in the floor plan layout. Then, vertical relationship entropy (VRE) calculations are made based on up-and-

down neighborhood relations between housing units in the sections. In this study, instead of representing the neighborhood relationships like a graph, the shared walls (lines for side-to-side relation) and slabs (planes for up-and-down relation) are named as segments and these segments are automatically counted by the algorithm. While counting the segments, algorithm neglected the length and the area of the segments. Based on parameters as the total count of segments (relationships), the number of segment types (relationship types), and the count of repetition of each segment type (relationship type), the frequency of each horizontal and vertical relationship type is found. These frequencies found are enough to conduct both HRE and VRE calculations.

3.1 Case Study

Silodam Housing Block is a 10-story (11 levels including rooftop) building and includes 158 housing units. It simply has the form of a single rectangular prism 130 meters in length and 20 meters in width (Figure 1).

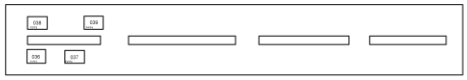
In this project, the designers aimed to create a neighborhood by combining different types of housing units. Within the Silodam MH block, different housing unit types were created and are coded from A to T, and sub-types of each type were also tagged (ex. A1, A2, T1, T2) (Figure 2) [21].



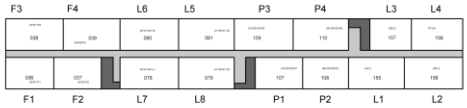
Figure 1. *Silodam MH block (Photo by Authors)*

Therefore, counting the number of different housing units and calculating entropy, based on their frequencies in all building does not provide valuable insight. The housing units in the project differ from each other in the context of many features such as the number of floors (single, duplex, mezzanine, rooftop), their orientation, plan types, colors, facades, and open space relations.

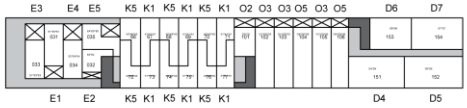
One of the factors affecting the plan and section layouts and the spatial relations observed in these layouts is the diversity of the methods to arrange housing units in the horizontal and vertical axis. For example, parts of a duplex unit can be completely overlapped, while parts of another duplex unit can be placed by shifting the upper part. Or a big housing unit can be placed over 3 small units.



Level 10



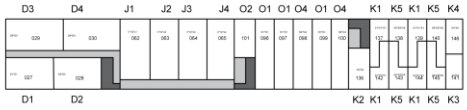
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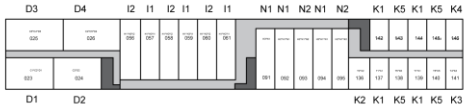
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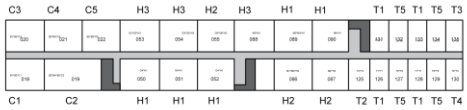
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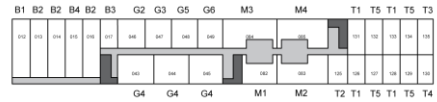


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Level 4

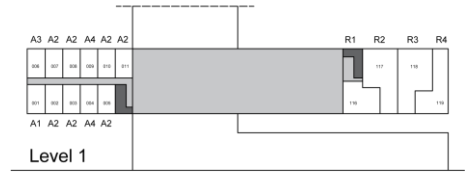
Figure 2. *Floor plans, plan types, and tags of the units (continues)*



Level 3



Level 2



Level 1



Level 0

Figure 2. *Floor plans, plan types, and tags of the units (continues)*

Before the HRE and VRE calculation, 11 floor plans were redrawn by the authors in AutoCAD environment by tracing the floor plans and sections derived from El Croquis [21].

Then, each segment (wall for HRE and slabs for VRE) defining a neighborhood relation between two housing units was labeled in the forms of X-X for HRE and X^X for VRE. The graphical representations of these relationships are illustrated in Figure 3 and Figure 4.

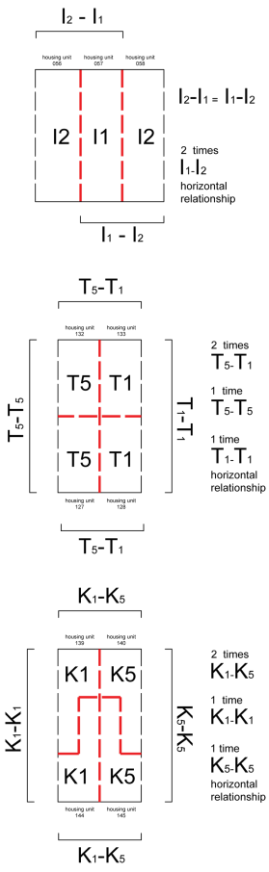


Figure 3. *Labelling and counting process for horizontal relationships*

Then, the prepared algorithm transferred all embedded labels in different layers to the Grasshopper Visual Scripting Environment (VSE) using the “Dynamic Geometry Pipeline” component of the Human plug-in.

After having all segments with their labels in the Grasshopper VSE, total count of relationships, number of relationship types (horizontal and vertical), count of repetition of relationship types is found by simple listing, counting, and grouping operations.

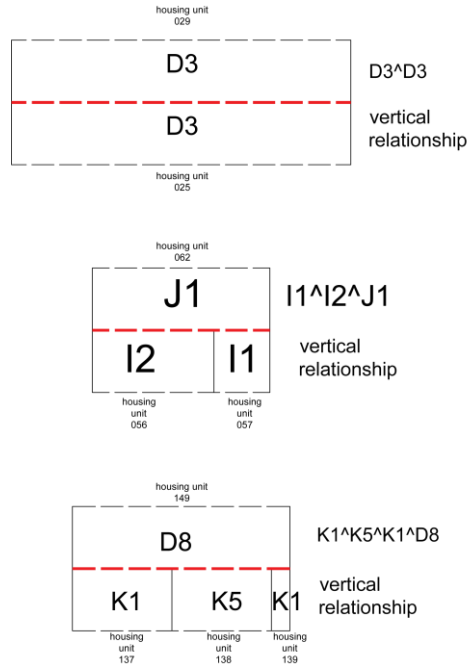


Figure 4. *Labelling process for various vertical relationships*

Afterward, by using the basic entropy equation of Shannon, an entropy value was found for each relationship type according to the ratio of the count of repetition of each relationship type to the total count of relationships. By multiplying the entropy value of each relationship type by the count of repetitions of that relationship type and adding these multiplications, the overall entropy value (carried amount of information) of the building was found. Last, the average entropy was calculated by dividing the overall entropy by the count of total relationships.

For example, in Figure 5, the highlighted rows from the HRE calculation shows that the K1-K5 horizontal relationship has been seen 30 times in the Silodam MH. The fact that 30 out of 209 relationships are K1-K5, increases the possibility of

this type of relationship to occur in the building. In cases where the probability of occurrence of a relationship type is high, entropy value of the relationship type (per piece) is low. For this reason, the K1-K5 relationship is clearly differentiated from the entropy values of the other relationship types with the lowest value of 2,800469 bits. On the other hand, since the K3-K4 relationship occurs only once in 209 relationships, the probability of its occurrence is minimum, and the entropy value is maximum as 7.707359 bits.

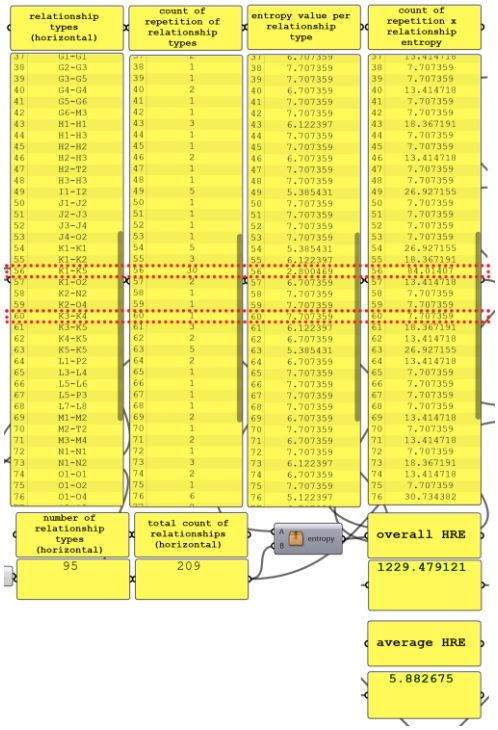


Figure 5. *Calculations for HRE*

Figure 6 shows the calculation of VRE. In Figure 6, vertical relationship types are listed in the far-left column. In this case, it has been observed that in Silodam MH block, vertical relationships are established between 2, 3 or 4 units at the same time.

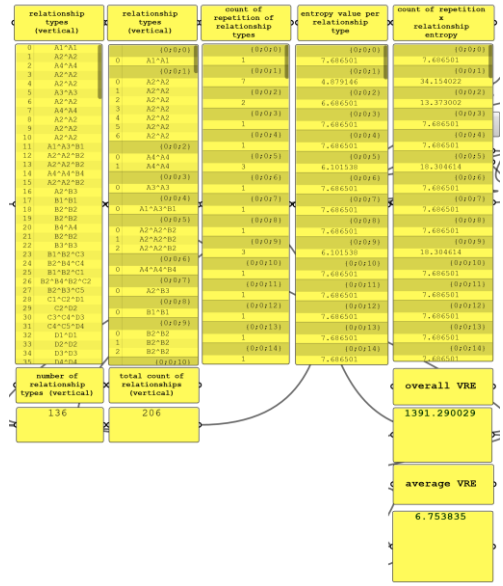


Figure 6. *Calculations for VRE*

Similar to the horizontal relationship types, it has been observed that many of the vertical relationship types are repeated once. This situation increased both overall and average VRE considerably. The brief results of HRE and VRE calculations are given in Table 1.

Table 1. *Results of HRE and VRE calculations*

Silodam MH Project	total count of relationships	number of relationship types	overall entropy (bits)	average entropy (bits)
Horizontal	209	95	1229.47	5.88
Vertical	206	136	1391.28	6.75

4. Conclusion

According to the values given in Table 1, both VRE and HRE are quite high. In this study, the developed objective calculation method is applied to a different context for the first time. Therefore, it has not been tested on any sample set yet. However, it is possible to analyze the entropy level of Silodam with comparative analysis by applying the same method to other mass housing blocks.

For a mass housing block that includes 158 housing units, it is obvious that manually counting 209 horizontal relationships, 95 horizontal relationship types, 206 vertical relationships, and 136 vertical relationship types can take quite a long time. Thus, the developed algorithm used to read similarly coded building plans and sections. In this context, Dynamic Geometry Pipeline component of the Human plug-in in Grasshopper VSE is an extremely useful method to read labels and automatize the calculations.

Last, overall and average VRE is slightly higher than overall and average HRE. This situation arises from the location of corridors that interrupt the relations of housing units located on different sides (orientation) of the building. In addition, it has been observed that large housing units are sometimes overlapped on 2 or 3 units and add variety to the relationship types.

References

1. Shannon, Claude E. 1948. A Mathematical Theory of Communication. *Bell System Technical Journal, 27* (3): 379-423.
2. Güzelci, O. Z., Alaçam, S., Şen Bayram, A. K., & Lacroix, I. (2020). Measuring the Entropy of Sinan's Muqarnas Patterns. *Nexus Network Journal*. https://doi.org/10.1007/s00004-020-00521-0
3. Krampen, M. (1979). *Meaning in the urban environment*. London: Pion Limited.
4. Crompton, A. (2012). The entropy of LEGO®. *Environment and Planning B: Planning and Design, 39*(1), 174-182.
5. Stamps III, A. E. (2012). Commentary on the entropy of LEGO®. *Environment and Planning B: Planning and Design, 39*(1), 183-187.
6. Güzelci, O. Z., & Şener, S. M. (2019). An entropy-based design evaluation model for architectural competitions through multiple factors. *Entropy*, *21*(11), 1064.
7. Stiny, G. (1980). Kindergarten grammars: designing with Froebel's building gifts. *Environment and Planning B: Planning and Design,* 7(4), 409-462.
8. Durhuus, B. & Eilers, S. (2014). On the entropy of LEGO®. *Journal of Applied Mathematics and Computing, 45*(1-2), 433-448.
9. Url 1. https://www.yourdictionary.com/complex
10. Url-2. https://www.merriam-webster.com/dictionary/complex

11. Boeing, G. (2018). Measuring the complexity of urban form and design. *Urban Design International*, *23*(4), 281-292.
12. Salingaros, N. A. (2014). Complexity in architecture and design. *Oz, 36*(1), 18-25.
13. Klinger, A. & Salingaros, N. A. (2000). A pattern measure. *Environment and Planning B: Planning and Design, 27*(4), 537-547.
14. Salingaros, N. A. (1999). Architecture, patterns, and mathematics. *Nexus Network Journal, 1*(1-2), 75-86.
15. Bailey, K. D. (2009). Entropy systems theory. *Systems Science and Cybernetics, Eolss Publishers, Oxford, UK*, 152-169.
16. Berlyne, D. E. (1960) *Conflict, Arousal, and Curiosity*; McGraw-Hill: New York, NY, USA.
17. Shaw, D., & Davis, C. H. (1983). Entropy and information: A multidisciplinary overview. *Journal of the American Society for Information Science*, *34*(1), 67-74.
18. Güzelci, O. Z. (2017). Investigating the role of Entropy in Design Evaluation Process: A Case Study on Municipality Buildings. In G. Çagdaş, M. Özkar, L. F. Gül, E. Gürer (Eds.), *Proceedings of 17th International Conference, CAAD Futures 2017: Future Trajectories of Computation in Design* (pp. 211-224). Turkey: Istanbul Technical University.
19. Güzelci, O. Z. & Şener, S. M. (2018). A design evaluation model for architectural competitions: Measuring entropy of multiple factors in the case of municipality buildings. *A|Z ITU Journal of the Faculty of Architecture, 15*(1), 107-122.
20. Güzelci, O. Z., & Alaçam, S. (2019). A Study on Measuring Complexity in Muqarnas Patterns. *The Turkish Online Journal of Design Art and Communication*, *9*(2), 191-201.
21. MVRDV (2002). *1997-2002 Stacking and Layering*. El Croquis.

Molecular Art In Evolution

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Evolution on various levels provides analogies between sciences and art



Abstract

The evolution of an actual chemical reaction between molecules, a process often giving the experience of artful shapes and movements if modelled properly on a computer, does show many, deeply analogous features and processes with the actual history of various aspects of the evolution of life on Earth, as well as the evolution of human thought processes involved in Art, and especially, in Science-related Generative Art.

Many of the fundamental components of the changes in Nature and the changes in our perceptions of artful forms, that are accessible today even on the sub-microscopic level of individual molecules, are following highly similar changing patterns and modifications, just as the initial impression of looking at an artistic painting is also evolving, leading to sequences of associations and interpretations, developing, maturing, and becoming a better match, in some sense, more fit, as they enter, and make room for themselves in the collections of our artistic and scientific experiences.

In this contribution, several examples are shown, aimed at enhancing the strong connections among various levels of evolution, in Nature, and in our minds.

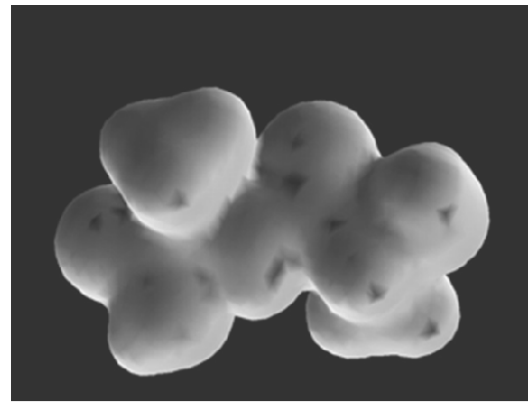
1. Evolution in Nature, Evolution of Individual, Molecular Evolution, and Evolution of Ideas

Evolution in nature, with all of its complexity, shows many analogies to fundamental processes on very different levels, for example, to the evolution of an individual, unborn human being to an active, thinking individual capable of appreciating both science and art, including their intriguing combination: Generative Art. These analogies are also strongly manifested in the actual, physical level of molecular processes, leading to intriguing shapes of artistically appreciable molecular forms, and also on a far more abstract level of evolution of ideas within the domain of human culture.

Figures. Evolution of an individual human in time, and the "abstract" evolution of Molecular Model as accurate low electron density becomes accessible



Evolving Individual



D-alanyl-D-alanine Molecule

Evolution is usually considered as a process in time, however, in a more general sense, evolution can be considered to represent changes along some coordinates different from time. For example, in the case of molecules, the evolution of our growing understanding of their behaviour, clearly a time-dependent process, correlates with another coordinate: it has become possible to model reasonably accurately the low electron density cloud outer regions of molecules only recently, due to the actual evolution of advanced quantum chemistry computer modelling methods. Hence, some sense of evolutionary change can be associated with the gradually diminishing density of electronic cloud as we consider molecular shapes further and further away from the atomic nuclei present in the molecules. In this sense, the value "ro" of electronic density, that happens to be 0.01 atomic unit, is also a coordinate for some type of evolution on the right side of *Figure 1,* a figure showing not only an evolving human on the left hand side, where evolution is, indeed, considered along the usual time coordinate, but also the dipeptide D-alanyl-D-alanine, where the electron density parameter "ro" is some "abstract" evolutionary coordinate, only analogous to time, the time-coordinate, that in turn is the most relevant to the evolution of the unborn individual on the left hand side of the figure.

2. How molecules, their shapes, and interactions show analogies with aspects of evolution

The direction of changes in all types of evolutions is influenced by a multitude of factors, however, some factors are often dominant, related to the physical concepts of energy and entropy. Processes left to their own without external influences often, but not always, progress from instable arrangements towards some more stable ones, and

also, time often tends to lead from well-organized arrangements towards toward some more disorganized ones. These factors can be considered as somewhat analogous with feasibility and probability, respectively.

In this context, if one considers the evolution of molecular interactions, which today can already be modelled rather reliably by quantum chemistry computational methods, often resulting in intriguing shape changes of the participating molecules, then the potential role of additional molecular parts as "helpers" in the process of evolving interactions provide new and intriguing features, worthy of the attention of Generative Art observers. In the following images two such scenarios are shown. In the first image, the "abstract evolution" of gradual refinement of the observed electron density values, from the "crude" 0.1 atomic unit (a.u.) value to the more delicate 0.001 a.u. value is shown, where the evolution is relevant to the interaction between a dimethyl-ether and an ethene molecule.

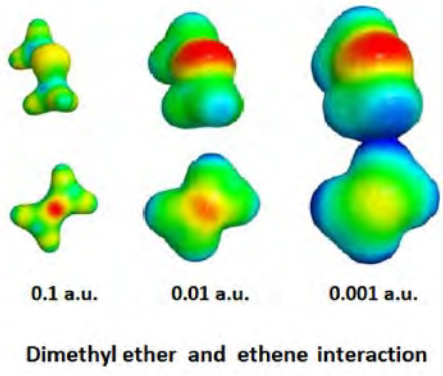


Figure 2. Evolution of molecular interactions between dimethyl ether and the ethene molecules as our focus evolves from the crude, high electron density value of 0.1 a.u. (atomic unit for electron density) to the fine, low density value of 0.001 a.u.

In the next image, in *Figure 3,* the same two molecular parts are considered, but with an intermediate molecular part added, essentially forming a benzene ring, that allows the local electron densities to interact more directly, "through chemical bonds", that is modifying the interaction process considerably. In reality, this "through-bond" interaction is the dominant, not surprisingly, after all, chemical bonds can be rather strong, keeping some molecules stable even at very high temperatures.

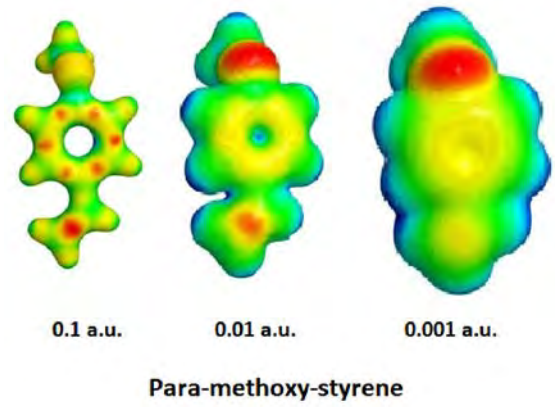


Figure 3. Evolution of "through-bond" type molecular interactions between dimethyl ether and the ethene molecules, as delivered by an intermediate molecular part, actually generating a benzene-ring structure, as our focus, again, evolves

from the crude, high electron density value of 0.1 a.u. (atomic unit for electron density) to the fine, low density value of 0.001 a.u.

Nevertheless, both sets of images provide an interesting glimpse into the "interaction-evolution" world of some molecules, which are, in some respect, representing some typical processes which often occur on the micro-microscopic level of the molecular world. In both of these images, the colour changes represent the changes in the so-called "electrostatic potential", a descriptor providing an indication, how some, hypothetical "wondering local charge" "would like" to be present at the given location, with red colour indicating the strongest such interaction. Whereas in practice no such wondering point charges can be moved along such surfaces, nevertheless, this "artificial experiment" provides chemically useful predictions for the likely locations, where a given molecule would prefer to initiate a reaction with a suitable partner molecule. It is a sombering thought to remember, that in every millisecond of our lives, more than million times million such reactions occur in our bodies, providing the very foundations of life. Hence, the study of molecular shapes and shape variations (see, for example, references [1-8]) are having connections to many fields beyond chemistry, involving biology, pharmacology, medicine, and in a broader sense, very few industry may claim to have no direct use of at least some of the benefits the information on molecules can provide.

Some of the original investigations leading to these images have been addressing the more general problem, how interactions develop and spread through various regions of molecules ([4],[5],[6]). Some of the fundamental relations are discussed in references [7] and [8], however, the original studies first using "missing molecular parts" for the analysis of interactions evolving exclusively through space or using in addition a through bond mechanism, have been described in references [9], [10], [11], and [12].

References

[1] Paul G. Mezey, *"Shape in Chemistry: an Introduction to Molecular Shape and Topology",* Wiley - VCH Publishers, New York, 1993.

[2] Paul G. Mezey, *"Topological Beauty and Molecular Shape",* Conference Proceedings of the XVIII. Generative Art Conference, University of Milano Press, Milano, Italy, 2015, pages 256-259. Available at http://www.generativeart.com/ga2015_WEB/topological-beauty_Mezey.pdf

[3] Paul G. Mezey, *"Molecular Symmetry Deficiency and Shape Deviation Measures",* l'Actualité Chimique, Vol. 320-321, (2008), pages 56-60. (Hommage à Jacques-Emile Dubois, Special Volume honoring Professor Jacques-Emile Dubois).

[4] Z. Antal and P. G. Mezey, *"Substituent Effects and Local Molecular Shape Correlations",* Phys. Chem. Chem. Phys., **16**, 6666-6678 (2014).

[5] Z. Antal, P. L. Warburton, and P. G. Mezey, *"Electron Density Shape Analysis of a Family of Through-Space and Through-Bond Interactions",* Phys. Chem. Chem. Phys., **16**, 918-924 (2014).

[6] Z. Antal and P.G. Mezey, *"Molecular Fragment Shape Variation Index Applied to Intramolecular Interaction Studies",* J. Math. Chem., 50, 942-948 (2012).

[7] P.G. Mezey, *"On Discrete to Continuum Transformations and the Universal Molecule Model - A Mathematical Chemistry Perspective of Molecular Families",*AIP (American Institute of Physics) Conference Proceedings, Vol. 963/2, COMPUTATION IN MODERN SCIENCE AND ENGINEERING: Proceedings of the International Conference on Computational Methods in Science and Engineering 2007 (ICCMSE 2007): Volume 963/2, parts A and B; pp. 513-516 (2013).

[8] P.G. Mezey, *"Natural Molecular Fragments, Functional Groups, and Holographic Constraints on Electron Densities",* Phys.Chem.Chem. Phys., 14, 8516-8522 (2012).

[9] W.F. Reynolds, P.G. Mezey, and G.K. Hamer,*"Ab initio Calculations on 4-Substituted Styrenes; a Theoretical Model for the Separation and Evaluation of Field and Resonance Substituent Parameters",* Can. J. Chem., **55**, 522-529 (1977).

[10] W.F. Reynolds, T.A. Modro, and P.G. Mezey, *"A Theoretical Investigation of the Effect of Positively Charged Substituents on Product Distribution in Electophilic Aromatic Substitution; Evidence for a Dominant Field Effect of the Positive Poles",* J. Chem. Soc. Perkin II, 1066-1070 (1977).

[11] P.G. Mezey and W.F. Reynolds, *"Ab inito Calculations on 4-Substituted Benzoic Acids; a Further Theoretical Investigation into the Nature of Substituent Effects in Aromatic Derivatives",* Can. J. Chem., **55**, 1567-1574 (1977).

[12] W.F. Reynolds, T.A. Modro, P.G. Mezey, E. Skorupowa, and A. Maron,*"An Experimental and Theoretical Investigation of the Unusual Substituent Effect of the Vinyl Group",* Can. J. Chem., **58**, 412-417 (1980).

Natural Structures through the Convergence of Particles and Shapes

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Figure 1. Tree made with particle-shapes

Abstract

This work reports on the development of a generative simulation for natural structures based on a convergence of particle systems and shape grammars. A review of procedural methods for natural vegetation leads to an integrative approach resulting in a new primitive: *particle-shapes*. Artistic aspects will be discussed as they relate to the abstraction of nature. Results emulate a wide range of complex natural structures.

1. Background & Motivation

One of the first processes to convincingly represent natural structures is the L-system, which expresses branching forms using *replacement* rules that progressively increase the detail of a shape in a hierarchical fashion, and has been used extensively to model plants and trees [1]. Subsequent work focused on modifications that allow for greater variety and irregularity. Oppenheimer introduced twisting and randomness over a generated hierarchy [2]. Weber introduced explicit shapes such as cones placed on a branching structure [3]. These works all share the notion of a rule-based fractal grammar.

Particle systems, on the other hand, were first applied to model soft objects such as fire and water [4]. Reeves also developed an early particle system for plants, although this effort focused primarily on dense forest rendering rather than elaborating on plant structure [5].

We explore the relationship between particles, grammars and shapes to develop a conceptual framework and a simple integrated model for the growth of natural structures based on merging these two representations.

	L-System	**Shape Grammar**
Definition	G = (V, w, p)	SG = (V_T, V_m, R, I)
Objects	V = alphabet of symbols	V_T, V_m = finite set of shapes
Initiator	w = axiom or initiator symbols	I = initial shape
Rules	p = production rule pair (s,t)	R = rules as ordered pairs (u,v)

Table 1. Similarity between L-systems and Shape grammars, both inspired by Chomsky production grammars. Definitions from Lindenmayer [1] and Gips [6].

2. Conceptual Framework

L-systems and fractals are related to the more complex *shape grammars* which have been applied extensively to architecture and design [6]. Indeed, the definition of both L-systems and shape grammars refer to Chomsky grammars as their underlying principle. Their similarity is observed in Table 1. By assuming the L-system is used to generate a geometric form, the symbols in V can be mapped to V_T. The L-system production rules, p, can be mapped to shape rules R. Whereas L-systems were classically a string rewrite language shape grammars are more powerful since the elements express arbitrarily complex geometric shapes in 2D or 3D.

While shape grammars are extremely expressive they come at the cost of increased complexity. One must keep track not only of hierarchical relationships, but must also represent 2D or 3D shapes, and perform complex geometric operations represented by the rules. The author previously developed a shape grammar language for procedural modelling [7], yet the program complexity continually limited software scalability.

Particle systems, on the other hand, are significantly simpler to design and implement than shape grammars. Particles typically follow physically-based *simulation rules* for motion. Rodkaew models plants using particle systems but oddly these particles start at the leaves and are attracted toward the trunk [8].

Conceptually we can understand L-systems, shape grammars and particles as systems which vary in terms of their *structure* versus *behaviour,* see Figure 2. Classic L-systems have a discrete hierarchy with no continuous growth. Newer models such as FL-systems, functional L-systems [9], and parametric shape grammars can be thought of as extensions that increase the behavioural aspect of these system. Significant work on shape grammars has focused on making them procedural, stochastic and more functionally flexible [10].

The present work explores the idea of extending particle systems to allow for an inherently behaviour-oriented particle object to have more structural properties.

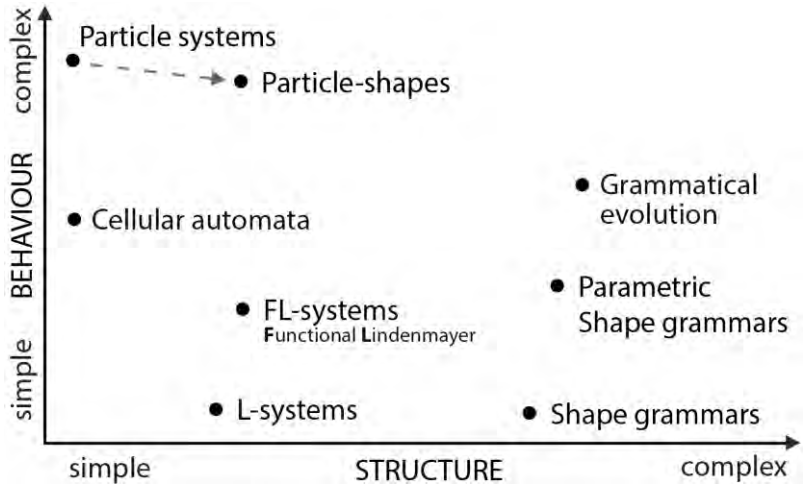


Figure 2. Structure and behaviour of several systems for the expression of form. Particle-shapes are inspired by extending the properties of particle systems to include structural qualities (top left).

3. Particle-Shapes

The notion of a *particle-shape* is introduced as an atomic element that has properties of both particles and shapes. These properties are listed in Table 2. Particle-shapes have position, velocity and orientation like their classical counterparts. Yet they also have mass and volume defined by a rectilinear solid space. Importantly, particle-shapes define child and next references allowing them to form chains and branches.

No explicit grammar is needed (but is implicit in the chains). The branching structure of trees is modelled with the notion of *spawning* new particles at regular, random intervals. Instead of replacing branches with fractally smaller pieces, these particles *grow* new branches in a natural way from previous points outward. While plant cells operate on a microscopic scale, the idea of growth based on cellular splitting and propagation is well supported by nature as in Figure 3.



Figure 3. Cells split and grow to form the solid parts of a plant in Alyssum alyssoides. Image © Stefan Lefnaer

Def. ParticleShape:

vec3	position
vec3	velocity
vec3	direction
vec3	scale
quaternion	rotation
matrix4x4	transform
int	level
int	child
int	next

Table 2. Properties of a particle-shape.

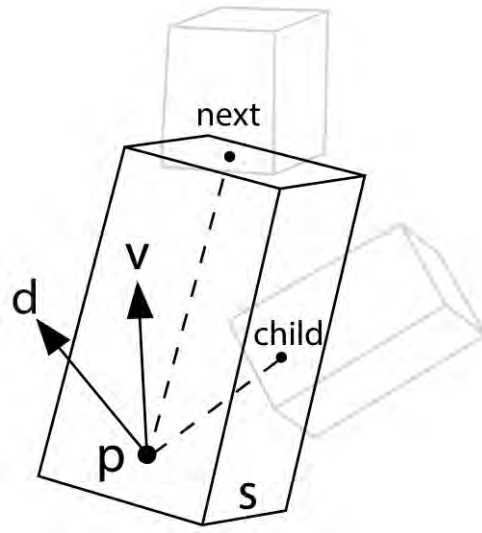


Figure 4. Design of a particle-shape: p (position), v (velocity), d (target direction), s (scale), child and next shapes.

The motion of particle-shapes is determined by Eulerian simulation techniques whereby force and velocity increment position, with additional terms for more complex behaviour.

$$d_{t+1} = d_t + rand[-1,1]\ wander\ dt$$

$$v_{t+1} = [v_t + spread\ (d_{t+1} - v_t)]\ Q(twist, d_t)$$

$$p_{t+1} = p_t + v_{t+1}\ dt$$

Velocity (v) expresses the current motion of the particle while target direction (d) expresses where it will or should move, allowing for complex motions such as twisting and bending of branches by *wandering* randomly in [-1,1]. The *spread* determines how strongly the velocity is attracted to the target direction. Q(twist,d) is a quaternion rotation of the velocity around the direction vector for twisting.

Tree forms evolve naturally as particles follow their trajectory and periodically spawn new branches, Figure 5. A set of parameters control the timing, distribution and orientation of new particle-shapes as they are spawned to form branches. The depth of recursion is controlled by maintaining the branch level with each particle and passing this onto its children. Limits to the age, length and level of particle-shapes terminate growth.



Figure 5. Trunk form from Figure 1 generated by the behaviour model described here.

4. System & Rendering

The present framework for particle-shape modelling, simulation and rendering are all developed as custom software written in C++/OpenGL including a custom rendering option using OptiX for high quality raytracing. The author builds on previous efforts in procedural modelling, Luna [7], to create the present framework, titled SHAPES.



Figure 6. Stages of rendering: a) Growth and spawning of particle-shapes, left, result in complex branching, b) The entire set of shapes is skinned, middle, to create a smooth appearance, and c) additional shapes are generated for smaller branches and leaves, right.

Direct rendering of particle-shapes is possible both in real-time and via raytracing by using the technique of *geometry instancing* whereby the same shape – in this case a rectilinear prism – is repeatedly rendered at different locations (Figure 6a).

Rendering of a smooth tree trunk and branches is desirable. Rather than replace individual shapes with geometry this is achieved by lofting the entire set of particles with a single skinning primitive (Figure 6b), similar to Subramanian [11] and Obradovic [12]. The resulting surface closely resembles a modelled tree to which color and texturing could be applied.

Additional particle-shapes may be generated at any time to fill in smaller branches and leaves (Figure 6c).

5. Results

The model presented provides a continuous parameter space for the generation of a wide range of natural structures. Trees and bushes generated using these techniques are shown in Figures 6, 7 and 8. These were created solely by modifying the parameters of the system as there are no discrete generation rules.

Particle-shapes are able to represent a wide variety of forms that are difficult to achieve with L-systems or shape grammars. Twisting vines and trees are represented by increasing the rotational force (Figure 7). Meanwhile, grasses are expressed by having many initial particle-shapes which then grow and fall due to gravity (Figure 8).



Figure 7. Tree generated with increased twisting force

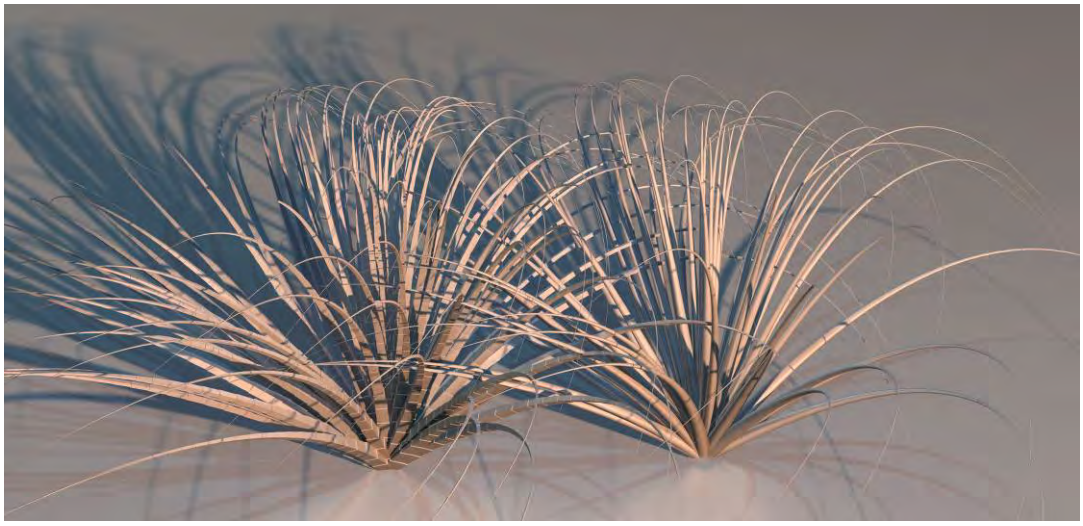


Figure 8. Grasses generated in the same framework by increasing gravitational force

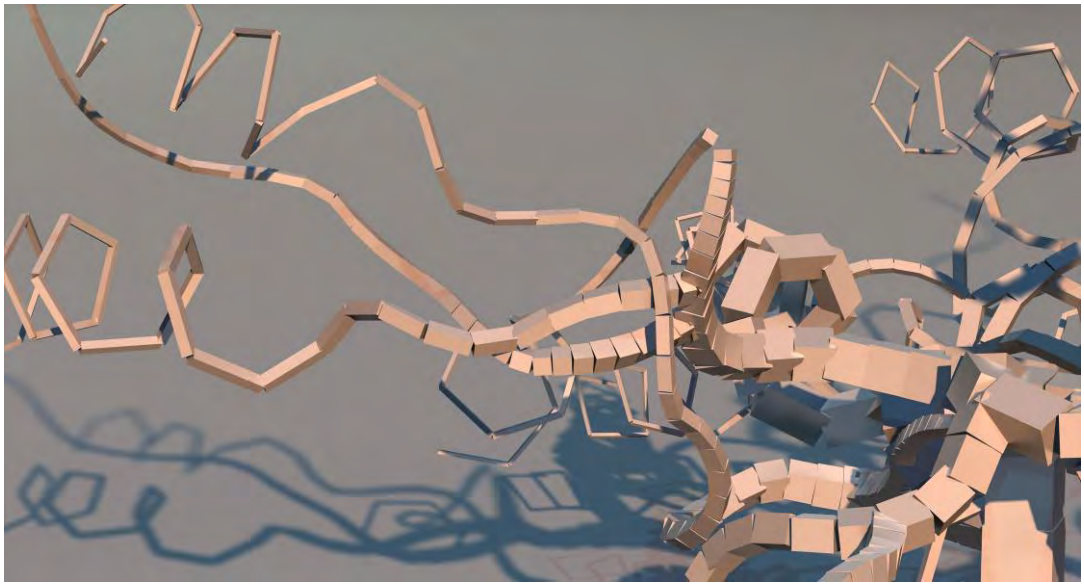


Figure 9. Detail of branch structures. Notice that each branch is not a rigid or substituted shape in a hierarchy but flows from a chain of particles. The tree hierarchy is implicit.

Behavioural changes in scale result in either fat, stubby branches or long skinny ones. The branching points are not decided a priori or deterministically. This approach supports many types of vegetation – from trees, to bushes, to grasses.

6. Aesthetic Discussion

Many interesting questions are raised by this work. Does nature operate more like a rule-based grammar or a particle-based simulation? There are arguments to be made for both. The typographic nature of DNA suggests a grammatic relationship between genetic code, genotype, and the observed forms of phenotypes [13]. Yet cellular splitting, growth and motility suggest the important role of physical forces in natural systems. Certainly, both play a role, yet our understanding of how complete biological structures derive from genetics is still limited.

Also fascinating is the degree to which abstraction is present in all simulations of nature. There is no current system capable of modelling complete plants down to the cellular level. Thus the present particle-shape model, while inspired by cellular growth, does not operate on that scale. Particles are a mathematical abstraction of behaviour similar to abstractions of shape in architecture [14]. Any simulation of nature raises the question of whether a complete model is possible, or what this would even mean, since nature is intimately interconnected with its environment. Nonetheless, our ability to build digital models of natural systems will continue to improve. Can these models eventually achieve structural parity with nature or will they always retain an element of abstraction?

Creatively, the distinction between artist and scientist has witnessed an increasing

overlap. The role of the artist is admittedly no longer to only mimic the outward appearance of forms but to reflect on their structure and substance. Yet there is an inherent element of play and fantasy present in generative art since these forms are not a true reflection of reality but a synthetic creation – unable to capture many natural forms, yet also capable of expressing forms well outside of nature. One difference between the artist and scientist, therefore, is that whereas the scientist proceeds continually toward an accurate reflection of nature (by testing theories), the artist is not limited thus and may explore generative worlds to understand new principles not bound to reality, or may simple explore beauty in form for its own sake.

7. Future Work

Regarding the present model there are several interesting directions for this work. Particle-shapes are currently much more like particles than shapes. The most natural extension is to replace these prisms with more complex geometries. This would allow for intricate leaf profiles, buds and flowers. Such an approach moves away from the purity of particles by introducing substitution rules – thus bringing them closer to shape grammars (Figure 2). Yet the author believes that a final convergence of behaviour-based particles and rule-based shapes is inevitable in this field. Nature does both at differing scales: it *behaves* (macroscopically according to physics) while also following *rules* (microscopically according to DNA, etc.) to create structures.

Other limitations are also apparent. This work has focused on the realism of branches yet much more could be done to generate other plant parts. Coloring and texturing in this work were intentionally avoided to focus on the modelling outcomes where it is understood that greater realism would be found by adding these. These and other extensions are left for the future.



Figure 10. Unexpected generated forms

While procedural methods can already achieve visual realism with vegetation using existing techniques, the future of generative natural forms is far from complete. Generative modelling and simulation deserve new attention beyond visual appearance. We are approaching a point where hardware will be sufficient to model entire plants at the cellular level. This will likely bring a whole spectrum of novel insights while providing new tools for advances in biology, genetics and ecology. Aesthetic visions found in this future are still unfolding and have yet to be discovered.

References

[1] Prusinkiewicz, P. and Lindenmayer, A. (1990). The Algorithmic Beauty of Plants, *New York: Springer-Verlag*, 1990

[2] Oppenheimer, P. (1986). Real Time Design and Animation of Fractal Plants and Trees. *ACM Transactions on Graphics*, Vol 20, No 4, 1986

[3] Weber J. and Penn, J. (1995). Creation and Rendering of Realistic Trees, *Proceedings of the 22nd annual conference of ACM SIGGRAPH '95*, Sept. 1995, p. 119-128

[4] Reeves, W. (1983). Particle Systems – a Technique for Modeling a Class of Fuzzy Objects. *ACM Transactions on Graphics*, Vol 2, No 2, April 1983, pp. 91-108.

[5] Reeves, W. (1985). Approximate and Probabilistic Algorithms for Shading and Rendering Structured Particle Systems. *ACM Transactions on Graphics*, Vol 19, No 3,1985

[6] Stiny, G and Gips, J. (1972). Shape Grammars and the Generative Specification of Painting and Sculpture, in CV Frieman, *Information Processing 71*, *Proceedings of the IFIP Congress*, North-Holland, Amsterdam, pp. 1460-1465.

[7] Hoetzlein, R. (2010). Luna: A Puzzle-Based Metaphor for Procedural Modelling. *In Dissertation*, University of California Santa Barbara. December, 2010

[8] Rodkaew, Y., Chongstitvatana, P., Siripant, S., Lursinsap, C. (2003). Particle Systems for Plant Modeling, In *Plant Growth Modeling and Applications*, p. 210-217

[9] Marvie J., Perret, J. and Bouatouch K. (2005). FL-system: A Functional L-system for procedural geometric modelling, *The Visual Computer*, Vol 21, pp. 329-339, May 2005

[10] Roncoroni, U. and Crousse V. (2016). Programming generative grammars. *Proceedings of the XIX Generative Art Conference*, GA2016.

[11] Subramanian, S., Eng, M., Krishnamurthy, V. and Ergun, A. (2019). Delaunay Lofts: A Biologically Inspired Approach for Modeling Space Filling Modular Structures. *ACM SIGGRAPH 2019 Posters*, Article 81, July 2019.

[12] Obradovic M. (2017). Creating 3D shapes by time extrusion of moving objects, *Proceedings of the XX Generative Art Conference*, GA2017

[13] Achim C., Caldwell D., Good, T., Olster, D. (2017), Understanding the Rules of Life: Predicting Phenotype, *National Science Foundation*, 10 Big Ideas, NSF News Release, Aug 8, 2017

[14] Leyton, M. (2001). A Generative Theory of Shape. *New York: Springer-Verlag*, 2001

Remapping and replay in generative spaces

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Abstract

The space we inhabit influences our perception, constrains our thoughts, and shapes our behaviour. In psychology experiments, larger spaces facilitate creative use of everyday objects, while arrangement of furniture affects the use of those spaces, for example for discussion vs. presentation. In these times of physical isolation, confined spaces are detrimental to mental health. How do we perceive space in these confining times, and overcome these restrictions to open our minds to a wider, more expressive environment?

We examine the human cognitive map that evolves with generative spaces, as humans enter virtual contexts and experience different functional spaces. Neuroscientists have found neurons called place cells in the hippocampus part of the brain that fires whenever humans enter a particular location. These cells remap when humans passage to different contexts, and rescale when they enter the same room but at a different scale. In between these transitions, place cells also replay their own prior activity as humans learn from their own navigation in space. These neuroscience insights are captured by abstract models of place cell networks as humans traverse virtual spaces that generate complex open structures depending on audience interaction within their boundaries.

The web experience takes the audience through procedurally generated spaces generated from player interaction. As the player moves virtually in space, a cognitive map of shape architectures representing place cells are shown above the player activated when stepping into a particular space. New spaces lead to remapping of the shapes to new locations, and trigger them to replay their activity when players remain stationary. When players visit certain areas, the confined spaces become wider and the shapes become more expressive, generating patterns that reflect the larger spaces and diverse sensory inputs they listen to. Finally the audience can begin to see the connection between the complexity of spaces they inhabit and their own evolving neural coding for these spaces.

1. Introduction

We are becoming increasingly isolated due to health and safety measures that serve as a double edge sword: protecting us physically from infection of each other, but causing mental issues by isolating us from each other psychologically, inducing depression, anxiety [15], trauma [9], emotional instability , and higher rates of suicide [34]. Indeed, space is the medium of our interactions, and when confined in restricted spaces for prolonged periods such as explorers in Antarctica or astronauts in space, humans experience social avoidance and physical incapacity analogous to the hikokomori syndrome in Japan, where people don't go out of their rooms for weeks at a time [19].

To narrate countering the effects of confinement by exploration, we created an interactive artistic intervention that allows people to control a character as it wanders beyond their isolated environments and discover the surrounding playground of a generative space. In the process we discovered how human minds process spatial interactions and used this insight to show audiences how their own cognitive maps react when they encounter generative spaces that change with audience interaction.

2. Background

2.1 Psychology of Space

The spaces we interact in defines our perception and actions within that space. Studies have shown that traits like creativity in the use of novel objects is reduced when subjects are enclosed in spaces like small rooms and corridors, and higher when located in larger spaces like auditoriums [7]. Meanwhile, the arrangement of space using instruments like furniture determines our interaction with it. For example, chairs in a circle imply discussion and communication while the same chairs in a column designate presentation [24]. Different seating arrangements can even affect how favourably subjects evaluate ads oriented towards individuals or towards families [42].

To use spatial arrangements for the benefit of those within it, we would need to generate spaces that take audiences from a state of confinement to a state of openness. Moreover the generative process should be meaningful in the social context of the interaction. A case in point is a study of social dining, wherein lighting (dim vs. bright) affected the way subjects assessed the situation (romantic or non-romantic) [40], indicating that the properties of the space can provide social hints for the interaction. What's more, these influences of space can work at an implicit, subconscious level without explicit evaluation from subjects. These "implicit interactions" can drive the design of everyday instruments [17] from the arrangement of door handles to traffic markings on the street. One of our goals is to tease apart the effect of these subtle changes in spatial interactions on how people perceive confined or open spaces.

2.2 Neuroscience of Space

In the original experiment that gave rise to the idea of a cognitive map, Edward Tolman gave rats a reward on successfully navigating a maze. Over time the rats get better at remembering where the reward was. In a surprising result, his group found that rats not given rewards could catch up to those given rewards after just a few trials of rewards, indicating that during the non-reward trials, the animals were actually learning something intrinsic about the maze itself, rather than being motivated by the reward [39].

This fundamental insight in neuroscience is instantiated today in the work in the hippocampus, where physiological analogues of the cognitive map have been localized as place cells of the CA1 and CA3 regions, and grid cells of the Entorhinal Cortex [28]. Place cells respond whenever humans and animals are in some specific location in a room, while grid cells [10] respond in a spatial frequency manner whenever they are in some area of a grid in the room (Figure 1). In addition, there are cells like head direction cells and boundary vector cells that code for other properties of space like current direction of travel and the boundaries in a room [23] (Figure 2).

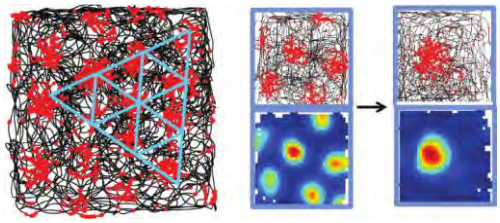


Figure 1: Heat maps of activity in grid cells (left) and place cells (right). High activity for a single cell indicated in red, low activity in blue. (From Moser et al, 2015 [27])

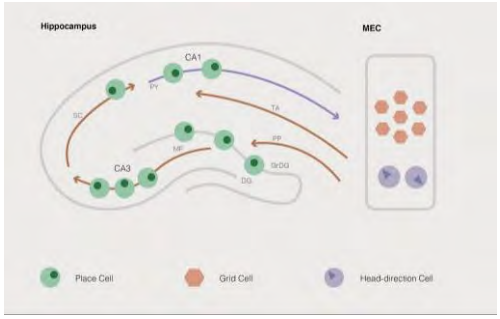


Figure 2: Diagram of locations of place cells, grid cells, and head-directions in a visual representation of the hippocampus.

Three properties of place cells are particularly relevant in the context of generative spaces:

(1) Place cells are **scale** invariant, i.e. if the room is enlarged 2x, then the place cell will fire in the same location scaled by 2x [21].
(2) Place cells adapted to a particular space can **remap** to fire to different locations when a new space is encountered [16] or remap by changing their firing rates [1].
(3) Place cells can **replay** the sequence of their recent activity when encountering rewards [2], and the "replay" can even take place before decision points in an attempt at prediction via "vicarious trial and error" [32].

These three properties of place cells suggest that generative spaces would produce neural firing that correspond to particular functions when people navigate in fenced-in spaces, revisit landmarks, encounter new environments, and learn to predict new contexts or consolidate recent spatial memory. Everyday functions like the use of tools (a light-pen in the study) can remap the structure of space [4], while replaying the insights gleaned from previous exploration can help predict optimal decision-making [33].

While the effect of confinement on human brain circuits have not been well-established, evidence has suggested that isolation leads to abnormality in the usually inhibitory circuits in the amygdala, causing persistent activation to other areas of the brain [13]. Work with humans even shows changes in EEG frequency bands with solitary confinement [11]. Interesting, social isolation makes deficits in spatial memory even worse in particular animal models [14:1], suggesting that

confinement in space affects spatial learning.

These ideas are consistent with recent general findings suggesting that hippocampal circuits like place and grid cells code more than only for spatial location. In particular, place cells can respond to locations of others in a room in addition to one's own [8], and even respond independently while watching a conspecific's demonstrated navigation [31], suggesting a role for place cells not only in navigation but also social foraging. Hippocampal signals have been found that facilitate learning in place cells that code for social memory, such as recognition of conspecifics [30]. Thus, a spatial-social system exists in the brain that helps us identify location and socially relevant rewards in these locations. Spatial interaction and social rewards appear to be intimately tied to each other. After all, humans are social creatures that navigate in space. When we move to a new city, we look up where the closest basketball court is, or the public library or symphony, or where to meet people integrated in the community. Navigating in space and social behaviour are paramount to our success in changing environments.

2.3 Computation of Space

If indeed spatial navigation is intimately tied to social rewards, how can we compute these spatial reward interactions in a virtual space during navigation? Computational models for rewards and spatial interactions have centred on work in reinforcement learning (RL) [36,38].

Two general types of reinforcement learning strategies are model-based and model-free methods. Model-based methods build state and structure representations that capture knowledge - based learning, while model-free methods use prediction errors to update a simpler heuristics-based learning [12].

A frequently applied model-free RL method is Q-learning, which involves learning the values of actions that lead to optimal rewards [41]. At each location of the interaction, we can associate a value with moving right, left, forward, or backward. Given reward at a particular location, Q-learning iterated over many trials can find the optimal path to the reward in the navigation process. Audiences engaged in the specific task can generate many trials that are used to train the parameters of Q-learning, and the learned parameters capture a model for how humans forage for reward interactions to remap the space they are in. More complex models versions of Q-learning like Dyna-Q can also account for replay of previously encountered activity and remapping of cognitive maps in new spaces [26]. These ideas serve as a possible extension of our work to show how learning occurs in the spatial interaction paradigm.

3 Methodology

3.1 3D Modelling

The cognitive map is an intricate network of neurons that communicate with each other to provide environmental, contextual, and social information to humans and animals. New stimuli that take place in space, like scenery, spatial sounds, and physical activities can cause activation of these neurons, signalling spatial information, and forming a network for navigation. We wanted to illustrate the neuronal network of cells in the cognitive map by highlighting its spatial coding properties, and to bring elements of architectural space into the visual design. In the first generation of the model, based on the morphology of the pyramidal cell,

we explore possible forms of the place cell, from concrete to abstract. We then extend the place cell into 3D, producing a modular model using an architectural approach.

3.1.1 Place Cell Visualization

We started from single place cells, which have pyramidal (triangular) morphology, with the apical dendrite of the cell extending vertically above the soma and the basal dendrites radiating laterally from the base of the cell body. From the morphology of the pyramidal cell, we made some sketches of realistic-looking pyramidal cells based on work from two-photon imaging of these hippocampal cells [20] (Figure 3, left).

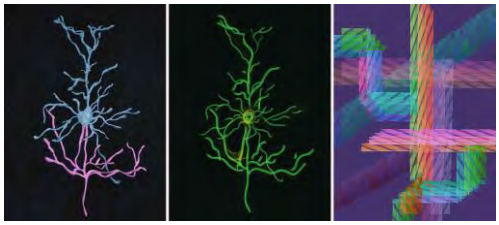


Figure 3: Sketch of the place cell (Left). Abstract representation of the place cell (Middle). Tubular synapses as sites of info exchange for a place cell (Right).

Next, we show the cells in a more abstract way by extracting their structure based on connectivity and function, (Figure. 3, middle), which further enables people's spatial imagination. Here, the central element no longer looks like a cell, but rather an information processor.

Finally, we discarded the canonical template of what cells should look like in our minds to show the information and connectivity inherent in single cells. Noting that visual representations of cells are only metaphors for the cells themselves, we chose to represent instead the importance of connectivity and information exchange in what cells do. Thus we used tubes to build "a world of information exchange." (Figure 3, right).

3.1.2 Network Architecture

Next, we move on to the design of systems of cells. Along with our abstract tube-shaped representation of single cells, we want to visualize how the connectivity of cells themselves evokes architectural space. This is inspired by work examining how architecture of human surroundings is related to the way our brain functions in space [3]. Instead of showing cells as biological entities, we decide to portray them as spatial entities, in so much as they are active in the processing of spatial information. Thus we provided a sense of architecture in characterizing the place cell (Figure 4). Instead of using morphology of cells under the microscope, we use functions of the cell as processors of spatial info to define the visual representation.

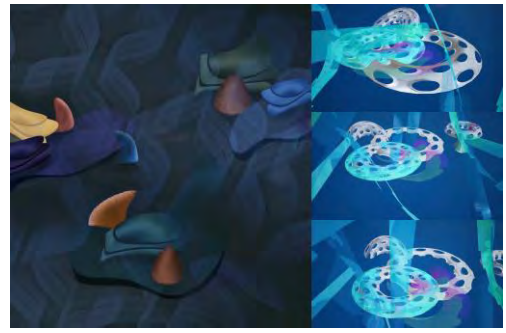


Figure 4: Sketch of the system (Left). 3D model of network architecture (right).

3.1.3 3D Model Realization

To instantiate the architectural ideas concretely for interactivity, we first have to create 3D models to represent cell systems that process spatial information.

We realized that different cells in the brain are like modular buildings with the same components that can be built in different ways in the short run [35]. The synapses, dendrites, and other cell components are like windows and doors that can be adapted to any form and specialized for function. Thus we introduced the modular model into the design of cells. On one hand, modular models provide a system that allows for the randomized configuration necessary in the generative process. On the other hand, each model of the modular system shares the same general structure, but has its own specific instantiation, mirroring the diversity of cell morphology in the brain.

In the first iteration (3-1 in Figure 5), we use various twisted tubes to represent cells, which end up looking like symbolic graphics and mysterious ancient text that conveys unspecified information. However, it is too abstract for players to identify the models as the cells, and tend to lose touch with the idea of information processing.

Next we used the shape of rings to represent a diversity of cell types, much as they would occur biologically in diversification of an evolutionary template (3-2 in Figure 5). They evoke a systems perspective to the design like the way different bacteria can be classified in a biology class. We took a more abstract approach to replace the tubes, which represent the connections between cells, with cells that potentially can be innervated by tubes.

Next we wanted to combine the cell diversification in 3-2 with connectivity. We realized that connectivity requires the presence of processes: an input and an output end. First we combined the elegance of 3-1 with the diversity of 3-2 to produce a line that also has processes that would serve as connectors (3-3 in Figure 5). Next we refined that design to make the entities more sculptural, three-dimensional, and hence more capable of representing the diversity of shapes and sizes in a hippocampal cell line (3-4 in Figure 5). By modifying the cell bodies to adapt for processes that allow for information exchange in the interaction, we created a morphologically more functional version of the cell system.

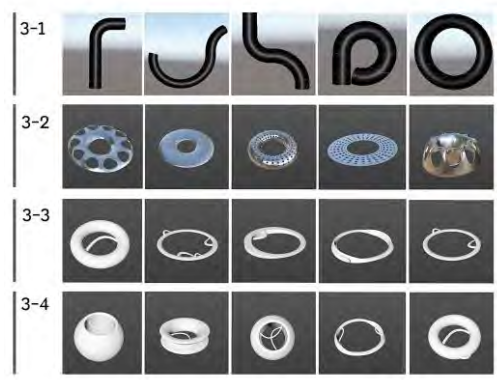


Figure 5: Catalogue of the modular models. Iterations of the modular models from the 1st generation to 4th generation.

3.2 Interaction

3.2.1 Spatial Representation

The existing research has suggested that mammalian spatial navigation ability relies on a neuronal representation of space provided by cells in the hippocampus [22]. Additionally, grid cells are thought to provide a hexagonal spatial frequency-dependent input to unitary place cell firing [6]. Inspired by this, we applied the hexagonal grid cell receptive fields to our design as a way to visualize the spatial cognitive map that players wander in. They can also play a triggering role that

reveals and subserves place cell activities. This is consistent with modelling and physiology studies showing Entorhinal grid cell input into pyramidal place cell outputs [37].

The first step is to form the hexagonal tiles that can be used as a cognitive map for player navigation. Inspired by the organization of place cells in hippocampal formation as a coordinate coding system that fire at regular lattice intervals [25], we experimented with arrangements of the hexagonal system in both fully supported and randomly supported forms (Figure 6).

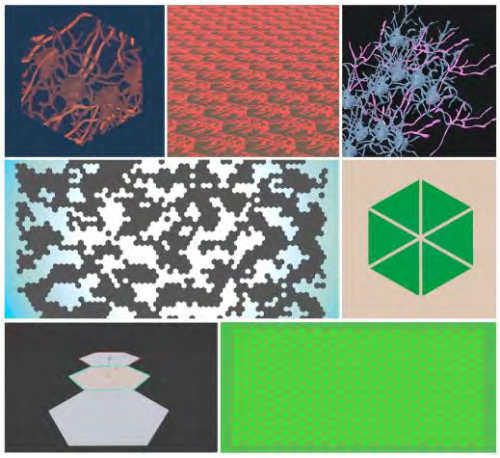


Figure 6: A texture of neural circuitry for a hexagonal place fields (Above). Simpler hexagonal tiles procedurally generated in the environment (Middle left). Grid model (Middle right) and grid combination, including fully connected spaces in perspective and overview (Below).

Next, we explored the effects of different shaders in a single grid and in a grid combination. First, we assigned a complex neural circuit texture as texture on the grid in order to highlight the context of the biological inspiration. As the design evolved, we realized that the hex-cell grid needs to be identifiable and visually clean to be recognized as an interactable component. Thus, we developed a non-textured grid and a dynamic strategy whereby the hex-cell grid revealed itself by changing colour when the player collides with it. In practice, this strategy was used not only as a visual indicator for the hexagonal grid, but also played a functional triggering role for neuronal Interaction (Figure 7).

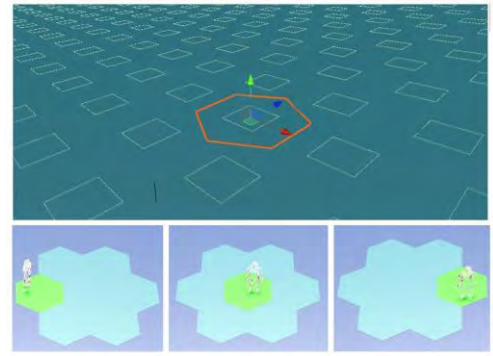


Figure 7: Development of a grid collider for triggered player interaction (Above). The effect of collider application (Below).

3.2.2 Player Interaction

We utilized a grey box character as our first controllable object to examine the core movement functionalities. As we tested interactive behaviours such as wandering, zooming, and ducking, we realized that objects and interactions needed to serve the target experience using different recognizable states, otherwise the identification with the movements would be weak (Figure 8).

Applying ideas from the architectural inspiration previously described, we attempted to enact the synecdochical characteristic of human navigation, which recapitulates its micro form in its macro

form. For instance, human macro behaviours such as calculating distance from subject to subject is related to the micro behaviour of coordinate measurement by grid cells. Meanwhile, the micro process of replaying is analogous to macro processes such as learning by vicarious trial and error. The covert activity that happened in our brain can be regarded as a mirror for the overt activity in reality.

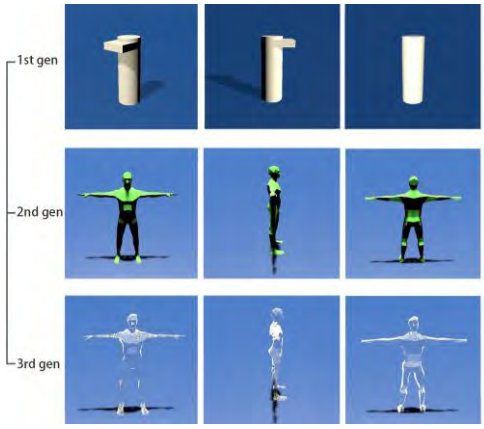


Figure 8: Iteration of the controllable player from the 1st generation to the 3rd generation.

This consideration provided a new viewpoint for our design of interactive components. In order to connect the world of neuron structure and the virtual environment, we introduced the humanoid as the player in our second iteration. This application allowed us to include a range of animated behaviours that served to bring the players into the role. In order to aid identification with the controllable character, we used a semi-transparent shader for the third iteration. This shows the generic player as a placeholder for the audience itself in transparent form.

Another issue that came along with the implementation of player control is the camera perspective. We experimented with first person and third person perspectives. First person perspectives allowed players to gain a more immersive experience, but the point of view is more limited, and it's hard to observe what tile you're on and get a global view of the entire space. As players interacted with objects, they needed to constantly switch sight from hex-cell grid to the 3D models that were above them. In third person perspectives, players were able to observe objects in the scene in a global view. However, as the controllable object moved far away, the details diminished due to the confines of the screen size and resolution.

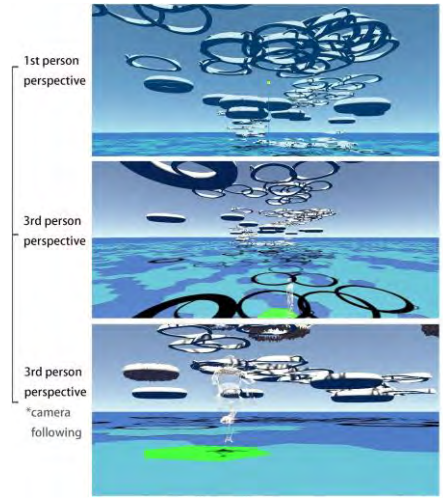


Figure 9: Player point-of-view in different camera perspectives.

For our last iteration, we wanted to combine the global view of a third person view with the immersiveness of a first person view by using Cinemachine in Unity to have the camera automatically follow the player when it's moving. We believed utilization of this technique

combined the merits of the first person and third person perspective, for it not only illustrated place cell activities in a global view when not moving, but also the player's interactive behaviour of triggering that caused the cells firing in the local view when moving (Figure 9). Finally we used AI Navmesh in Unity to allow click-based navigation, so that players can use arrow keys to control the camera while not moving to customize the global view.

3.2.3 Neuronal Interaction

With the 3D model, hexagonal spatial map, and controllable player configured, we moved on to incorporate all three elements into the core interaction design. In this we are inspired by the neuroscience insights from cognitive maps, namely the properties of rescaling, remapping, and replay in place cells.

Based on what we know about human spatial navigation, grid cell metrics can be regarded as an internal spatial-coding system, and place cells utilize that coordinate reference along with other cues to generate location awareness [5]. In other words, place cells fire in sequence based on path and grid metric processing. To adapt this cell mechanic to an interaction mechanic, we used hex-cell grids as the trigger that lead to place cell model firing. Thus, a player walking through the hexagonal space would create a path that causes a series of place cells to fire in sequence.

On the other hand, replay is believed to both consolidate spatial memories and predict navigation planning during periods of rest [29]. Thus we introduced an idle stage as part of interaction to mimic the spatial replay in place cells. That is, when the player is idle, the path and cells sequence replay past behaviours or test out future possibilities. Idle stage replay can be helpful for contextual understanding, as one pauses and reflects on mental model assumptions of causes and effects in the world, much as in the field of walking simulators in video games [18]. The interactive loop proposed is shown in Figure 10, while the algorithm for the interaction is Figure 11.

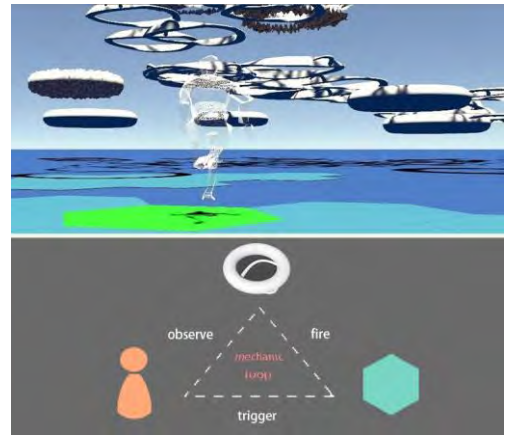


Figure 10: Interactive main loop. The grid is triggered by the player that leads to cell firing. Activation of cell firing serves as visual feedback to the player.



Figure 11: Step by step interactive procedure. The loop consists of place cells firing (orange) and chronological sequence replay while idle (cyan).

3.3 Generative Processes

There are two generative processes underlying our work: generating cells in space that respond to particular receptive fields by activating, and generating the receptive field boundaries themselves.

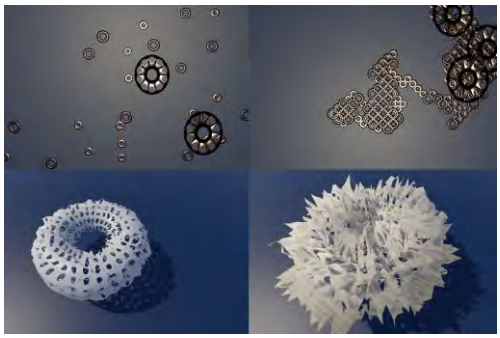


Figure 12: (Above) Generating neuronal cell population using uniform randomality (Left) and Brownian Motion induced randomness starting from centre of the space (Right). (Below) Representing activation of a cell using displacement vertex shader. Beginning of firing sequence (Left); peak of firing (Right).

We wanted to generate the cells above the players in order to allow the player to see them easily as part of the landscape of the space they are navigating. Beginning with two cell types that could be matched to, say globally or partially remapped place cell for instance, we populated them in our space first using uniform distributions (Figure 12). Upon examination of the outcome, we realized that people have a better sense of which cells correspond to which hexagonal receptive field if they are arranged in a probabilistic manner. Thus we followed a Brownian Motion generation procedure to create cells that are successively one step away from each other:

1. Create cell at current location.
2. Move step-length randomly in either positive or negative x and y directions (50% probability each).
3. Move in z direction following smooth 1D Perlin noise.
4. Create a new cell there with different probabilities for different cell types and return to 2.

The resulting hex-cell grid has a probabilistic but consistent relationship with the neurons in that cells that are close to each other are likely to have receptive fields that are closer to each other during the co-generation process.

To represent the activation of cells, i.e. how they fire in response to the player being at a certain location, we used a vertex displacement shader to perturb the displacement amount every time the player triggers the collider of the hexagonal cell corresponding to the particular cell. Speed of firing depends on a tuneable parameter that determines the rate of relaxation back to zero displacement.

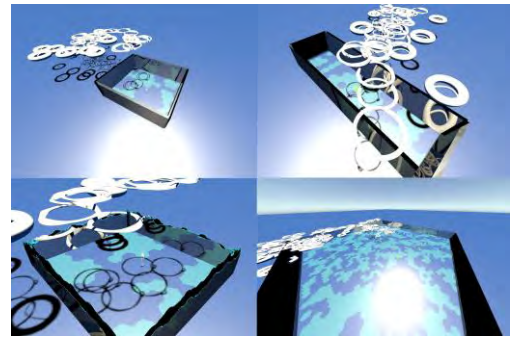


Figure 13: Generative boundary creation conditions. Small and large spaces for interaction are procedurally generated using an algorithm that respects the hexagonal tile locations. (Lower left) process of removing the walls using a dissolve shader during remapping to a different space.

The other generative process involves making the boundaries of interaction that allows a transition from confined space to open space (Figure 13). When the player triggers a specific tile in the scene, the walls come down and we remap to a new space depending on the locations of the randomly generated tiles. The spaces get progressively larger as the player continues to find trigger tiles at each stage. These generative spaces illustrate the evolution from confined to open spaces through exploration.

4 Outcomes

Our web-based environment allows the player to explore a generative world that shows the properties of the player's own cognitive map in the form of stylized shapes that become active in different ways when environments are regenerated.

4.1 Rescaling

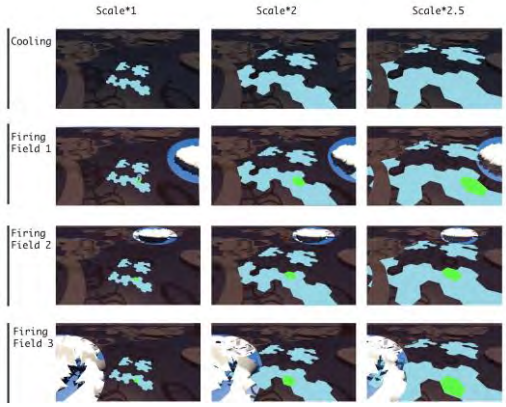


Figure 14: Grid maps generated in different scale (Scale increasing from left to right). Note that no matter how the scaling condition changes, the binding relationship between the place cell and grid remains the same.

A robust finding from the neuroscience of spatial navigation is that when the scale of the room changes, the area that causes a particular place cell to file scales with the environment [21]. In our application, when the space is regenerated with different grid sizes, the relationship between location and particular cell activity is preserved (Figure 14), showing place field scale independence.

4.2 Remapping

Particular place cells remap their activity when encountering new spaces, both by changing the location that activates it, and by the rate of spiking the activation triggers [16] (Figure 15). In our application, the new spaces are generated by the player as it explores the environment. A small, confining space becomes a bigger, explorative space when the right tile is triggered, leading to further exploration.

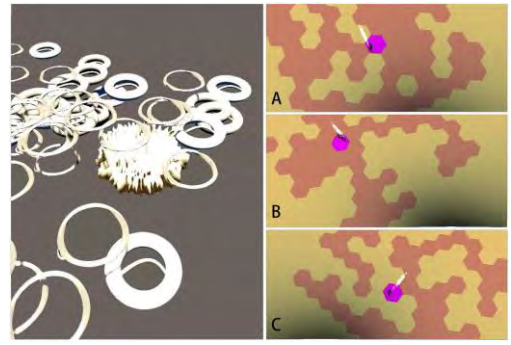


Figure 15: Receptive fields for a single place cell when spaces are regenerated. The cell in question (Left) responds to different areas of a remapped grid rearranged in the form of different cognitive maps (Right) caused by changes in the space occupied.

In the new space, certain cells retain their receptive fields while others take on new fields as the space is changed, both when the space is fully innervated, and when it's partially innervated by the grids.

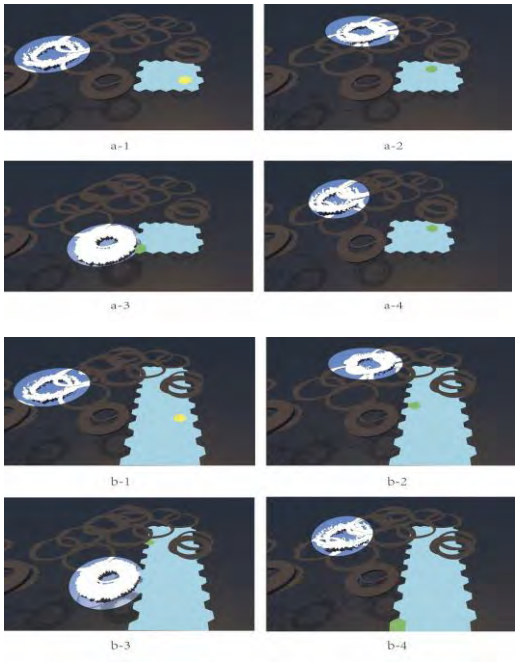


Figure 16: Characteristics of remapping. When a new space is encountered, place cells adapted to a particular space can remap to fire to different locations. Here, a small boxed-in space (a) is changed to a corridor (b). (a-1) and (b-1) portray the phenomenon when one cell fires to a location that remains the same upon regeneration of space.

In the fully innervated situation, every location in the space leads to a place cell activation (Figure 16). When the space changes, the cells may fire to a new location or to the same location if that location still exists in the new space.

In the partially innervated situation, a set of locations that lead to place cell activity is changed when the player encounters a new environment or is in a different mind set (Figure 17). Here, the place cells have remapped to different locations that partially cover the location, and some of the locations have lost their place cells.

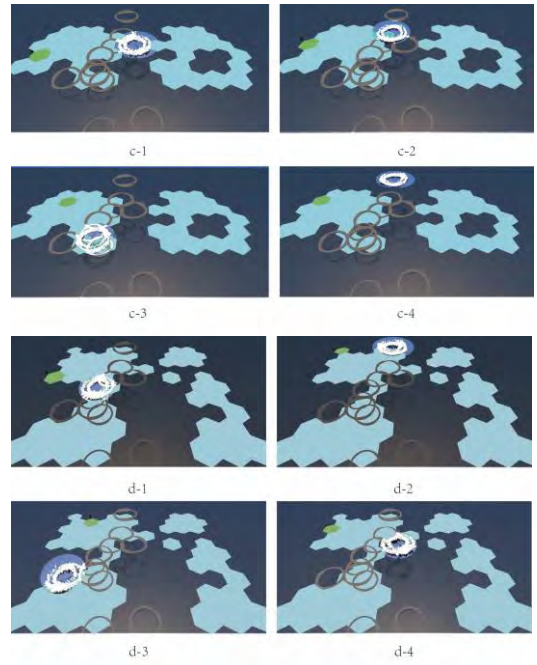


Figure 17: Characteristics of remapping in the case where spaces are partially covered by the present set of place cells. Place cells that fire to particular locations before remapping (c) change their location of activation when in new contexts (d). Some locations lost their place cell, while other locations gained a new place cell upon regeneration.

4.3 Replay

Even when spaces don't change, place cells can engage in replay of its recent activity [2] or predict future decisions [32]. The replay can show a reverse sequence of past visited paths that helps to consolidate the exploratory behaviour the player has seen in her actions to trigger the regeneration of space (Figure 18). Replay can also be activations that help determine imagined future possible choices as a vicarious trial and error decision making strategy (Figure 19).

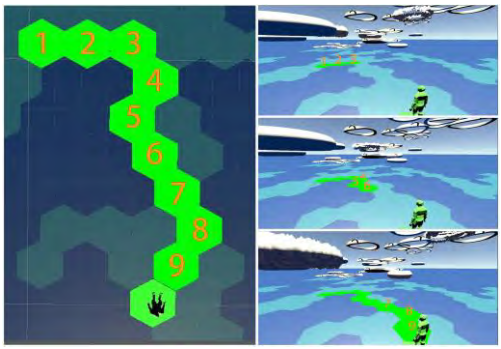


Figure 18: Replay while idle. The grid tiles change colour while cells fire one by one in reverse chronological order (Left). What the player sees while looking at a path she had visited before (Right).

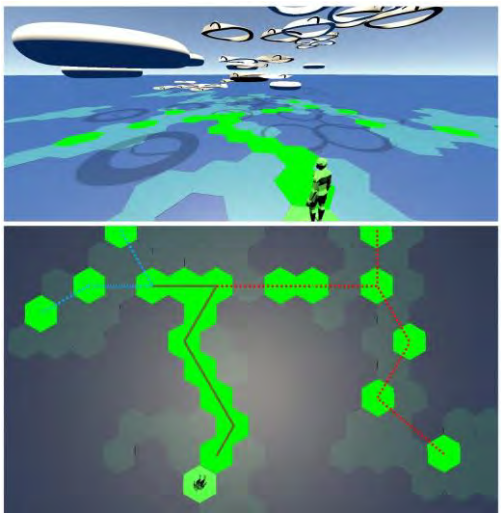


Figure 19: Replay on future decisions. When a fork path is presented to the player, replay tests the potentially routes at a branch point (Above). Left turn (Blue) and right turn (Red) routes (Below).

The former occurs in our framework as a random traversal of cell firing sequences for previously travelled paths without player movement. The latter occurs when the player encounters a decision point at a previously unknown location.

5 Summary

Our work shows how mental aspects of spatial navigation can be shown in an interactive, generative environment. As audiences explore their way out of confined spaces by finding the locations of interest, they can begin to understand how their own cognitive map of space is altered by rescaling, remapping, and replay of place cell activity specifically tuned to their spatial experiences.

We are now conducting work to build a physical analogue of the immersive space using projection mapping to configure the generative spaces and display corresponding cell activations. Physical interactions using human movement and gestures will provide greater identification with spatial confinement and naviation.

6 Supplemental Material

A preliminary playable prototype is found at: https://recfro.github.io/navigating-in-place/

7 References

[1] Kevin Allen, J. Nick P. Rawlins, David M. Bannerman, and Jozsef Csicsvari. 2012. Hippocampal Place Cells Can Encode Multiple Trial-Dependent Features through Rate Remapping. *J. Neurosci.* 32, 42 (October 2012), 14752–14766. DOI:https://doi.org/10.1523/JNEUROSCI.6175-11.2012

[2] R. Ellen Ambrose, Brad E. Pfeiffer, and David J. Foster. 2016. Reverse Replay of Hippocampal Place Cells Is Uniquely Modulated by Changing Reward. *Neuron* 91, 5 (September 2016), 1124–1136. DOI:https://doi.org/10.1016/j.neuron.2016.07.047

[3] Michael Arbib, Juhani Pallasmaa, and Harry Francis Mallgrave. 2016. *Architecture and Neuroscience*. Tapio

Wirkkala-Rut Bryk Foundation.
[4] Anna Berti and Francesca Frassinetti. 2000. When Far Becomes Near: Remapping of Space by Tool Use. *Journal of Cognitive Neuroscience* 12, 3 (May 2000), 415–420. DOI:https://doi.org/10.1162/089892900562237
[5] Daniel Bush, Caswell Barry, and Neil Burgess. 2014. What do grid cells contribute to place cell firing? *Trends Neurosci* 37, 3 (March 2014), 136–145. DOI:https://doi.org/10.1016/j.tins.2013.12.003
[6] Daniel Bush, Caswell Barry, Daniel Manson, and Neil Burgess. 2015. Using Grid Cells for Navigation. *Neuron* 87, 3 (August 2015), 507–520. DOI:https://doi.org/10.1016/j.neuron.2015.07.006
[7] Joel Chan and Timothy Nokes-Malach. 2016. Situative Creativity: Larger Physical Spaces Facilitate Thinking of Novel Uses for Everyday Objects. *The Journal of Problem Solving* 9, 1 (February 2016). DOI:https://doi.org/10.7771/1932-6246.1184
[8] É. Duvelle and K. J. Jeffery. 2018. Social Spaces: Place Cells Represent the Locations of Others. *Current Biology* 28, 6 (March 2018), R271–R273. DOI:https://doi.org/10.1016/j.cub.2018.02.017
[9] Giuseppe Forte, Francesca Favieri, Renata Tambelli, and Maria Casagrande. 2020. COVID-19 Pandemic in the Italian Population: Validation of a Post-Traumatic Stress Disorder Questionnaire and Prevalence of PTSD Symptomatology. *International Journal of Environmental Research and Public Health* 17, 11 (January 2020), 4151. DOI:https://doi.org/10.3390/ijerph17114151
[10] Marianne Fyhn, Torkel Hafting, Menno P. Witter, Edvard I. Moser, and May-Britt Moser. 2008. Grid cells in mice. *Hippocampus* 18, 12 (2008), 1230–1238. DOI:https://doi.org/10.1002/hipo.20472
[11] Paul Gendreau, N. L. Freedman, G. J. Wilde, and G. D. Scott. 1972. Changes in EEG alpha frequency and evoked response latency during solitary confinement. *Journal of Abnormal Psychology* 79, 1 (1972), 54–59. DOI:https://doi.org/10.1037/h0032339
[12] Jan Gläscher, Nathaniel Daw, Peter Dayan, and John P. O'Doherty. 2010. States versus Rewards: Dissociable Neural Prediction Error Signals Underlying Model-Based and Model-Free Reinforcement Learning. *Neuron* 66, 4 (May 2010), 585–595. DOI:https://doi.org/10.1016/j.neuron.2010.04.016
[13] Rafael T. Han, Young-Beom Kim, Eui-Ho Park, Jin Yong Kim, Changhyeon Ryu, Hye Y. Kim, JaeHee Lee, Kisoo Pahk, Cui Shanyu, Hyun Kim, Seung K. Back, Hee J. Kim, Yang In Kim, and Heung S. Na. 2018. Long-Term Isolation Elicits Depression and Anxiety-Related Behaviors by Reducing Oxytocin-Induced GABAergic Transmission in Central Amygdala. *Front Mol Neurosci* 11, (August 2018). DOI:https://doi.org/10.3389/fnmol.2018.00246
[14] Hei-Jen Huang, Keng-Chen Liang, Hsing-Chieh Ke, Yen-Yu Chang, and Hsiu Mei Hsieh-Li. 2011. Long-term social isolation exacerbates the impairment of spatial working memory in APP/PS1 transgenic mice. *Brain Research* 1371, (January 2011), 150–160. DOI:https://doi.org/10.1016/j.brainres.2010.11.043
[15] Tzung-Jeng Hwang, Kiran Rabheru, Carmelle Peisah, William Reichman, and Manabu Ikeda. 2020. Loneliness and social isolation during the COVID-

19 pandemic. *International Psychogeriatrics* (2020), 1–4. DOI:https://doi.org/10.1017/S1041610220000988

[16] Kathryn J. Jeffery. 2011. Place Cells, Grid Cells, Attractors, and Remapping. *Neural Plasticity* 2011, (November 2011), 182602. DOI:https://doi.org/10.1155/2011/182602

[17] Wendy Ju. 2015. The Design of Implicit Interactions. *Synthesis Lectures on Human-Centered Informatics* 8, 2 (March 2015), 1–93. DOI:https://doi.org/10.2200/S00619ED1V01Y201412HCI028

[18] Jesper Juul. 2018. The Aesthetics of the Aesthetics of the Aesthetics of Video Games: Walking Simulators as Response to the problem of Optimization. Retrieved November 8, 2020 from https://adk.elsevierpure.com/en/publications/the-aesthetics-of-the-aesthetics-of-the-aesthetics-of-video-games-2

[19] Takahiro A. Kato, Norman Sartorius, and Naotaka Shinfuku. 2020. Forced social isolation due to COVID- 19 and consequent mental health problems: Lessons from hikikomori. *Psychiatry Clin Neurosci* (July 2020). DOI:https://doi.org/10.1111/pcn.13112

[20] Ryosuke Kawakami, Kazuaki Sawada, Aya Sato, Terumasa Hibi, Yuichi Kozawa, Shunichi Sato, Hiroyuki Yokoyama, and Tomomi Nemoto. 2013. Visualizing hippocampal neurons with in vivo two-photon microscopy using a 1030 nm picosecond pulse laser. *Scientific Reports* 3, 1 (January 2013), 1014. DOI:https://doi.org/10.1038/srep01014

[21] Kirsten Brun Kjelstrup, Trygve Solstad, Vegard Heimly Brun, Torkel Hafting, Stefan Leutgeb, Menno P. Witter, Edvard I. Moser, and May-Britt Moser. 2008. Finite Scale of Spatial Representation in the Hippocampus. *Science* 321, 5885 (July 2008), 140–143. DOI:https://doi.org/10.1126/science.1157086

[22] Julija Krupic, Marius Bauza, Stephen Burton, and John O'Keefe. 2016. Framing the grid: effect of boundaries on grid cells and navigation. *J Physiol* 594, 22 (November 2016), 6489–6499. DOI:https://doi.org/10.1113/JP270607

[23] Julija Krupic, Marius Bauza, Stephen Burton, and John O'Keefe. 2018. Local transformations of the hippocampal cognitive map. *Science* 359, 6380 (March 2018), 1143–1146. DOI:https://doi.org/10.1126/science.aao4960

[24] RAY LC, Natalie Friedman, JD Zamfirescu-Pereira, and Wendy Ju. 2020. Agents of Spatial Influence: Designing incidental interactions with arrangements and gestures. In *The 15th ACM/IEEE International Conference on Human Computer Interaction.* (The Forgotten HRI), Cambridge, UK. Retrieved from https://www.itec.rwth-aachen.de/global/show_document.asp?id=aaaaaaaaangkias

[25] Alexander Mathis, Martin B Stemmler, and Andreas VM Herz. 2015. Probable nature of higher-dimensional symmetries underlying mammalian grid-cell activity patterns. *eLife* 4, (April 2015), e05979. DOI:https://doi.org/10.7554/eLife.05979

[26] I. Momennejad. 2020. Learning Structures: Predictive Representations, Replay, and Generalization. *Current Opinion in Behavioral Sciences* (2020). DOI:https://doi.org/10.1016/j.cobeha.2020.02.017

[27] May-Britt Moser, David Rowland, and Edvard Moser. 2015. Place Cells, Grid Cells, and Memory. *Cold Spring Harbor perspectives in medicine* 5, (February 2015), a021808. DOI:https://doi.org/10.1101/cshperspect.a021808

[28] J. O'Keefe and J. Dostrovsky. 1971. The hippocampus as a spatial map. Preliminary evidence from unit activity in the freely-moving rat. *Brain Research* 34, 1 (November 1971), 171–175. DOI:https://doi.org/10.1016/0006-8993(71)90358-1

[29] H. Freyja Ólafsdóttir, Francis Carpenter, and Caswell Barry. 2016. Coordinated grid and place cell replay during rest. *Nat Neurosci* 19, 6 (2016), 792–794. DOI:https://doi.org/10.1038/nn.4291

[30] Azahara Oliva, Antonio Fernández-Ruiz, Felix Leroy, and Steven A. Siegelbaum. 2020. Hippocampal CA2 sharp-wave ripples reactivate and promote social memory. *Nature* (September 2020), 1–6. DOI:https://doi.org/10.1038/s41586-020-2758-y

[31] David B. Omer, Shir R. Maimon, Liora Las, and Nachum Ulanovsky. 2018. Social place-cells in the bat hippocampus. *Science* 359, 6372 (January 2018), 218–224. DOI:https://doi.org/10.1126/science.aao3474

[32] A. David Redish. 2016. Vicarious trial and error. *Nature Reviews Neuroscience* 17, 3 (March 2016), 147–159. DOI:https://doi.org/10.1038/nrn.2015.30

[33] Diogo Santos-Pata and Paul F. M. J. Verschure. 2018. Human Vicarious Trial and Error Is Predictive of Spatial Navigation Performance. *Front. Behav. Neurosci.* 12, (2018). DOI:https://doi.org/10.3389/fnbeh.2018.00237

[34] Leo Sher. The impact of the COVID-19 pandemic on suicide rates. *QJM.* DOI:https://doi.org/10.1093/qjmed/hcaa202

[35] Hyun Kyu Shin, Joo Sung Lee, Chan Woo Jung, and Yong Han Ahn. 2020. Relocatable Modular Buildings For A Short-term International Event: The Pyeong-chang Winter Olympic Games. *Journal of Green Building* 15, 3 (June 2020), 3–35. DOI:https://doi.org/10.3992/jgb.15.3.3

[36] Hanan Shteingart and Yonatan Loewenstein. 2014. Reinforcement learning and human behavior. *Current Opinion in Neurobiology* 25, (April 2014), 93–98. DOI:https://doi.org/10.1016/j.conb.2013.12.004

[37] Trygve Solstad, Edvard I. Moser, and Gaute T. Einevoll. 2006. From grid cells to place cells: A mathematical model. *Hippocampus* 16, 12 (2006), 1026–1031. DOI:https://doi.org/10.1002/hipo.20244

[38] R. S. Sutton, A. G. Barto, and R. J. Williams. 1992. Reinforcement learning is direct adaptive optimal control. *IEEE Control Systems Magazine* 12, 2 (April 1992), 19–22. DOI:https://doi.org/10.1109/37.126844

[39] E. C. Tolman. 1948. Cognitive maps in rats and men. *Psychol Rev* 55, 4 (July 1948), 189–208. DOI:https://doi.org/10.1037/h0061626

[40] Prabu Wardono, Haruo Hibino, and Shinichi Koyama. 2012. Effects of Interior Colors, Lighting and Decors on Perceived Sociability, Emotion and Behavior Related to Social Dining. *Procedia - Social and Behavioral Sciences* 38, (January 2012), 362–372. DOI:https://doi.org/10.1016/j.sbspro.2012.03.358

[41] Christopher J. C. H. Watkins and Peter Dayan. 1992. Q-learning. *Mach Learn* 8, 3 (May 1992), 279–292. DOI:https://doi.org/10.1007/BF00992698

[42] Rui Zhu and Jennifer J. Argo. 2013. Exploring the Impact of Various Shaped Seating Arrangements on Persuasion. *Journal of Consumer Research* 40, 2 (2013), 336–349. DOI:https://doi.org/10.1086/670392

From Objects of Sensation to Objects of Thought: Construction of the Space & the Text

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In the most basic definition, the activity that a concrete object forms in the human mind is defined as a '***perception***,' whereas the activity that an abstract object forms in the human mind is defined as a '***thought***.' While the perception is both a problem of intuition and cognition, the thought may be accepted as only a problem of cognition and comprises all mental incidents directed to the knowledge. *'This entirety includes all the facts of consciousness like perception, sensation, comprehension, requisition, contemplation, and visualization.'* [1]. To enable thought, perception has to be realized first. From this point of view, the thought –from the perspective of the empiricists– is regarded as relevant to the ***experience***.

When the perception and thinking activities are entreated specific to the Space Design Education, it may be accepted the First Grade (basic) studio is based on perception focused studies. Various studies based on being able to query and discuss the parameters that built the space and the space perception, in fact, aim to make the student gain awareness related to the outer world and her/his inner world, not to teach something she/he doesn't know. "*Getting her/him to query the principles based on the images that the sensory experience reveals in consciousness"* [2] will also be the prerequisite to enable the student to develop a 'new language' and communicate through this language.

As the student's experience in solving a design problem and know-how related to

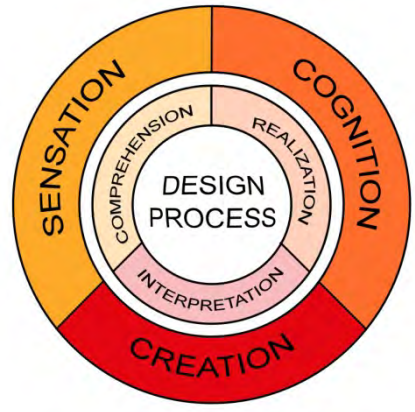
the field increase, the design language that is expected to evolve in her/him will become more competent, and the thoughts expressed with this language will start to deepen. By this competence, the thought can turn on itself, making it possible to generate information about its actions [3]. The student will be able to produce –a double layered– thought based on her/his thought which is the source of her/his actions only when she/he can ***transform*** her/his ***objects of sensation to the objects of thought***.

This study aims to present the ***design knowledge*** produced by a student in the First Grade Design Studio at 2018-2019 Academic Year in the Undergraduate Program of TOBB ETU, Department of Interior Architecture and Environment Design, and the ***design thought*** by the same student in the same context as a result of two-year experience. Both projects to be identified by associating each other are based on the same inductive method and the traceability of the process has been the basis in both of them. Here, the first action is concluded as the construction of a 'space' and the second action is concluded as the construction of a 'text.' In this context, with the first study it was intended the student generate thought, and with the second study, it was intended the student can capture a outlook in her/his mind by generating the thought of her/his thought.

1. Introduction

The First Grade Design Studios where the foundations of the design education are laid create a new activity field directing the student from passive thinking to active thinking. Regardless of the parameters in which the content is defined, the student is expected to switch to a new action-oriented thinking system through the current thinking patterns. This system creates a value for not solving a variety of design problems; but also for the ability of the student to look at the worlds outside and within; and in the intersection of these two areas, and create alternatives to her/his way of being.

These values, which can be read through concrete parameters such as responses to design problems, define a cognition triggered by a sensation in the design process, a new invention based on this cognition, a continuous cyclic structure [4]. The values whose indicators can be read through abstract parameters like the perspectives and attitudes developed for design problems –just as it can be observed in concrete parameters– point to the same circular structure, with an awareness triggered by the understanding of the environment in which it is present, and with a new interpretation based on this awareness.



(Figure 1)

Figure 1. Design Process

Both the answer to the problem and the attitude developed for the answer are the traceable and untraceable actors of the design process. Both are developed by personal experience and skills; any sensory input recorded through awareness creates a new image in the mind by associating with past experiences. These images are the result of the exchange between the space and the subject. While space creates its own sensation, the subject reflects her/his own perception onto the space [5]. This space causes an impression to be produced by the perception if it has a physical definition that can be explained by concrete parameters, and by the thought if it has a conceptual definition that can be explained by intangible parameters. For this reason, the subject of the cycle in question is space perception/space thought, which undoubtedly constitutes the basis of this study.

The First Grade (Basic Design) Studio is an environment where awareness of the depth of the concept of space is just beginning to be gained. The ability of the student to create her/his definitions will only be able to turn into an awareness/cognition as a result of her/him being able to link the concepts she/he is exposed to with her/his own experiences. Therefore, space is approached based on the perspective of the empiricist: According to this, space is a subjective reality that is understood through the senses [6]. Thus, each suggestion made to define the space will require that the student who created it to be aware of her/his mental processes and make it traceable.

The First Grade Design Studio carried out under the coordination of Şaha ASLAN, in the Undergraduate Program of TOBB ETU, Department of Interior Architecture and Environmental Design Department since the 2015-2016 school year, ***builds its approach upon the student acquiring the ability to structure her/his thought string.*** The space at the focus of the thought essentially creates both a field of material and an emotional field with its form. These two concepts, which cannot be treated individually, require both sensory and intuitive perspectives. For awareness development in this context, an analytical approach to the subject will liberalize the studio environment so that each student can define her/his perspective.

The mentioned study includes a proposition on how the students can produce the **design thought** they have built with their subjective experiences in the first year of their education through the **objects of the senses**, and the **designer perspective** they have built with their awareness gained over a four-year training period through the **objects of thought**. In the first of these propositions, the space becomes meaningful through the material substance and in the second through the correlations established through a text.

The necessity for the representation of both propositions as a text has been resolved by two interlaced text constructs in the paper. The sensory pattern to be defined within the scope of ‘Objects of Sensation’ (through the writing of the class coordinator and the work of a student) is the conceptual structure of the textual pattern to be defined within the

scope of 'Objects of Thought' (written by the same student). With this information, the reader can jump to the conclusion by bypassing 'Objects of Thought,' if desired or consider this title as an independent section.

2. Objects of Sensation: Construction of Space

Design thought needs an active action-based thought environment, not a passive one. A photograph is one of the most effective tools that can lead a mind that has not experienced thinking by doing.

With its very strong relationship with time and space concepts, photographic image represents a moment fixed in the fluidity of the time, in which the subject's act of seeing is represented by ***camera obscura***. With its status as the only tool in which vision can be understood and represented, between the 16th and 19th centuries, camera obscura is regarded as a way of objectivizing the individual cognitive process where sensory data turns into perception and interpretation. The ***photographic image***, as a product of 19th-century industrial society, defines reality through visibility, and creates a match between the two concepts [7].

The transformation of spatial space into a photographic image by reducing it to two dimensions with a tool, in other words, the transformation of the physical reality of the space into an illusion and disappearance of its depth, creates a very valuable environment for the subject to gain awareness of the dimensions he did not realize while fixing this image and to generate ideas about what is objective. Thus, she/he will have the opportunity to show her/his (objectiveness) view/stance in the (objective) image fixed by reconstructing the image.

The lack of experience of the individual who will create design ideas (in the context of the First Grade Design Studio) in producing this idea influences the way the space is constructed in the said studio work, by not building it from scratch, but reinventing (transforming) the existing one. Thus, the rebuilding of the physical space discussed will require the identification of the elements that make up the existing, in other words, the identification of the objects of the sensation.

Creative Species (2017) written by D. Eagleman who carries out his studies in the neuroscience field at Stanford University in company with A. Brandt, the composer, and composition and theory professor, suggests that the human mind produces information through remodeling activity by feeding on raw material like experience, memory rather than creating innovation from the void, and defines this activity through three methods [8]:

- BENDING process in which the event is portrayed in new ways,
- FRAGMENTATION process where the event is broken and a new whole is created from the parts,
- BLENDING process where two or more resources are combined in a new way.

Bending, fragmentation and blending are the tools of the brain to transform concepts, events, and situations. The activity of these tools references that the environment is regarded as a set of

possibilities that produce alternatives (subjective) and not as a set of (objective) facts in which it is presented as patterns.

'*Considering what is available and creating different reality options by converting it into a series of possibilities*,' [8] evaluating sensory data as an operating system rather than a kind of recording device, '*remodeling what is present*' plays a decisive role in the mentioned studio's perspective on the design problem. In this context, the studio defines the concept of *creativity* from its infinite definition as '*not inventing what is not present but creating new relationships between what is present.*' [9]

At this point, the identification of the elements that create the space, and the space expected to be rebuilt on a single type of relationship selected among the network of infinite relationships between these elements are ready to focus on 'how' the mind that produces it thinks, rather than 'what' it thinks, and to comprehend what is there and to produce possible alternatives.

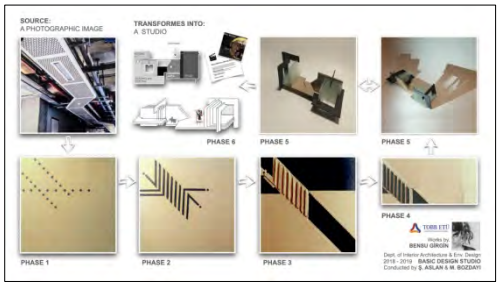


Figure 2. Construction of the Space.

As part of the Basic Design Studio carried out under the coordination of Şaha ASLAN, in TOBB ETU, Department of Interior Architecture and Environmental Design in the 2015-2016 school year, the starting point/source for the (re)construction of the space is a photography frame from the place where the students are most familiar, the building where their studio is located. (Figure 2: Source) The volume reduced to two dimensions with this frame should be redefined with the point, which is the most basic element that makes that volume detectable. As of this first stage, the student will also provide initial descriptions of the relationship between the 'Designed Space' with only an objective reality and the 'Perceived Space' with which he has produced limited experiences in this reality. (Figure 2: Phase 1) Undoubtedly, this action whose awareness will develop over time, the formal intervention on the image, will start to transform and transfigure as it becomes dimensional at first with the lines and then with the surface elements. (Figure 2: Phase 2-3-4) Each stage of transformation focuses on the ***aesthetic function*** of the space which is the resource by removing its pragmatic function.

The search for the third-dimensional equivalent to the alternatives that are also created in two dimensions of the volume which has been reduced to two dimensions before by the student by photographic imaging (Figure 2: Phase 5) is a kind of construction phase, in which new types of relationships are designed. As of this stage, the pragmatic function is now completely excluded. The student starts to be able to monitor the tendency she/he showed (herself/himself) about the form and forming approach, to

assess and manage herself/himself through the alternative producing skill in that progress.

Rebuilding the form is not just a plastic (aesthetic) problem. Transformation of the form, with its potential, will cause the content to transform as well. The change of the perceptible will also start to change the thought; perception patterns will begin to transform and create new meanings within the new string it was defined in. At this point, as of yet, activation of the ***symbolic function*** along with the ***pragmatic function*** is a moment when the physically 'reproduced' space through a photographic image is once again 'redefined' as content. (Figure 2: Phase 6) The process ends with a 'Space of Living' proposition developed by the student.

The experience recorded through this process refers not only to a simple transformation/metamorphosis process designed for the construction of design knowledge/space but also to a concept development process built for the construction of the design thought. In other words, these actions (often unconsciously carried out) set the stage for ***untraceable outcomes*** like establishing the foundations for the construction of thought, and is not limited to (recently acquired) ***traceable outcomes*** like 'the ability to do,' 'language skills,' and 'the ability to deal with a problem.'

The method must be learning-centric, as the design information is a type of information that cannot be transmitted from the outside. However, it can be structured as discovered by the student [10].

3. Objects of Thought: Construction of Text

Undoubtedly, when it comes to design and creativity, both notions of design and creativity are comprised of processes, and cognitive approaches that are developed to explain these processes are diverse. Some approaches are focused on those processes through ***creative personality*** and the unconscious mind of personality (Freud) or the level of intelligence (Guilfold), some are through the ***creative product*** and originality/availability of the product (Stein) or problem compatibility/transformation potentials (Jackson & Messick), some are through the creative process and the differences and similarities of this process observed by individuals, and some are through the ***creative environment***. Regardless of the focus, these four factors (4P's Model of Creativity, Rhodes) are in a holistic relationship that can't be separated from each other.

B. Bloom, an educational psychologist of American origin, summarizes the learning patterns in the taxonomy he developed (1954) with three main areas: thought, attitude, and skill. Accordingly, the ***thought*** (knowledge, comprehending the knowledge, using the knowledge, analysis, synthesis, assessment) is related to the cognitive domain of the mind, the ***attitude*** (perception, answering, evaluation, organizing, identification) is related to affective domain of the mind, and the ***skill*** (imitation, manipulation, debugging,

articulation, adoption) to the psychomotor domain of the mind.

When a literature review is carried out throughout the work on creative processes, although it is observed that the tendency is to position students' design activities under cognitive processes, design training has a balanced relationship with those three areas of Bloom. The student is obliged to develop her/his cognitive competence, readiness level in the studio environment, willingness, ability to characterize the problem encountered, description of the problem with master-apprentice interaction, approach to the problem, and thoughts, attitudes, and skills with the investment required to make herself/himself to obtain all the necessary infrastructure for the solution, as a whole [11].

This holistic structure can also be observed in the *Experimental Learning Theory* (1984) of Kolb, a U.S.-based education theorist. According to him, the thought an action is determined by the perception and experience. In this environment, thought creates an endless cycle of abstract to concrete so that each action can give rise to a new thought or each thought can trigger a new action [12].

In this study, the string built for the CONSTRUCTION of the SPACE which references the ACTION was defined so as to identify the elements that compose the space as the objects of sensation, and to define the relationship between them. At every stage the process has been managed so that the work gains a dimension at every stage (Figure 3); this multidimensionality expected an awareness would arise not only about volume but also about the concept of space. The student was expected to perceive that the conceptual dimension of the space deepened with its aesthetic, pragmatic, and symbolic functions as she/he developed her/his experience in building the material space.

With this method, the student's response to the defined design problem is open to observation and evaluation. However, the attitude developed by the student against this problem cannot be evaluated with the same clarity. Perhaps the most fundamental problem of the first-year design studios is the complication of qualitative assessments of the methods that are applied due to awareness gained not before but after.



Figure 3. The String of the Construction of Space .

The skill which the studio coordinators want to provide students is not only about the building of space, but also about the building of thought, in other words, the aim of learning to learn makes all methods assessments inherently incomplete. Due to the mentioned concern, this study defines a second study for the CONSTRUCTION of TEXT that refers to THOUGHT in the same string with the same supervisor and the

same student, two years after the sample study was carried out.

This study, which questions the objects of thought, considers the source as a 'point' by abstracting it from its depth, just as in the previous study. This point will take a course as the mind defines it, meaning will be given by the expansion of this definition. (Figure 3) However, a meaning fed from a single source will be insufficient in creating value. For this reason, the student is expected to identify at least two points to help the conceptual depth of the thought he developed, no more than three points to deal with this idea, and size those points. The resulting pattern is again a space pattern, but this time space was identified by the construction of a text. (Figure 4)



Figure 4 The String of the Construction of Text

The reader can find the constructed text discussed in this section under the heading "*The Flow Process of Perception From Subject, Space and Education*".

3.1 The Flow Process of Perception From Subject, Space and Education

Introduction

Both embodying of its reality and self-positioning of the entity, and gaining a description of the space through the incident is a problem of perception. The development of perception in different shapes in different bodies in line with the environments in which we live and what we are taught is directly related to the fact that the individual forms circles –in which she/he lives– that eventually create a border, no matter how large it is. These circles form perception. We are deciding through what kind of window we look at the world and how we interpret spaces, in a way that we think is free, by going into one of the perspectives that the environment offers and defining our circle. The same perspective applies to education... In areas like design training that create a new way of thinking from scratch, interact with a wide range of disciplines and thereby feed itself, the methods supporting the existence of the circle are a major problem. To create an alternative to this problem, the supporter's, rather than the guide's, ability to fly with those who want to learn should be the main goal to achieve the authenticity that the design should not lose. The Bauhaus school that is often referred to in today's design education is a barrier to students' efforts to break their circles as the definition of instructing is still hosted by it and continues today.

From Subject to Consciousness

Ernst Fischer, in his book The Need for Art, suggests that the moment passed was not real and that situations would only become reality when they were mentioned. When interpreted



from this point of view, the transmission is the prerequisite for reality, and reality is a balloon that is suspended only in space-time space without transmission. The fact that someone died never existed for us until we thought that that person had died. By interpreting this through the entity, Hegel says, 'The entity is not real on its own, but the only thing that is understood is real,' and this sentence [13] suggests that "According to whom and related to what an entity/event/situation is real?" or through the same questions again, 'How much has it been able to make itself real?'

W. Ross Ashby, in writing Design for a Brain, states that he does not use subjective elements, with similar concern to the questions and problems mentioned earlier; because it is impossible for a self-defining subjective reality to be transmitted to the other party based on the description of the individual according to him as well [14].

At this point, according to whom and related to what the situations and entities are perceived, becomes a question mark also for space where they can realize themselves. To what extent can space achieve the goal of defining perceptions and movements laid on it. Or are the initial ideal definitions clear and universal (!) definitions?

Within the scope of these questions, we can accept that we have adopted the space as much as we have experienced and subjectified and that we can exist (within). This space we have a relationship with continues to exist in our subjectivity.

Everything we think we perceive as concrete and abstract around us is the reality we adopted through experiences and subjective life experiences. So, is the subjectivity leading us to percept this in our reality, subjective? According to Ulus Baker, what determines the subject and its perspectives is the position she/he obtains from the perspectives within the environment and the period the subject lives in [15]. So, the things that we perceive and interpret with their tangible or abstract nature around us are not as subjective as we think. We become the subject as much as we can position ourselves in the perspectives of the environment and start to perceive the environment from this perspective. We can describe this situation as an infinite interaction with both sides on the circle.

From Space to Event


Space

The space-event relationship can be explained with a similar approach. According to Tschumi, space identifies the event and vice versa, and the events that take place in the current environment (political and social) affect the production of architecture and images [16]. Tschumi's focus on concepts such as the program, event, performance, and urban space he defined himself is based on the methods of thinking proposed by the era. Playing the subject role by finding a place himself in one or maybe a few perspectives offered to him by the past, future, and today in which he maintains his active existence within the period he lives, and the ideas he has generated in that process, creates new spatial concepts.

Another issue Tschumi puts on is overflowing the circle! According to him, the idea of order should be a concept

that needs to be constantly questioned. By saying that architecture can only exist to the extent it rejects the form society expects from it [17], he defines flowing out of what is imposed and becoming free, and the situation of the aforementioned people and the environment being in a continuous movement that affects each other, brings that freedom and overflowing situation under question. In other words, the situation of overflowing the form is as permissible as the environment it is in, and no matter how large the prison, it is a prison at the end of the day.

Subject and Space Relation

The subject evaluated through Ulus Baker and Bernard Tschumi in the flow of text up to this point has to place itself within the views that are created by the circle constructed around it, that defines a border to some extent, like an environment it is present at and the culture where it is born. Based on this, it can be claimed that the event defines the space and space defines the incident. Because the events introduce different identities into spaces that can be defined as new subjects. Any change the subject/space experienced may have a meaning for the first time or a new meaning again in one of the ways of thinking the period and conditions present it; and continues to exist until a new pattern (circle) is formed. The blindness that is meant to be expressed by this pattern, circle, and boundary analogy is that it pushes a person to become a subject as much as the environment allows. In other words, ideas and judgments are not values composed with free will, but thoughts that evolve to the extent permitted within a given pattern.

Aristoteles can be characterized as an someone that goes beyond the times with his thoughts, and being shown as a reference still today is a situation supporting that. However, when Aristoteles' history is examined, it was not the product of his birth as a person with a sense of power, intelligence, or foresight that makes him ahead of his time, it was the opportunities offered to him. At this point, Marx's saying, 'It is thought differently than a palace in a cottage' has come to mind. Affirmatively, Aristoteles was born into an elite environment and raised in that environment. His father is the private doctor of the King of Macedonia (grandfather of Alexander the Great). When he grew up, he went to Plato's Academy, which was the best school in his time, where he studied for 20 years.

By his thoughts on this world, he was one of the first names to question the moral dimension of slavery. In a way that is never acceptable due to today's perception, under the name of science, he has divided people into two categories by constructing a cover to the enslavement system from the past: Those who are born slaves and who are not born slaves. According to him, those who are born slaves are those who cannot think adequately and have physical deformations that cannot be happy if they cannot find an owner. Based on this idea, he argues that working 18 hours a day is something that would make them happy.

From the same point forth, believing in the superiority of men, he defines women

as a second-class citizen who does not understand money affairs, cannot think, or take care of herself, and he attributes the fall of Sparta to the fact that Spartan men are ruled by women [18].

The culture of slavery in which he was born and the idea that non-slave women should also be close to slaves is the desire to live the pros of Aristoteles, who were born in an elite neighborhood as a man. In other words, he becomes the subject of the environment by settling in one of the patterns provided by the environmental conditions he is present in.

From Education to Bauhaus



Today's design training, although it appears to be independent of the content mentioned above, is essentially located on the same problem.

In general, the educational process has a role for each student strong enough to be based philosophy of life. In particular, design training is an equivalent process to learning to read and write at some point. In this period, while it is learned how to think, express thoughts, evaluate environmental-human relations, and the methods to create alternatives for these values, on the other hand, the student is expected to delete the learning patterns for the pre-license period and open a new clean book, however, her/his perspective on learning is defined through the instructor.

At this point, students are expected to set their mind free and to come up with different ideas by moving out of the box, it is expected that the free mind will be positioned in a new circle directed by the academician. For the student who is not familiar with the culture of the environment she/he is in, the new circle presented to her/him undertakes the role of some kind of shelter. The vessel berths at the safe harbor for a period changing from person to person. Each passing period and each year with new circles offering perspectives changing with changing academicians, cause the student to ask the question of 'Which border should I be within this time?!'

In fact, at some point here, the guiding person who approaches the student to the circle may represent an academician who has never believed in or stopped believing in the idea of a pathless and open-minded free environment of thinking mentioned above... living the anxiety of a parent instinctively pushes her offspring that walked away, back into the herd!

When an individual defines her/his sense of success and satisfaction, especially like design, through her/his authenticity, limits her/his mind to the radius of a circle called Ecole, and restricts her/his self-criticism with the area defined for her/him; she/he shall be able to perceive and evaluate her/his surroundings to the extent permitted by this pattern.

In the design field, discussions continue on the search for ideal training models and the nature of the training provided; with time changing, with new technologies and new ideologies emerge, new training methods emerge. One of these is the Bauhaus Ecole, which is known in our country and can be tracked in institutions that provide design training and aim to integrate arts and crafts as a kind of improvement strategy

after the collapse of World War I. In this integration, the method was to bring the work created by the artist to the public, either by making concessions or without waiting for the public to reach their level [19].

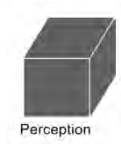
The modernization movements of the Ecole were essentially a standardization act. Given its time and circumstances, its quest for answers to the problem and its acceptance of its students as part of the solution was important and very valuable. Van Der Rohe expressed the importance of that value with the following words: 'The fact of being an idea lies based on its strong impact on all of the progressive schools in the world. Such an impact can be achieved with no organization or propaganda. Only an idea has the power to make an impact so that it can arouse wide echoes.' [20].

This school is a big part of today's education, from our queries under the Basic Design class to the rationale and the solution of the ideas that form the basis of studio lessons. But it's like asking for different solutions to questions and problems and trying to get to the same red house in different ways. Even though different ways take people through different ways of thinking and experience, the effort to always get to the same point does not define a free space, even though circumstances and situations are allowed to be approached from different perspectives.

When you search the meaning of the word Ecole used frequently next to Bauhaus, the definition you will find is a method or stream/school definition that has different qualifications and characteristics in an art branch. In other words, there is a user's manual that does not include the 'never do' part. The designs of almost all designers identified through this Ecole have timelessness and universality. So, when Bauhaus challenges the time and idealizes yellow, red, and blue, isn't it clearly defining a circle? Doesn't it standardize its thoughts and turn the artist into a craftsman rather than a designer? When it is reviewed through the conditions of the period in which it was created, isn't it wrong to say that this idea, which seems perfect and works smoothly, can continue in all of today by serving its aim?

Today, as the Bauhaus idea finds a 'comfortable' place for itself because of its important role in education in history: it defines a new circle that needs to be entered in the hope of liberating minds. When the learners who come out of these and that kind of circles will be the ones who teach tomorrow, the design methods and strategies they develop will compose from the boundaries of that circle. Because as an instructor and as a learner for at least four years in the past, he may not even know about the existence of the circle during the period of his activity, with the self-confidence that is anchored by his experience. She/he will have taken her/his reality from a point of view in parallel with the training he received; because it's going to be presented to her/him from the very beginning, 'What is design?'

Conclusion



In an interaction that we can define the subject through the conscious and space through the event, the key point is the perception describing the conscious and

event through the subject and space. With the approach developed through this text, perception is defined by the width and area of the circle created by the environment lived within. Educational institutions, as the most significant factor defining the environment, should have a structure that gives an individual a new perspective and that essentially refuses to be trapped between boundaries with the role of new thinking and creation relations. Otherwise, it will define a situation that requires much more precision and rigor, such as being inside the circle metaphor, staying out, standing on its side, and flying on it. The worst thing, no doubt, is that even the existence of the circle is unnoticeable.

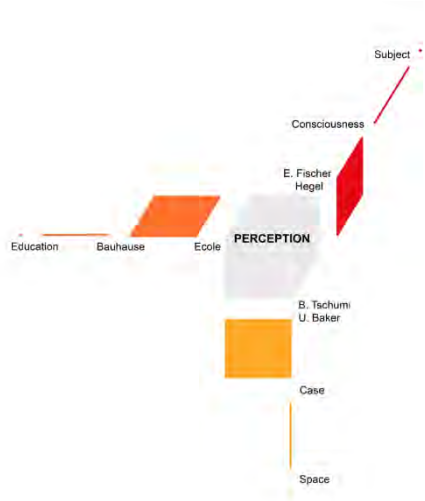


Figure 5 The String of the Construction of Section 3.1.

4. Conclusion

As part of this study, the basic dynamic of the relationship between perception and thought was defined as experience. Both studies sampled as both for the construction of space as the object of sensation and the construction of text as the object of thought were based on the ability of the student to structure his or her thought-line by deductive method. In this context, the work aimed to ensure the traceability of the relationship between the non-existent and not the invention of the non-existent.

The deeper and more comprehensive implications of text (words) than the space[3] will lead to longer periods and wider experiences for the construction of the text.

'*The senses first let in the partial ideas, start to tile in the room that is still empty, and as the mind gradually recognizes some of them, it places them in memory and names them. Then the mind goes further and abstracts them and learns to use step-by-step general names.*'[3]

The transformation of the collaboration at the First Grade Design Studio and design information produced as a result of this collaboration into the production of design thinking with another collaboration at the end of the two years passed, serves as a good example of Locke's thought above quoted from his work entitled *An Essay Concerning Human Understanding* (p. 78).

As mentioned earlier in the study, the ability of the student to create her/his definitions can only be transformed into an awareness/cognition as a result of associating the concepts she/he is exposed to with her/his experiences. It is undoubtedly the best gift for a studio coordinator to lay the groundwork for this awareness and observe development.

References

[1] Orhan Hançerlioğlu, *Felsefe Sözlüğü* (Dictionary of Philosophy), Remzi Bookstore, Istanbul, 1985.

[2] Şaha ASLAN & Ferhan KIZILTEPE, 'The Senses in Basic Design Education,' XXI. Generative Art Conference, Verona, Italy, 2018.

[3] John Locke, *An Essay Concerning Human Understanding*, Kabalcı Publishing House, Istanbul, 2004.

[4] Mesut Çelik, 'Tasarım Sürecinde Nesnellik: Tasarım Sürecinin İzlenebilirliği Üzerine Bir Yöntem Denemesi' (Objectivity in Design Process: A Method Trial on the Traceability of Design Process), Istanbul, 2011.

[5] Juhani Pallasmaa, "The Eyes of The Skin", YEM Publication, Istanbul, 2011.

[6] Ahmet Cevizci, *Felsefe Sözlüğü* (Dictionary of Philosophy), Ekin Publications, Ankara, 1997.

[7] Ahmet Elhan, 'Fotografik Bir Düşünme Biçimi' (A Photographic Thinking Form); Ayşe Şentürer, Şafak Ural, Özlem Berber, Funda Uz Sönmez, in 'Zaman-Mekan' (Time-Space) (pp. 68-73), YEM Publication, Istanbul, 2008.

[8] David Eagleman, Anthony Brandt, "The Runaway Species", Bkz Publication, Istanbul, 2019.

[9] Şaha ASLAN, 'Temel Tasarım Stüdyosunda Bir Kavram Geliştirme Deneyimi: Kavramı Dokumak, Kavrama Dokunmak' (A Concept Developing Experience in Basic Design Studio: Weaving the Concept, Touching the Concept), 6th International Interior Architecture Symposium: Innovative Approaches in Space Design, Trace of the Material (pp. 72-88). Istanbul: Mimar Sinan Fine Arts, 2018.

[10] Semra AYDINLI, 'Tasarım Eğitiminde Yapılandırıcı Paradigma: Öğrenmeyi Öğrenmek' (Configuring Paradigm in Design Education: Learning to Learn) Design Theory. 2015; 11(20): 1-18.

[11] Şaha ASLAN, 'Temel Tasarım Eğitiminde Duyum Sürecine Yönelik Bir Yaklaşım' (An Approach to the Sensory Process in Basic Design Education), Hacettepe University, Institute of Social Sciences, Interior Architecture Program, Proficiency Thesis in Art, Ankara, 2012.

[12] David KOLB, 'Experiential Learning: Experience As The Source Of Learning And Development,' Journal of Business Ethics, Englewood Cliffs, NJ, Prentice Hall Publ., 1984.

[13] Fischer, E. (1985). *Sanatın Gerekliliği* (Necessity of Art) (Volume 5. Edition). Ankara, Maltepe/Ankara, Turkey: Kuzey Publication.

[14] Ashby, W. R. (1960). *Design for a Brain* . London: John Wiley & Sons. Inc.

[15] Baker, U. (2015). *Kanaatlerden İmajlara Duygu Sosyolojisine Doğru* (From Opinions to Imagination, To Sense Sociology) (Volume 4. Edition). (K. Ünüvar, Ed.) Istanbul, Topkapı, Turkey: Birikim Books.

[16] Bekmezci, B. (May, 2016). Mimarlığın İşaret ve Semboller Dili: Tschumi'nin Manhattan Transcript'ini Anlamak (Marks and Symbols Language of Architecture: Understanding Tschumi's Manhattan Transcript). *Gazi University, Faculty of Architecture - Department of Architecture*.

[17] Tschumi, B. (1996). *Architecture and Disjunction.* London, England: The MIT Press.

[18] Kıran, A. (14th October 2017). *Aristoteles ve Kölelik* (Aristoteles and Slavery). Quoted from Serbestiyet: https://serbestiyet.com/yazarlar/aristoteles-ve-kolelik-13408/

[19] Şaha ASLAN & Ferhan KIZILTEPE, 'Bauhaus Ekolünün Değişen Paradigmaları: Tasarım Eğitimini Yeniden Düşünmek' (Changing Paradigms of Bauhaus Ecole: Rethinking

Design Training); A. Derin İnan, Ali Cengizkan, In *Bauhaus_100+TR (pp.300-319),* TED University, Faculty of Architecture Publication, Ankara, 2020.

[20] Serap BULAT, M. B. (2014). 'Bauhause Tasarım Okulu' (Bauhaus Design School), *Dergi Park. 2014;* (18):105-120.

Bewitching Books: using technology to add magic to picture books

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Premise

Picture books introduce children to wondrous new worlds where thoughtfully crafted images enable them to expand their imaginations. But what if those images could move? How would they help tell stories better?

For the longest time technology has been looked at as something that reduces attention spans and diminishes traditional reading experiences. So, it's easy to look at it as an adversary. However, in this paper we discuss how technology can be used to reach more readers and develop new ways of storytelling.

Writing and illustrating are inherently creative processes and it's easy to dismiss the involvement of technology in them. However, fresh illustrating techniques and styles have evolved out of the use of computers, access to millions of children has been made possible and, in Pratham Books, new storytelling techniques have emerged -- like our GIF (Graphics Interchange Format) picture books. In these books, with the help of technology, we were able to bewitch picture book illustrations and make them move and dance as GIFs.

The looped images make the books come alive by creating an immersive experience. We put this to test by choosing to tell three stories using GIFs. We will elaborate on how we went about picking stories, illustrators and art styles best suited to this unique format. We will also discuss what technical specifics were involved in making sure that the

GIFs would load quickly on our digital content platform StoryWeaver even on a low speed internet connection, with minimal loss of quality. We examine how these books and other unique formats reach even the most reluctant of readers, a lot of whom don't have access to books and technology freely.

1. The joy of reading

Give a child a book, and you are giving them the most advanced technology. A book allows a child to travel to places, both real and imaginary, to inhabit the lives of people vastly different from their own lives, and to encounter ideas that they may not have a chance to, in their immediate environment. Reading shows children what the world is like and gives them the tools to imagine what it could be. In addition to developing literacy and language skills [1] and contributing to mental well-being [2], reading from a young age develops empathy and understanding [3]. It helps create open-minded and kinder adults.

However, a significant number of children in India, and across the world, don't have access to books at home. Of the 387 million primary school-age children unable to read proficiently, 262 million (68%) are in school. A primary reason for this gap, as per a UNESCO report [4] is that children should be taught in a language they understand, yet as much as 40% of the global population doesn't have access to education in mother-tongue languages. Already dire, the situation has worsened during the global COVID-19 pandemic we are facing right now. As of mid-April, 1.5 billion children and youth across the world had been at home as schools and colleges were closed [5].

Making sure children have books they can afford, in languages they understand, and ones that are engaging and relatable, is a significant step towards spreading the joy of reading.



It is with this idea, to spread the joy of reading to *all* children, that Pratham Books was set up in 2004.

Pratham Books is an Indian nonprofit publisher of good quality, multilingual picture books. Picture books, meaning books where words and pictures work together to tell a story, are typically made for young readers. The mission of seeing 'a book in every child's hand' makes clear the goal of the organization, which is to support book access by producing books that are available at a low cost, are set in a context that is familiar, are published in mother-tongue languages, and, most importantly, have words and pictures that draw readers in.

The way this is ensured is by working with a robust network of some of the best editors, art directors, writers and illustrators in the country, through a process that is cognizant of the needs and reading habits of our readers, especially the most disenfranchised ones.

Since its inception, Pratham Books has published 5000 books in 24 languages.

2. Climbing the mountain

Imagine a place full of books, located on top of a mountain. No one lives there but anyone can climb the mountain. Now imagine that some people have helicopters to fly them there whenever they like. Others have cars or very good hiking boots. But there are some who have no shoes, and still others who cannot walk.

So how do we make sure everyone can climb the mountain?

For a large part of the world's population, books are not a privilege they are able to enjoy. When they first encounter books, it is in school and their ability to read is not at par with other children their age, and the books are either only academic or too challenging. According to the Annual Status of Education Report (ASER) of 2019, 21% children in Std I of government schools could read words as compared to 46.7% children in private schools – an advantage of 122%! [6] A big part of ensuring book access is creation, but the other major part is being able to get these books in the hands of those who need them most.

3. Enter StoryWeaver

To this end, in 2015, Pratham Books launched StoryWeaver, a digital platform that publishes richly-illustrated, multilingual books for free, under the most liberal open license, CC-BY 4.0. This licence allows books on StoryWeaver to be completely adaptable to users: they can read, download and print books, they can translate or relevel books, and they can also create their own stories. Its core mission being that of inclusion and erasure of boundaries, StoryWeaver is a multi-publisher platform with books from publishers like Room to Read, Book Dash, and translation partners like African Library & Information Associations & Institutions, Darakth-e Danesh Library, Konkani Bhasha Mandal, among others.

In five years, StoryWeaver's repository has grown from 800 books in 24 languages, to over 27,000 books in 280 languages, with a readership of 50 million and users from 150 countries: 57% of languages featured on the platform are indigenous, 12% of the languages have been classified as vulnerable or endangered by UNESCO.

The impact of StoryWeaver is being realised in a dramatic way now, during the pandemic. In the initial months of lockdowns and school closures, from April to June 2020, the StoryWeaver user base grew by 150% over the previous quarter, with increased proportion of traffic from early COVID-19 impacted countries in Europe like Italy, France, Spain. In Italy, for instance, we saw users creating stories to help them cope with their situations, like that of a lonely tree in an isolated garden, or of a child who is forced to stay home because of a mysterious virus.

Pratham Books was awarded the 2020 David M. Rubenstein Special Response Award by the Library of Congress for its impact during the pandemic [7].

4. Glued to the screen

The increased availability of low-cost smartphones in India since 2010 has created the right conditions for digital adoption and literacy to grow. In 2018, at 483 million users, India had the world's second largest internet population, of

which 81% of these users accessed the internet through their mobile phones [8]. From 2018 to 2020, the proportion of households owning a smartphone increased enormously – from 36.5% to 61.8% [9].

Pratham Books has found that over 60% of all consumption of StoryWeaver is on mobile phones. Keeping this in mind, we wanted to explore different ways in which a story can be read and enjoyed on mobile phones.

One of our first forays into these explorations were PhoneStories [10], which were launched in November 2017. Containing subtle animations which make the illustrations gently move through the story guided by a narrator, this set of four stories were meant to be easily shareable in a video format.

Telling stories about wildlife, the books used visuals and sounds to make the books engaging for younger readers. A callout to the community resulted in people sharing actual forest and bird sounds and releasing them under the CC-BY licence out of sheer goodwill. These were used in titles, *Watch Out! The Tiger is Here!* and *Did You Hear?* Readers who might not get an opportunity to visit a forest, could experience it come to life on their screens. Books have always had the ability to be able to transport us to new and unexplored places. But technology can be used to take this ability to the next level.

By collaborating with literacy organisations and government schools, we were able to reach 2,800 schools/centres and teachers, resulting in over 56,000 children reading these stories via WhatsApp.

Encouraged by the success of the audio narrations in PhoneStories, StoryWeaver launched Readalongs in September 2018. Available in four languages, these are audio-visual storybooks with subtitles that mirror the audio narration, allowing early readers to listen to as they learn to read. Readalongs and are used by educators to help early readers build language and pronunciation skills. They have been viewed more than 4 million times and, given the demand, efforts are being made to make Readalongs available in more languages.



A still from the video of the first of the PhoneStories, Watch Out! The Tiger is Here! (written by Sejal Mehta, illustrated by Rohan Chakravarty)

With PhoneStories, we were able to introduce motion into storytelling. However, it has been observed [11] that too many interactive elements sometimes take away from the narrative itself and reduce story comprehension. What we wanted to do was combine the appeal of watching a video with the intimacy of a traditional reading experience, so it would feel like reading a magical book.

5. The GIF of movement

That ideas come from unexpected places is not just a platitude. The team that worked on these books (led by Bijal Vachharajani, senior editor at Pratham Books) is often known to have entire, rather complex, conversations only using

GIFs. It was one such conversation that led to the idea that the singular enjoyment provided by the limited but expressive movements of GIFs could be combined with the joy of picture books.

The intent behind GIF books is to make the digital reading experience a uniquely enjoyable one. It's no secret that human eyes are drawn to colourful, moving images. To use that tendency to get a child to read a book was an idea that held appeal, especially for us, knowing that so many of our readers are reluctant and approach a book tentatively. Moreover, since many of our books are accessed digitally, we wanted the readers to know that digital reading was not a compromise. We did this by giving them something that they could not get from a physical book.

GIF books are just like picture books, except that the pictures move. By using an image in the GIF format, instead of a stationary image, we are able to enchant the book to make the reader want to turn the page. The pictures in the books contain specific repeated movements, so we avoid losing the essence of reading a book. Readers can still turn the page at their own pace, spending time poring over the text and enjoying the images.

5.1 When we read, we begin with G-I-F

We decided to create three GIF books, in five languages each. This was the first time something like this was being attempted, so selecting the right scripts was very important.

We wanted to pick stories that would work across different age groups, and appeal to readers with varied interests. However, we did want to make sure that they would lend themselves to this format. Since GIFs are all about movement and magic, the three books needed to contain these elements. We wanted the books to have a universal appeal, so we reached for the most universally beloved children's book quality: humour.

Gappu Can't Dance [12], written by Menaka Raman and illustrated by Krishna Chandran, is about a girl who keeps getting her steps wrong in a dance class. When everyone in class raises their right hand, Gappu raises her left. Using sounds and movement, this book tells a story about self-acceptance and embracing your differences. So, to be able to see and dance along with these wide-eyed children, and to see Gappu doing the opposite of what the rest are doing, enhances the experience of reading the book.

The Big Book of Boochandis [13], written by Pavithra Sankaran, illustrated by Rucha Dhayarkar and art directed by Somesh Kumar, is about Indian folkloric monsters called boochandis. Through irreverent rhymes, the book introduces readers to a cast of wildly different boochandis who live all around them, if only they would notice. And what better way to get them noticed than by watching them move in and out of the frames and wiggle their bellies.

Shoecat Thoocat [14], written by Shalini Srinivasan and illustrated by Aindri C., is the story of the relationship between a girl and Shoecat, an alien that crashes into a tomato field. It's a droll fantasy that is both amusing and unsettling, often at the same time. The use of GIFs here was able to heighten the otherworldly feeling of the story. Whether it's the Shoecat's iridescent fur, or the green glow left by its

scratches, the GIFs in the book immediately give the reader the impression that this is no ordinary book.

5.2 Drawing out the GIFs

Once the three titles were selected, we had to figure out who would be the best illustrators to bring these books to life. We considered the following:

- An illustrator with animation skills
- An illustrator who would be able to consider movement while creating the illustrations

The brief given to the illustrators was to emulate the effect created by a cinemagraph. Cinemagraphs contain subtle motion that plays in a short, never-ending loop, while the rest of the image remains still. It would also be important for the illustrators to seamlessly loop the GIFs, so as to avoid creating a distracting reading experience.

We approached Krishna Chandran, a talented illustrator and animator to illustrate *Gappu Can't Dance*. In this book, it would be important to convey the dynamism of Gappu's movements. The movements would be simple - up/down, left/right, in/out and, since this is a character-based story that strongly revolves around human emotions, the characters' expressions would need to be suitably animated as well. A slight frown, a raised eyebrow, a wide grin: with these simple animations, the book and its characters could grow beyond the screen.



This illustration was originally published in ' Gappu Can't Dance' by Pratham Books. www.prathambooks.org.

Next, we asked Aindri C., a prolific illustrator and GIF maker to illustrate *Shoecat Thoocat*. The animated elements ranged from the wavy gas cloud released by the shoecat and the green glowing trail that followed it, to the dramatic shattering of pickle jars and light bulbs. When the Shoecat would howl, the 'OOOO' would be made to move across a page. The animations in this book would focus less on movement, and more on creating an eerie atmosphere using elements in the environment.



This illustration was originally published in 'Shoecat Thoocat' by Pratham Books. www.prathambooks.org.

Lastly, we approached clay artist Rucha Dhayarkar to create wonderfully weird creatures for *The Big Book of Boochandis*. Since the characters were to be made out of clay, they would be brought to life painstakingly through claymation. We wanted their movements to be subtle and humorous to support the text.



This illustration was originally published in 'The Big Book of Boochandis' by Pratham Books. www.prathambooks.org.

The illustration process has a number of stages and includes a round of feedback and discussion at each stage.

- Character sketches
- Storyboard/thumbnail sketches
- Rough sketches
- Final artwork

At Pratham Books, the artwork is always created for printed books, and then adapted to a digital version for StoryWeaver which has a different set of templates.

First, all the artwork is converted from CMYK (print) to RGB (digital). Then there is a round of colour editing. Each image is then resized in order to fit the template exactly and avoid cropping. This usually involves altering the image in subtle ways so that it is the best version to fit in the template, while retaining the essence of the illustration and story as a whole. The images have to be a minimum of 150 PPI (pixels per inch) and in the JPEG/PNG format. This is to ensure that the image can be resized in different layouts, without compromising the quality of the image. The images are then uploaded on the site, the text is added and the story is published. This template (now called a digital master layout) is shared with editors of the other languages for typesetting in those languages. Once published, the story can be read on StoryWeaver and even downloaded as a printable PDF or ePub.

The process in the case of the GIF books would be different as we would be working with GIFs instead of static images. So, there were two main elements to be considered when thinking of the outcome of the books themselves:

- GIFs on the StoryWeaver platform
- Downloadable PDF/ePub

5.2.1 GIFs on the StoryWeaver Platform

StoryWeaver is built on Rails, a web application framework with ReactJS as its front-end technology. The third-party libraries used are open source. The most active codebase is released under the OSI-approved MIT license, one of the most liberal licenses. All the code is on GitHub where anyone can view and participate in the further development of StoryWeaver.

Pratham Books has a team of developers and technical advisors who analyse requirements and assess the possibilities as well as limitations of the platform. We worked with them closely on this project.

As a part of the art process, illustrators are usually given a time frame of 2-3

months. While they started the process of creating the illustrations, we began testing a random selection of illustrated GIFs on our test site. In order to do so, we collected samples of different kinds of GIFs, with varying sizes and illustration styles.

Then we did a preliminary study of the GIFs. We noticed that the larger GIFs weren't necessarily of a better quality. The 1.2 MB GIF was just as good as the 45 MB GIF in its appearance. Upon researching further, we found that GIFs have different parameters to consider when it comes to optimization. Some of these parameters and their implications are:

- Image size

  A larger image size would lead to a larger GIF, which would take longer to load on the StoryWeaver site and create an unbalanced reading experience.

- Number of frames

  A range would need to be established to manage the size of the GIF.

- Number of colours

  The GIF format allows only 256 colours in order to manage the size.

- Dithering

  While dithering, a technique that improves the colour transitions and overall appearance, could be used, care would have to be taken to keep it as low as possible to maintain a low size.

Next, we moved on to testing. We started with uploading the following GIFs, keeping size as the only variable:

- Extra small size (119 KB)
- Small size (1.2 MB)
- Medium size (6.1 MB)
- Large (45 MB)

GIF size	*Appearance on screen*	*Upload time on testing site*
119 KB	*Unclear, pixelated*	*Low*
1.2 MB	*Very clear*	*Low*
6.1 MB	*Somewhat clear, slightly pixelated*	*High*
45 MB	*Very clear*	*Did not load*

Table showing results of GIF testing

Based on these tests and further trials, the tech team was able to narrow down the limitations of the platform to the following:

- GIF size

  It is crucial that the load time of a story is low, so that the reading experience isn't hampered. If the images load too slowly, the reader might lose interest in the story. Since it is important for our books to reach as far as possible, we had to consider remote locations, and therefore slower internet speeds. Hence, a size limit of 2 MB was imposed, as that is the acceptable limit for a static image upload as well.

- Number of frames in the GIF

Reducing the number of frames reduces the GIF size most drastically. Hence, it was suggested that the illustrators stick to a range of 8-12 frames, keeping the number as low as possible without taking away from the quality.

- Minimum frame size

Each frame was to be at least 4 KB, and the image could not contain transparent colour in any of the frames as that was leading to the GIFs not being able to get uploaded during testing.

- Number of GIFs in a single story

The number of GIFs in a story was limited to 20 since it was anticipated that a number larger than that would lead to severe delays in the loading of the books during reads and also while downloading. Hence, all three stories were paginated to be less than 20 pages.

- GIF as the cover

Since the GIF books would be sharing the same space as the non-GIF books on the site, it was decided to not have the cover animated, since that would distract from the other stories. Instead, the books would be indicated by the word GIF which would be seen when hovering over the story cover image.

- GIF dimensions

When starting with a dimension, 1073 x 771 for the horizontal layout and 745 x 1100 for the vertical layout was recommended. However, it was found that it resulted in a larger GIF size than desired (>2 MB). Further analysis was done to determine what would be a good trade-off between size and resolution. Hence, there had to be specific resolutions for GIFs (or as close as possible to it) to fit the whole page template. The final dimensions, based on the text-to-image ratio in different StoryWeaver templates, are listed below:

Orientation (Text x Image)	*Dimension (pixels)*
Horizontal Layout	
1. Side x Side (50 x 50)	*391 x 561*
2. Top x Bottom (66 x 33)	*775 x 373*
3. Side x Side (66 x 33)	*516 x 560*
4. Top x Bottom (75 x 25)	*775 x 420*
5. Full Image (100 x 100)	*775 x 560*
6. Top x Bottom (33 x 66)	*775 x 373*
7. Full Image (100 x 100)	*775 x 560*
8. Full Image (100 x 100)	*775 x 560*
Vertical Layout	
1. Top x Bottom (50 x 50)	*415 x 306*
2. Bottom x Top (33 x 66)	*415 x 408*
3. Top x Bottom (50 x 50)	*415 x 408*
4. Full Image (100 x 100)	*415 x 612*
5. Top x Bottom (50 x 50)	*415 x 459*

Table showing final GIF dimensions for StoryWeaver

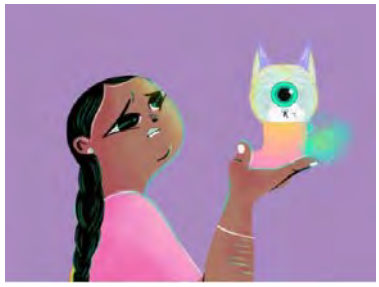
Once these parameters were finalised, they were shared with the illustrators. Horizontal templates were chosen as they would be closest to the print version, which consisted of landscape format images.

We had to go through multiple rounds of discussion with the illustrators, and several rounds of testing of the GIFs with the tech team. Since all the animated GIFs were created on Adobe Photoshop, we were able to look at the number of frames, as well as export options, which included the number of colours and dithering.

However, in the case of *Shoecat Thoocat*, the illustrator Aindri exported the GIFs as a series of frames rather than a .MOV file, took it to GIMP and converted it into 10 frames instead of 24 frames.



Before (24 frame GIF exported from .MOV file)



After (10 frame GIF exported from frames as a sequence)

An unexpected thing we found was that a textured style ended up disguising the artifacts, making them look more natural. An artifact is a noticeable distortion in the quality of the GIF brought about due to data compression.

The GIFs for *Gappu Can't Dance*, for example, were illustrated in a very textured style, which hid several artifacts. A low average frame rate of 4/sec also led to fewer artifacts.

In the case of the Boochandi GIFs, art director Somesh's decision to use flat white backgrounds instead of detailed ones made the GIFs look cleaner.

By playing around with the many variables mentioned earlier, we were able to achieve good quality GIFs with minimum artifacts and of a reasonably small size that loaded quickly on the testing platform.

5.2.2 Downloadable PDF/ePub

Once a book is published on StoryWeaver, readers can also download it in the ePub format and as a printable PDF. This enables a book to be printed and distributed, allowing it to be read without an internet connection. Usually how it works is when the download button on the story is clicked, the images in the story are automatically populated into a PDF/ePub template and then downloaded to the device.

The process was smooth for the ePub format, since it would display GIFs on all devices. However, the PDF would have to be populated with static images from the GIF source. So, the process would once again have to be slightly different.

Initially, we planned for the PDF template to be populated with the first frame of the particular GIF since most PDF readers

automatically do that. So, it was communicated to the illustrators that they should arrange their frames in such a way that the first frame would work as a standalone illustration as well.

When the final GIFs were ready, we started testing them on the StoryWeaver site. However, no matter what combination of varying parameters (resolution, size, number of frames, etc.) we tried, the still images on the PDF appeared to be pixellated and we were unable to pinpoint the exact reason.

So, we decided to upload static images separately. This way, when downloaded, the PDF would be populated with the aforementioned images instead of a frame from the GIF. At last, the PDF looked good and did justice to the reading experience.

5.3 Moving books

The GIF books were launched on Children's Day (November 14, 2018) amidst much fanfare, and were an instant hit. Several media outlets wrote about these books [15,16] and *Gappu Can't Dance* quickly became one of our most read titles. The books have been translated in over 15 languages and read over 46,000 times. Since then, several more GIF books have been created, and can be read for free on StoryWeaver.

During reading events, the moment the first page loads, and the children see that the pictures in the book are moving, they let out a collective gasp. These moments of awe and wonder are what drive us to dream up new ideas.



Children dance along with Gappu and author Menaka Raman during a school event

Conclusion

Storytelling using pictures is an art form that has endured for generations, and will continue to do so. However, its timelessness does not obviate its ability to transform. Hand in hand with technology, we can extend and reinvent the scope of what a picture book can do: whether it's in terms of how far it can travel and how inclusive it can be, or the form of the book itself.

At Pratham Books, we want to enable young readers everywhere to enjoy reading because we believe that stories have the power to change lives. A reader has immense independence: they read a story at their own pace, linger over images and words, place themselves in a story or even make the stories a part of their world. Our GIF books, as with all our innovations, have been created to further this idea, while maintaining the sanctity of this independence. What sort of picture book experience could we cook up if we were to sprinkle some virtual reality, or a dollop of artificial intelligence? Given the astonishing pace at which technology is developing, GIF books are surely just the beginning of what's possible.

References

[1] Sullivan, Alice & Brown, Matt., 2015, 'Reading for pleasure and progress in vocabulary and mathematics', *British Educational Research Journal*. 41. 10.1002/berj.3180.
https://tinyurl.com/y35yx64l

[2] Clark, Christina & Teravainen-Goff, Anne, 2018, 'Mental wellbeing, reading and writing - How children and young people's mental wellbeing is related to their reading and writing experiences', *National Literacy Trust*
https://tinyurl.com/y4mmtfa2

[3] 2015, 'Reading for pleasure builds empathy and improves wellbeing', *The Reading Agency*
https://tinyurl.com/yazv3ff5

[04] 2013/14, EFA Global Monitoring Report, 'Children need to be taught in a language they understand', *UNESCO*
https://tinyurl.com/yy68fvet

[05] April 2020, '1.3 billion learners are still affected by school or university closures, as educational institutions start reopening around the world, says UNESCO', *UNESCO*
https://tinyurl.com/yxhddv7n

[06] January 2020, 'Annual Status of Education Report (Rural) 2019, Early Years', *ASER Centre*
https://tinyurl.com/rcvglul

[07] September 2020, 'Library of Congress Announces Winners of the 2020 Literacy Awards', *Library of Congress*
https://tinyurl.com/y6avyakq

[08] Sandhya Keelery, October 2020, 'Mobile phone internet users in India 2015-2023', *Statista*
https://tinyurl.com/y3fzuqa2

[09] October 2020, 'Annual Status of Education Report (Rural) 2020 Wave 1', *ASER Centre*
https://tinyurl.com/yyfvpokk

[10] 2017, 'Children's Day: A publisher is designing stories for mobile phones to get more children to read', *Scroll.in*
https://tinyurl.com/y3dy55ev

[11] Adriana G.Bus, Zsofia K. Takacs, Cornelia A.T.Kegel, 2015, 'Affordances and limitations of electronic storybooks for young children's emergent literacy', *Developmental Review Vol. 35*
https://tinyurl.com/y2633a4c

[12] 2018, Gappu Can't Dance, *StoryWeaver*
https://tinyurl.com/yyc97b5r

[13] 2018, The Big Book of Boochandis, *StoryWeaver*
https://tinyurl.com/y27qegkj

[14] 2018, Shoecat Thoocat, *StoryWeaver*
https://tinyurl.com/y4slw4kr

[15] 2018, 'A children's publisher is designing GIF books for an immersive reading experience', *Scroll.in*
https://tinyurl.com/y8kbxx9b

[16] Disha Roy Choudhury, 2018, 'Now, kids can not only read but also watch stories unfold through GIF books', *The Indian Express*
https://tinyurl.com/y6qpcaqv

Generative Art inspiration for interior design approach

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Premise

The use of digital tools in design and art allows for a more significant number of experiments, which result in obtaining an infinitely wide range of possibilities for art creation in interior design. Thus, the boundaries of expression and expression of contemporary art are continually expanding. Generative art perfectly fits the trend of the process of creation understood in this way. Additionally, the very process of recording the act of creation becomes a carrier of artistic expression. It allows the viewer to observe and document the generative process of creativity as if to be in the middle of cultural events related to the continuous transformation of form in the creation's time and space thus realized.

Today, digital tools supporting the creative activities allow for virtual simulations of matter, which becomes a vehicle for searching for generated art when transformed. It is not easy to define what generative art is precise. Undoubtedly, its influence becomes enormous in contemporary design, architecture, film, music, and fine arts. One definition says: Generative art refers to any art practice where the artist uses a system, such as a set of natural language rules, a computer program, the machine, or other procedural invention, which is set into motion with some degree of autonomy contributing to or resulting in a completed work of art [1]. Different

definition claims: Generative Art is the idea realized as a genetic code of artificial events, as the construction of dynamic complex systems can generate endless variations. This approach opens a new era in Art, Design, and Composition: the challenge of the artificial event's new naturalness as a mirror of Nature [2].

1.

There is no doubt that the broad spectrum of creative possibilities of Generative art becomes an inspiration for artists and architects in their work. Generative art in its tectonics is recognizable in style and form. Like any other style of creativity, generative art becomes flexible. Its quotations can be used or transferred directly to art understood as traditional or using traditional media and creative methods. It happens so, among others, because the proper scope of generative art is created by the computer language of code, script and impossible to create in any other way. Generative art as a creativity method also allows for creating traditional art differently because extending the artist's working tool with computer simulation capabilities or machines favor it. There is nothing innovative about it because supporting the creative process with various technologies has always been present in art. Science, technology, and art support each other, form a tandem that allows us to discover the world of creativity full of emotions. It has always been so. In the nineteenth century, the invention of photography allowed for a more realistic understanding of the phenomenon of movement, which, thanks to, for example, time-lapse photography, could be documented and examined. The famous photos of racing horses in motion, captured in time-lapse, have become the subject of research on the phenomenon of movement so far unknown to the human eye. As a result, the direction of futuristic art was born, which perceived momentum and speed presented in the picture in a completely different way (Fig.1). It turned out that the depictions of running horses, known from previous epochs, did not comply with the laws of physics and anatomy of an animal in motion. Such representations were the image of an artist who could not correctly capture a running horse's movement without a machine's support. As a result, until the invention of photography and the famous photo of a trotting racehorse, all previous equestrian performances on this topic had nothing to do with a real picture of an animal's anatomy in such fast motion.

Other examples of assisting a classically created painting with a machine are related to the invention of the camera obscura. The famous Dutch painter of the XVIIth century, Vermeer, successfully used camera obscura for almost hyper-realistic representations of interiors and figures [3].

The tool projected the painted space onto the canvas. The painter carefully copied the image generated in this way, giving it accuracy in applying paints. Does Vermeer's work lose its value if the "camera obscura" machine is included in the painting workshop?

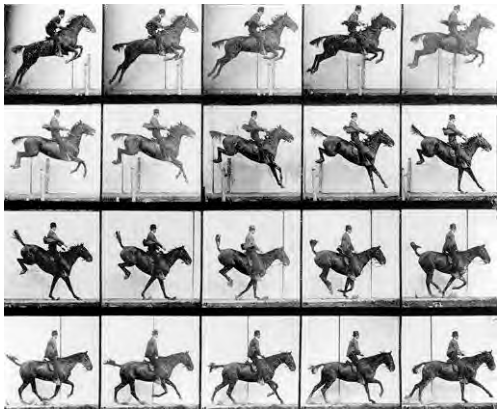


Fig.1. *A man jumping on a horse, photo: Eadweard Muybridge, Bridgeman Art Library / FotoChannels*

No, because without using this technology, it would not be able to convey as much emotionality in images as we know them today

(Fig. 2).

Similarly, we can consider the role of devices supporting the painter's workshop in the era of discovering the rules of perspective in Renaissance painting. The laws of the perspective unknown in the Middle Ages revolutionized Renaissance painting. Furthermore, although they were described mathematically, the artists began to use tools that supported their even more faithful representation. It seems that they even needed such devices that would help them achieve the illusion of presenting the world seen by the human eye on a flat plane.

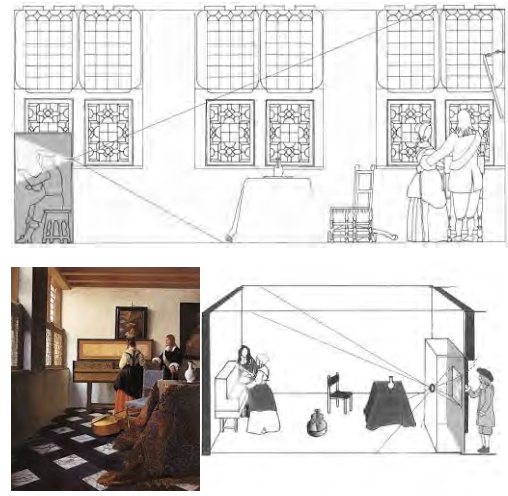


Fig.2. *A hypothetical view of Vermeer tracing the scene of The Music Lesson inside a cubicle type camera obscura (drawn from three drawings of Philip Steadman, Vermeer's Camera: Uncovering the Truth behind the Masterpieces (2002)*

One of the researchers of the mathematical rules of perspective was Piera Della Francesca. The artist's famous work entitled "Flagellation of Christ" (Fig.3) next to a profoundly symbolic layer is an example of masterful use of the illusion of perspective of the depicted scene with the architectural interior's background [5]. Centuries later, this mastery of presenting the architectural interior became a pretext for research into an architectural interior's real character [6].

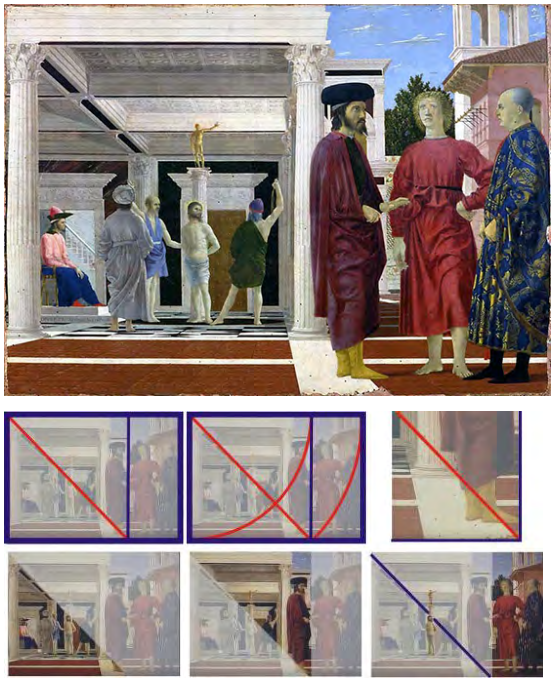


Fig.3 Piera Dela Francesca *Flagellation of Christ, painting composition analysis – own source*

On the other hand, Albrecht Durer used specially constructed grids in his performances, which helped him transfer the observed reality to the canvas. Moreover, he used a tool far from purely painting devices to copy, generate, and transform an image. This method became a necessary means used in painting in the following centuries.

Generative art's possibilities, impossible to achieve with other tools than digital ones, often become an inspiration to create works that can be said to be traditional in terms of definition. However, they greatly enrich both the artist's workshop and the layer of meaning of the work.

2.

In this article, I would like to present inspiration with generative art in the development of graphic decoration for my dental clinic's interior design. The project is to be implemented in the city of Białystok in Poland. A dental clinic with two treatment rooms, an entrance hall, a sanitary and social area has been designed on 96 m2. The room division layout was developed based on the legal guidelines in force in the Polish construction law and a dental clinic's medical technology. The figure below shows the functional solutions of the project (Fig.4).

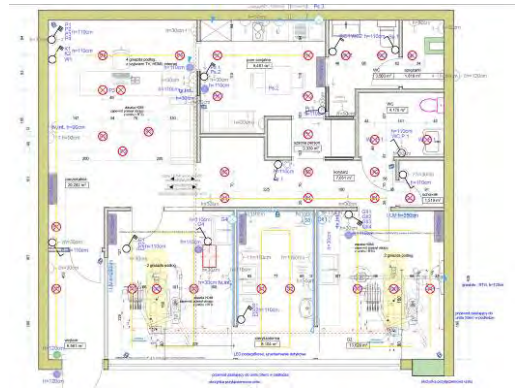


Fig.4. *The floor plan designed dental clinic – S.Wojtkiewicz 2020*

The ide of composition was the use of texture materials and glass that interpenetrate. The lighting was to play the connecting role. Classical art became the central graphic theme of the interior, which was then subjected to generative transformations. In their final shape, these transformations reduced the known classical works in the form of abstract forms. In this

way, the elements of the walls, on the one hand, evoked the works of classical masters; on the other hand, they operated with an abstract arrangement of lines, spots, points, emphasizing selected parts of the architectural space. The interior space was to maintain an elegant character embedded in European classical art tradition in confrontation with contemporary art expression. This action was supposed to add value. The starting point for the generative processes was Judith's portrait from the painting "Judith and Holofernes" painted by Carravagio [Fig.5].



Fig.5. *Judith and Holofernes, Caravaggio Galleria Nazionale d'Arte Antica*

Caravagi's painting was a breakthrough in the transformation of Renaissance art towards Baroque. Caravaggio became a precursor of painting techniques changes, and these changes were preserved for the next centuries. The psychology and realism of his representations still go beyond the purely figurative treatment of the painting plane. The painted figures capture not so much with realism or a painting composition as with subconscious psychological depth. The transfer of selected Carravagia works to the designed office's interior was to show the coexistence of "historical sounds of art" with the "sounds" of contemporary art and its impact on modern people. The entire process of overlapping several traditions of visual art took place at the level of interior architecture. The image does not have the same visual meaning but is part of the architecture. The boundary between what is architectural and what is plastic has been blurred. Caravaggio's paintings characterized an "objective reading of beauty" in the spirit of the classical aesthetics described and known in ancient Greece, preserved in ancient Rome's art. The painterly figures of Carravagio had classic proportions, a classic arrangement of the presentation's composition - often following the rules of the golden ratio, a precisely planned arrangement of the robes and gestures of the figures, the contrast of light and shadow interpenetrating one another. Thus, the classic beauty of the modern

portrayal in painting transferred to the space of a contemporary interior undergoing transformation processes - it was the necessary procedure creating the character of the designed place.

The portrait of Judyth in the act of murder of Holofernes captivates with the concentration of her face. The quote taken in this way from the Caravaggio painting in the form of a woman's portrait became an element used in shaping the interior graphics of the designed premises and further transformations.

In the first stage of transformation, lines were applied to the portrait. The lines referred to the arrangements of architectural forms and expressed the dynamic performance of the composition. For this purpose, several variations were generated that were to be the material for transforming the portrait. Below we see a graphic of lines referring to the dynamics of deconstructive architecture [Fig.6]. Pictures were created from the arrangements of lines in certain relations. Images constructed in this way were to express interesting combinations of dependencies and connections in space. Generative techniques made it possible to multiply the number of such compositions.

Furthermore, despite their multiplicity, the scope of perception was based on the same principles. Then, the resulting variants were arranged in specific sequences that formed the compositions' layouts, which were to create the artistic range of the graphics placed on the walls. Line sequences were initially created as vector graphics sequences.

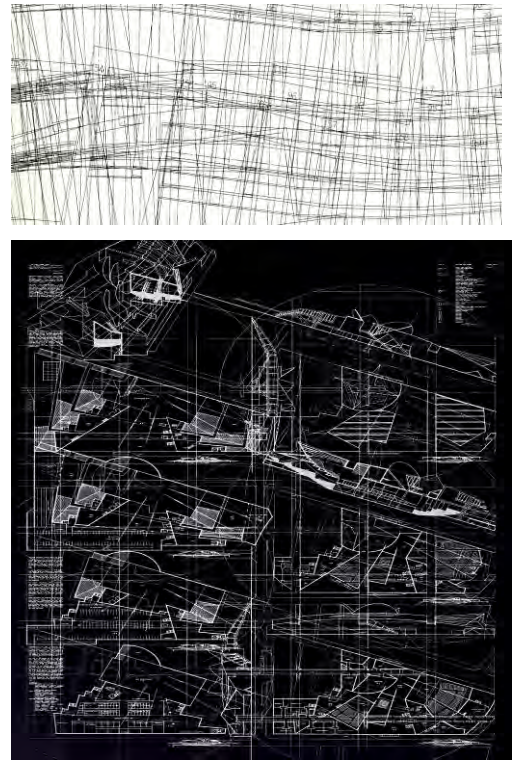


Fig.6. *Shape of line – alignment in a grid, variations – S.Wojtkiewicz*

In the next step, these vector lines were combined with the patterns of forms created in a bitmap manner. These were abstract architectural forms previously generated on a computer. The first images were created by combining vector graphics and bitmap graphics [Fig.7].

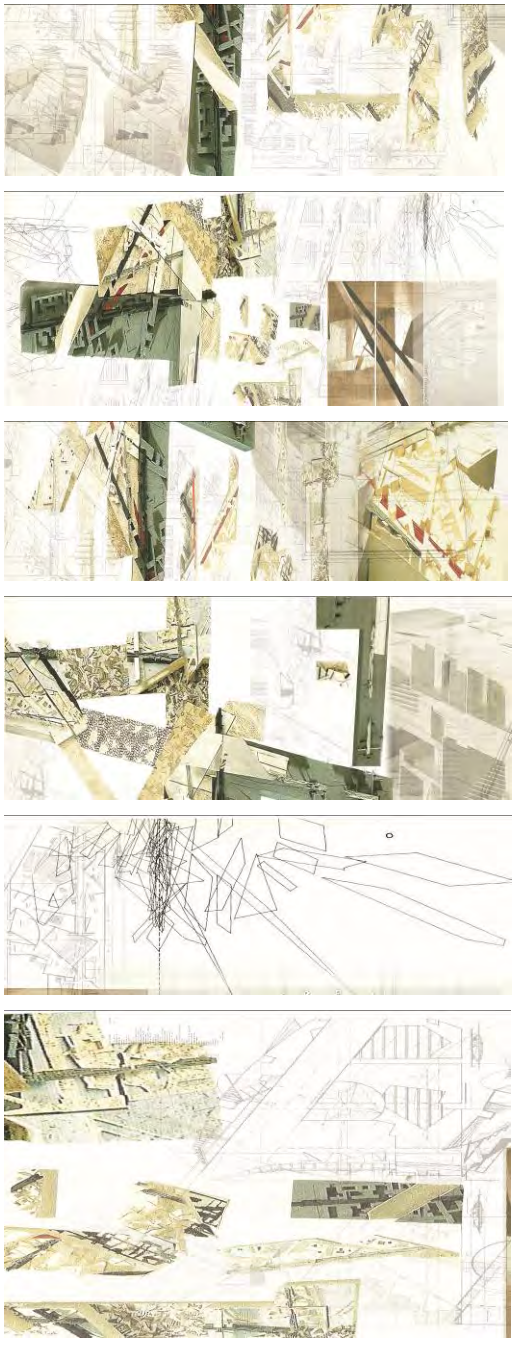


Fig.7. *Vector lines combined with the patterns of bitmap forms – collage from image collection – S.Wojtkiewicz*

The next step, the created generative abstract paintings with architectural content, was combined with classic illustrations from the modern era. In this way, wallpapers were made to fill the walls of the designed interiors [Fig.8].



Fig.8. *Combination shapes of line and forms with Judyth portrait of Caravaggio – S.Wojtkiewicz*

3.

The project is still at the concept stage. In this part of the work, interior architecture's successful effect requires a skillful arrangement of the transformed images into architectural

solutions for the premises' functional layout. The paintings will be juxtaposed in the space of glass, stone, and light. Therefore, the last step of the project will be to create a relationship in the form of architectural tectonics of the interior, i.e., the textures of materials and their properties combined with the already realized image of generative lines in connection with the classic art of Caravaggio painting.

According to this paper, "Generative Art inspiration for interior design approach," I would like to present a series of graphics that illustrate the transformation process from figural, famous classic masters artwork into abstract art.

References

[1] Galanter, P. (2003). *What is generative art? Complexity theory as a context for art theory*, GA2003 – 6th Generative Art Conference

[2] Soddu D., Collabella E., *Generative Art, www.generativeart.com*

[3] Steadman, P. (2001).*Vermeer's Camera: Uncovering the Truth Behind the Masterpieces.* Oxford: Oxford University Press,

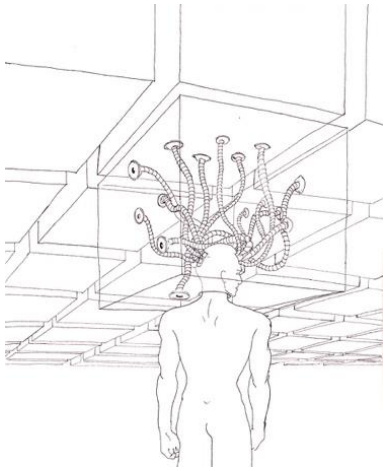
[4] Wojtkiewicz, S. (2017). *Piero Della Francesca "The Flagellation of Christ" - painting experience of sacrum; among art and since.* Architecturae et Artibus, pp.58 - 74

[5] Wittkower, R., & Carter, B. (1953). *The perspective of Piero Della Francesca's flagellation. Journal of the Warburg and Courtauld Institutes*, pp. 292-302.

re-prOCesS.iN(G)ene/R^{ate}: [From Dry-media to 'organic complexity']

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Abstract

From processing within a computational framework of *Dry*-media and '*algorithmic complexity'* towards infinity and '*organic complexity'* by navigating through a field of consciousness. This artistic vision is put to test through a series of experimental creative projects based on the combination of three principles, "Reprise", "Processing" and "Generative" – that recreates an artwork by reprocessing and regenerating it within a computational system. Through the observations of this practical and creative experimentation called, **re.prOCesS.iN_(G)_ene/R^{ate}**, along with the introduction of a number of theoretical and conceptual ideas, I shall seek to elaborate, contextualize and understand the properties of a computational system within a digitally *Dry* environment; in order to define qualitatively the nature of an '*algorithmic complexity'* – which emerges or manifests itself through an artistic process. This exercise will provide the foundations for me to further develop a methodology of counter-argumentation, in order to perceive and comprehend the nature of the yet unknown territories of an '*organic complexity.'*

Introduction

This paper is the first of a multi-part series of articles related to this ongoing activity of research, focusing on the observation and understanding of emergent properties within an artistic process, revealing a complex functioning of a system [1]. The idea is to derive some form of understanding of the very nature of *complexity* [2] that emerges out of a creative process with respect to the

environment [3] within which it manifests itself. Hence, in an attempt to separate into two broad, yet distinct categories, I begin to ask myself whether or not the nature of complex emergence can be differentiated having at least two fundamentally different facets? If so, how or on what basis could I separate them? To answer to this question in the overall context of my PhD research, I announce a speculative hypothesis where on one hand, we have what I describe as an '*algorithmic complexity*' that emerges within a computational system based on a programmable or mathematical process and bathed in a digital *dry* [4] media or environment – which will be one of the focal points of discussion in this paper. On the other hand, we have a more transcendental[1] complex form, which I will be referring to as an '*organic complexity*' that manifests itself through an artistic process as an effect of connectedness and of awareness, "*within the continuum of consciousness…where our field of becoming"* provides *"endless exploration and contemplation, in all its complexity"* [5].

Inspired by some of the observations made throughout my own creative practices, the motivation for this first article is to begin by focusing primarily on non-dynamic computational systems that run in a linear form of progression, aimed specifically to investigate the parameters of a *dry* media environment while also addressing the nature of '*algorithmic complexity'* – which here is rather a classification method based on a qualitative description (using theoretical references to define this category of complexity). Contrary to the standard of (AC) algorithmic complexity or (AIC) algorithmic information content both of which are measurement tools to quantify the relative complexity of a given system [6]. Therefore, to avoid any potential confusion, I shall not use the acronym AC to describe the notion of '*algorithmic complexity'* in my work.

For the practical part, the experimentation will focus particularly on the observation of a continuous and/or repetitive creative processes - that often tend to leave a trace or a mark, like "...*an active line, flowing freely without a goal*" [7] - unravelling a sequence that would not be entirely predetermined by the artist, revealing a far greater level of self-dependency or autonomy within the process than what was probably intended by the artist or at times even ignored or overlooked. Here, I refer to generative art or computer art [8] only as a theoretical reference platform which will provide the basis to study a *dry* media environment, by exploring a range of process-based systems – through the course of my research – within which, the 'autonomy' of the process allows or permeates a certain form of *complexity* to emerge or to manifest itself.

1. 'Process approach' or a 'Systemic approach'?

Let me explain what is meant by a 'process approach' and a 'systemic approach' in the overall general context of this research - where "*contemporary practice engages in systems aesthetics through the use of system as a medium*" [9]. But first, for the sake of clarity it is immediately important for me to differentiate and distance myself from the well-known movement of the Post-Minimalists from the 1960s, where the term "*Process Art*" simply implied that the

process of making art, was not meant to remain hidden in the artwork, instead it was to remain a prominent and visible aspect of the completed work, where a part or even the whole aspect of its subject, may reveal the making of the art work.

In the context of my research, the notion of 'process approach' to contemporary art has slight undertones that are important to note here.

- process: is "...*a set of interrelated or interactive activities that transform the state of an item from an entry point into an output*" [10].
- procedure: is a "*specified way of carrying out an activity or a process*."

In other words, the process answers the question 'what to do'? While the procedure answers the question 'how to do'? This idea of a 'procedure' will be implemented in the experimental and creative aspect of the project, where the focus will be on providing a set of instructions: 'how to do'; following that primary characteristic of a process as its purpose, while that of a procedure in the set of rules it contains – highlighting the difference between the "*natural processes and artificial procedures"* [11]. Emphasising more on the later, the creative aspect of this project consists of a threefold path, based on the following concepts:

a. ***La Reprise****,* a French term which here suggests a process of redoing, repeating and recontextualization of a work of art.

b. ***Processing***, is that which undergoes a passage of change or evolution within a system.

c. ***Generative***, is that which is produced or created through a repetitive or continuous gesture, act or movement (as a set or sequence of items) within a systemic process.

When combined together, they create an amalgamation of sorts, suggesting a recreation of an artwork by a method of reprocessing and recontextualizing it in a different environment and in a different ecosystem than the original artwork – which here is within a computational system and a digitally *dry* media. Hence, the idea of coining the term, "**re-prOCesS.iN(G)ene/R**^{ate}"; serving not only as the title of this series of artwork, but also as a conceptual term in itself that is used as a basis for a practical observation, turning this creative experimental project into an empirical form of research work, in order to observe and validate any form of emergent phenomenon or complex behaviour around the properties of a computational system – helping in identifying of the nature of an *algorithmic complexity*.

However, in contrast to the practical 'process approach', I will progressively introduce a certain number of speculative theories related to 'Systems Art' [12] hoping that there will be the possibility of exploiting a number of crossovers of concepts and ideas between complexity theory and systems theory which have been studied in the scientific field, but which may be equally relevant to explore in the context of contemporary art practice, especially where the system acts as the medium. This will enable me to open up to a wider field of creative practices that allows for the integration of various other non-algorithmic and ecosystemic forms [13] of artistic processes into the dialogue over 'Systems Art', establishing a new vision

on the systemic approach through a theoretical and conceptual dialogue on the key characteristics of "system-aesthetics."

2. A periodic action as a simple, linear system

In the context of contemporary art, if we take a look at Richard Long's work "A Line Made by Walking" 1967 (see Img.1) we can see a line in the middle of an open field, created as a result of walking up and down a patch of grass in a straight line. Although this work belongs particularly to the Land Art movement, with only this photographic image that captures this artwork; but when we look deeper at the creative process, it suggests that the artist engages in a physical performance which directly determines the gradual emergence of the line. Therefore, this rapport between the emergent form and the repetitive, periodic action used by the artist as a form of 'process art' is of profound interest to me in the context of my research. Through the analysis of the performance, we can tell that the artist produces a basic periodic motion by walking precisely on one particular axe, from point *A* to point *B* and back to point *A*, while repeating this sequence over and over again. The artist's conscious effort to use his own body to 'generate' a periodic motion in order to connect himself directly to his environment (which is the field representing Nature or the Earth) turns this artistic performance into an organic generative process. This provides a glimpse that within a natural/subjective environment, it is sufficient to have at least one process that cannot be algorithmically simulated and remodelled, i.e. using a purely syntactic programming language, which according to *Robert Rosen* is a 'complex system' [14]. In contrast to *Long's* organic process, I shall seek to reproduce this artwork within an algorithmic environment using '*la Reprise'* and '*Processing*'.



(Img.1 Richard Long A Line Made by Walking 1967, © Tate Collection, Richard Long)

2.1. `re-prOCesS.iN(G):`

```
[richard.long, undo= "a line made by walking"];
```

This work is the first of the series, "**`re.prOCesS.iN(G)`**" and its purpose is to establish the parameters of a digitally *dry* environment, by merging together the first two of the three concepts (as seen in section 1.) – '*la Reprise*' and '*Processing*'. As the title suggests, the reconstruction of this artwork in digitally *dry* environment, highlights also a process of reversal or rather an undoing of the 'line made by

walking' by engaging in a computational procedure of visually erasing the line [15]. This fabricates a digital image which is basically an imaginary re-fabrication of the moment in time, prior to the performance done by *Richard Long*.

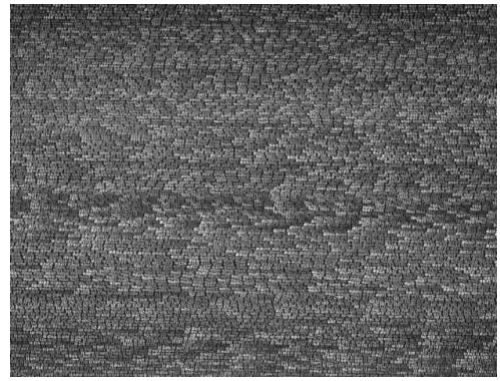


(Img.2 Tanmay Banerjee, 2020
`prOCesS.iN(G):[richard.long, undo= "a line made by walking"];)`

But more importantly, this work paves the first step towards the idea of 're-doing' and 're-processing' using only a computational creative framework [16], eliminating any other possibility of a conscious manifestation or emergence of creation, in total contrast to the very performance of *Richard Long*. This leads me to further develop this series of creative projects, introducing the third concept of "Generative" into the mix, while still emphasizing on the linear progression, as we shall see in section 3.2.

3. The idea becomes a machine that makes Art

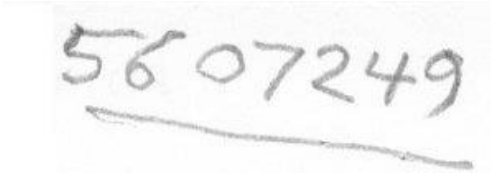
First, let us look at *Roman Opalka's* monumental lifetime's work, "1 – ∞" 1965-2011 where the artist begins his work by painting a sequence of numbers starting from 1, 2, 3, 4 and so on, using white pigment and using a "0" size paint brush. The progression of digits begins from the top left corner gradually moving forward to finish at the number "35327" (see. Img.3.a) on the bottom right corner of the canvas or (*Detail*) as he called it – (which are all dated '1965' followed by the first and last number of the *Detail*). This rigorous process continued for eight hours a day, piling up approximately 400 numbers daily until decades later he reached a staggering 233 *Details* in 2011.



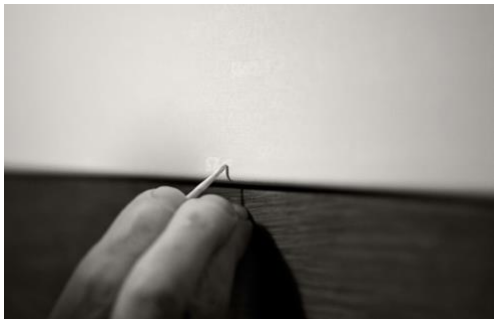
(Img.3a – 1965-Detail 1-35327)

After a few years into this process (in 1969) the artist began adding 1% of white to the black background colour – based on a statistical calculation involving the average lifespan of the male population in Poland at the time, which was seventy-five years. *Opalka* then made a mathematical calculation which determined that by adding 1% of white

into the black paint, it would be sufficient to have a white background by the time he would be seventy-five years old. And indeed, for the last five years of his life, the artist would practically paint with 'white on white' – which is what he had wished to accomplish, "*within whiteness and on the verge of infinity*" – until his death in 2011, which would also determine the culmination of a "*lifetime of painting*" as he had proclaimed, "*It's important that my last 'Detail' of my life should not be finished by me, but my life."* [17] (See Img.3b, 3c)



(Img.3b Roman Opalka, 2011 "The Last Number")



(*Img.3c Roman Opalka working on the second to last Détail painting in his studio, Le Bois Mauclair, February 14, 2011 (photo by Vincent Lespinasse, courtesy Dominique Lévy Gallery)*

The artist's physical action of counting and writing down the numbers repeated over years and years, can be interpreted as a form of robotization, which in his own words, he describes as "an act of stupidity and a waste of time" [18] However, in practice, the artist is basically following (a procedure) containing a set of rules that are based on:

a. The action of counting with an increment of one
b. The degrading background colour, from a contrasting black towards a fading white
c. A series of self-portraits, with one that accompanies each *Detail*
d. A series of vocal recordings (that is not relevant in this context)

The combination of each of these set of rules accompanied by the sheer volume of this manual task, transforms this creative act into a 'generative' or an 'automated' process - where the painting (as a technique) is merely an ancillary, a convenience to execute the idea. The system partially forms the painted language, with each *Detail* constituting an integral part of the whole, that we may call a 'system/painting'. But more importantly, evoking one of the more well-known principles in both systems and complexity theories, the '**system holism principle'** commonly addressed as "*the whole is greater than the sum of its parts*." But more carefully explained by fact "*that microlevel behavior can lead to macrolevel behavior that cannot be easily (if at all) derived from the microlevel from which it emerged.*" [19] This can be observed in the artist's quest for 'infinity' which remains indeed a greater whole than the sum of the parts – the (*Details*) – from which it has emerged.

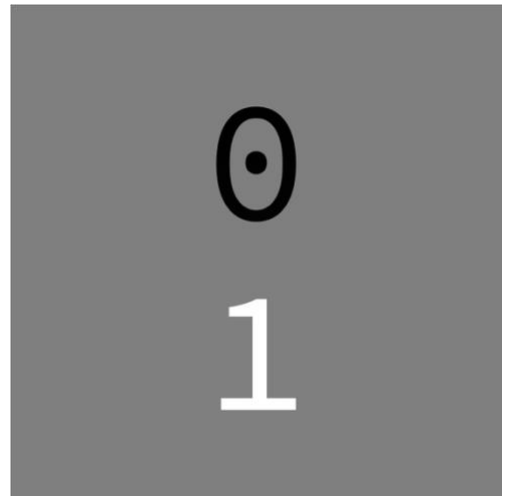
3.1. re-prOCesS.iN(G)ene/R^{ate}:[roman.op

```
alka, range= "0-∞", "black-
white"];
```

The second of the series, **re-prOCesS.iN(G)ene/R^{ate}** – (is a work in progress) that turns *Opalka's* manual attempt to count to infinity, into a computational, automated and programmed process of generating a sequence of numbers in a linear progression, within the framework of a digital environment. As far as the process is concerned, there is an obvious correlation to the time factor, taken to generate this sequence - which is in total contrast to the temporality or (time at work) of *Opalka's* manual creative endeavour. But more importantly, *Opalka's* gradual progression towards white, is also used here as a study of grey tone values that can be represented as an even passage form black to white, within this digital environment.

With regard to the visual representation of the work, unlike *Opalka's* horizontal lines, I have decided to generate the numbers and emulate a "scale invariance" [20] which gives us a way to visually perceive the repetitive pattern of the digits 0-9 , while being suggestive of visual complexity of this representation, especially as the numbers begin to increase. Secondly, for the distribution of colour, I have decided to attribute a smooth degradation of grey tone colour depth, ranging from pure black to pure white, as it can be represented digitally, through the increment of bits. So, what is important to note is that each generated digit can have only one corresponding grey tone value in RGB and as the total number of bits increase so to multiplies the numbers that can be generated.

Like *Opalka* I have also decided to produce *Details* that have a generated sequence of numbers in function of the number of representable bits. So, in *Detail*-01, we have a 1bit binary representation, known as a bitmap image where we can have two colour values, '0' being pure black and '1' being pure white (see. Img.4a) [21].



(*Img.4a. Tanmay Banerjee, 2020, Detail-01, 1bit–2 grey tone*)

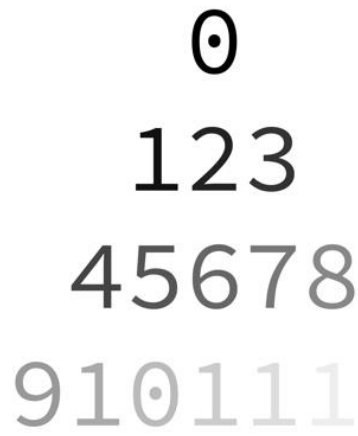
Similarly, in *Detail*-02, we have a 2bit integer = 4 colour values of grey, which means that a sequence of four digits are generated with "0" being pure black, with '1' and '2' having different grey tone values respectively and "3" being pure white. (see Img.4b) To generate a sequence of numbers ranging from 0 to 3, I have a simple generative code below, that can be used for any range of numbers (n):

```
x = range (4)
for n in x:
    print(n)
```



(Img. 4b. Tanmay Banerjee, 2020 Detail-02, 2bit–4 grey tone)

In *Detail-03,* we have a 4bit integer = 16 colour values of grey, but here mathematically generating a range of numbers from 0 to the number 16 provides [0 - 9 (1 x 10) = 10 digits] + [10 - 16 (2 x 7) = 14 digits] = 24 digits – which is not right. So, if every digit has to have one single grey tone value, then a sequence of numbers ranging from 0 - 12 (containing 16 digits) must be generated to have an even distribution of 16 colour grey tone value. Unlike the manual calculation done above for 16 digits, as the numbers of bits begin to multiply so too does the sequence of numbers, so a basic mathematical formula using python language (see below) helps calculates the right range of numbers to be generated for the corresponding grey tone values represented in the form of the digits.

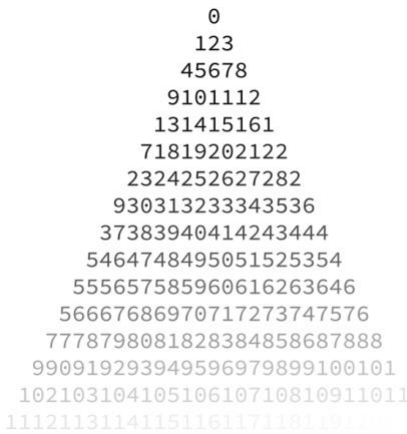


(*Img.4c. Tanmay Banerjee, 2020 Detail-03 4bit-16 grey tone)*

For example, coming to *Detail*-04, we have an 8bit integer that provides 256 possible greyscale values or tonal steps, from ‘0’ (black) to ‘255’ (white) [22]. To find out the range of numbers to be generated, we have:

```
def findDigits(N):
    if N == 0:
        return 1
    s = str(N)
    return len(s) + findDigits(N - 1)
N = 121
print(findDigits(N)) 256
```

Therefore, generating a sequence of numbers from 0 to 121, provides 256 digits, each representing the 256 greyscale values. And so on in *Detail*-05, we have a 16bit integer that provide 65535 possible greyscale tonal steps from ‘0’ (black) to ‘65535’ (white); requiring to generating a sequence of numbers from ranging from 0 - 15328 (using the same formula above and modifying the value).



(Img.4d. Tanmay Banerjee, 2020 Detail-05, 8bit–256 grey tone)

(Img.4e. Tanmay Banerjee, 2020 Detail-06, 16bit–65535 grey tone)

To reflect upon this, briefly we notice that *Roman Opalka* in his first *Detail,* had already painted from 1 to 35327 (see Img.3a) which means that the total number of digits he had painted at this stage was already a staggering "165529" digits. Instead here, in a 16bit integer I have generated only 15328 digits, but I have nearly reached double the amount of numbers at 65535 in contrast to *Opalka's* 35327 at the end of "1965 1-∞ *Detail 1-35327*".

Finally, moving forward to a 32bit integer greyscale will provide at least theoretically, well over a billion possible tonal steps from '0' (black) to '4294967295' (white) - far exceeding anything that can be humanly possible to attain. But, going beyond the computational process of generating the numbers, this series of images (see Img.4a to 4d) is a study on the distribution of grey tone values in function of the multiplying bit depth. As the bit depth increases, (from 1bit to 16bit), we notice a progressive dilution of grey tone values that gets evenly distributed through the increment of the generated numbers, showing us linearity through this series of digital images.

Despite the high efficiency and accuracy, as well as the perfect linearity and uniformity of this computational process – a level that *Opalka* could never have achieved through his work – the *Dryness* of this digital and computational environment, devoid of connectivity, interaction or transformation, makes the process devoid of experience too. Thereby any attempt to evolve towards infinity is brutally rendered finite. This is the nature of an '*algorithmic complexity'* in a Dry media environment, it can be observed/studied through the command lines, perceive through the emerging, but it cannot be fully experienced or comprehended.

4. Discussion: *Dry* Media and '*Algorithmic complexity*'

As seen in the two experimental projects in (section 2.1 and 3.1) my attempt to produce a creative project comes with a certain challenge to not only define qualitatively the environment within which the 'recreative' procedure takes place; but also, to describe qualitatively the nature of emergence that manifests through the computational process. The environment that underlines the functioning of these two creative processes is composed of a computational subsystem comprised of bits (a basic unit of information in computing) based on which a computer program can provide a set of instructions to carry out a task. Then comes the digital representation of a visual that is comprised of electrical signals passing light and colour through a pixel or (picture element) which is the basic controllable unit, allowing to display the task that was asked to be executed.

Thus the project **re-prOCesS.iN(G)ene/R^{ate}** reveals the interactions of this computational system by performing the task and in the process highlighting the very essential component of a digitally *dry* environment – composed of bits, pixels, (Px), control unit (CU), arithmetic logic unit (ALU) – and run by a syntax (codes or rules) that a computer language can interpret. Hence, any form of 'emergence' that mediates through the functioning of this complex computational system and digital interface is qualified here as a *Dry* media and '*algorithmic complexity*.' However, the profound question lies in understanding in what way the manifestation of an '*organic complexity*' different from the emergence of an '*algorithmic complexity*.'

5. Conclusion: Towards an 'organic complexity'

While *Opalka's* work and process may evoke numerous aesthetical and philosophical questions related to life, time, etc. but one of the key aspects related to the question of linearity and complexity in his work, is perceived through the physicality of 'time' that only extends forward, highlighting this unidirectional and linear passage of time through the increment of numbers. Yet, the complexity of his work lies in the perception and experience of 'time' that is showed in his work, as the artist points out, "…*is not programmed, it has its own rhythms that echo with our life*" this "*random*" temporality is vividly present in his work [23]. Ultimately, the quest for infinity reveals that "there would be no distinction between the white numerals and the white surface, culminating towards a form of blankness or possibly transcendence as the numerals grow invisible, within the prospect of infinity or '*Samadhi'* [24] - a state of ("*meditative absorption*") that leads the path towards liberation [25]. As *Opalka* puts it, "*The consciousness of this inevitable disappearance broadens our experiences without diminishing our joy.*" [26] This experience through art and process is in tandem with *Ascott's* "*instinctive pursuit of consciousness as a 'field'* that we enter and navigate from birth" [27]. Here it is this experience (of 'becoming' through the artistic process) that is both 'organic' and 'complex' [**Error! Bookmark not defined.**].

To conclude, it is "*In art that the field of interactivity integrates the work, the artist and the viewer in what is both a material and immaterial connectedness"* [**Error! Bookmark not defined.**]. With this reference to *Roy Ascott* in his quest for connectivity, coherence and consciousness – in Moist-media, that I shall conclude this 1st paper. Paving the way for the future instalments of this series of articles, where I shall continue searching for non-linear dynamics of both 'Process approach' as well as 'systemic approach' through relational interactivity and feedback – further evoking *Ascott's* five-fold path of *connectivity, immersion, interaction, transformation and emergence* [**Error! Bookmark not defined.**] as an '*organic complexity'* – issue of awareness and of consciousness.

Notes

[1] Not necessarily referring to a spiritual realm, instead to an immaterial state of connectedness and awareness that permeates or confers to a state of complex manifestation, through the phenomenon of emergence.

References

[1] Y.Bar-Yam, "General Features of Complex Systems" , New England Complex Systems Institute, Cambridge, MA, USA

[2] Nathanael LAURENT, « Qu'est-ce que la complexité ? », Revue des questions scientifiques 2011, 182 (3) : 253-272 p.

[3] Leonid A. Rybakov, Environment and Complexity of Organizations, 2001 Emergence, 3:4, 83-94, DOI: 10.1207/S15327000EM0304_6

[4] Roy Ascott, Technoetic pathways towards the spiritual in Art: a transdiscilplinary perspective on issues of connectedness, coherence and consciousness, p.

[5] Roy Ascott, The Grand Convergence: art, technology and consciousness in a planetary perspective, Dept. of cognitive science, Ecole normale supérieure, Paris. 30 May 2002

[6] Philip Galanter, "What is Generative Art? Complexity Theory as a Context for Art Theory", online, https://goo.gl/un6S3J. p.4, p.10

[7] Paul Klee, The pedagogical sketchbook, the polyglot Press New York, 1925 p. (translated by Sibyl Moholy-Nagy

[8] Celestino Soddu, "Generative Art", online, http://www.generativeart.com (last access 7 November 2017).

[9] Francis Halsall, Systems Aesthetics and the System as Medium, Peter Lang 2008 http://systemsart.org/halsall_paper.html

[10] L'approche Processus, Hans Brandenburg, Jean-Pierre Wojtyna, Edition d'Organisation, 2003 p.

[11] E. Driessens and M. Verstappen, "Natural processes and artificial procedures," in *Design by Evolution: Advances in Evolutionary Design*, P. F.

[12] Francis Halsall, Systems of Art. 2008 Bern, Switzeland:Peter Lang UK. Retreived Nov 6, 2020, from https://www.peterlang.com/view/title/10159

[13] Taras Kowaliw, Jon McCormack & Alan Dorin, "An interactive electronic Art System based on electronic systemics"

[14] Robert Rosen, “Autobiographical Reminiscences” 2006, *Axiomathes*, 16(1-2), 1-23.
[15] Christopher Fry, Visuality and the haptic qualities of the line in generative Art, proceedings GA2019
[16] Alan Dorin and Kevin B. Korb, “Improbable creativity,” 2009 *Proceedings of the Dagstuhl International Seminar on Computational Creativity*, Jon. McCormack, Margaret Boden, and Mark d’Inverno, Eds. Springer.
[17] Robert C Morgan, Roman Opalka’s Numerical Destiny, 2014. Online: https://hyperallergic.com/153559/roman-opalkas-numerical-destiny/
[18] Peter Lodermeyer, Karlyn De Jongh, Sarah Gold, Personnal Structures, Time - Space - Existence , Global Art Affairs Foundation, Dumont Buchverlag Gmbh & co, Cologne 2009 456 pp, Roman Opalka pp 8, 10, 40-43, 234-241, 16 ill c., 2 rep c. (citation on p.42)
[19] Kurt Richardson, Systems theory and complexity: Part 1. Emergence: Complexity and Organization. 2004 Sep 30 [last modified: 2016 Nov 23]. Edition 1. doi: 10.emerg/10.17357.7ec106df2487e832480906e35d688f00.
[20] Khaluf Y, Ferrante E, Simoens P, Huepe C. Scale invariance in natural and artificial collective systems: a review. *J R Soc Interface*. 2017;14(136):20170662. doi:10.1098/rsif.2017.0662
[21] Bruce Duyshart, The Digital Document, 1997, Routledge p.91
[22] Stan Birchfield, Image Prcessing and Analysis, Clemson University, Cengage Learning, p.10
[23] De Jongh, Karlyn, Time in the Art of Opalka, Tatsuto Miyajima, and Rene Reitmeyer. 2010 KronoScope. p. 92 https://doi.org/10.1163/156852410X561880
[24] Robert C Morgan, Roman Opalka’s numerical destiny, 2014, online: https://hyperallergic.com/153559/roman-opalkas-numerical-destiny/
[25] Stuart Ray Sarbacker, The numinous and Cessetive in Indo-Tibetian Yoga, State university of New-York press, Albany 2005 p.13, 14.
[26] Roman Opalka, « Opalka 1965 / 1 - ∞ , rencontre par la séparation », in: Le Travail de l’Art n° 1, Winter 1997, Paris, pp 100 – 111, 5 ill. n.b. Online : http://opalka1965.com/fr/demarche.php?lang=en
[27] Melentie Pandilovski, Roy Ascott. Melentie Pandilovski Interview with Roy Ascott 2018 p.1

Introduction to Generative Musical Morphing

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Abstract

This paper is about musical morphing, a technique that is still waiting to develop its full potential. The goal of its generative upgrading is to engender new music as the pairing of musical fathers and mothers. To do this, generative grammars and especially L-systems are used, since they store information in strings like DNA does. First, will be introduced some basic concepts. In the second section will be discussed some technical problems, since interpolations between pitches or durations using MIDI codes are not mathematically precise and cause unpredictable behaviors and the algorithm must consider harmony, rhythm, counterpoint and different musical forms. The last section of this paper, on the basis of Mole's theory of aesthetic information, will describe an experimental morphing architecture and implementation, considering its levels of complexity. The conclusions will stress the importance of interface design to improve the L-systems musical notation for the efficiency of the process and of the human machine interaction.

1. Introduction

Remixing and sampling are popular methodologies in audiovisual artistic practice. Even if DAWs and plugins provide an incredible variety of functionality, musicians and sound artists are always seeking new ways to expand their creative and generative capabilities [1] [2]. Morphing is a well know procedure to create 2D/3D forms by the interpolation of geometrical data using different weights and parameters. In the case of music, with the exception of a few solutions to solve specific compositional problems or to make real-time transitions between tracks in videogame levels, morphing as creative remixing technique is still unexplored [3]. In this paper, using generative grammars, I will suggest some experimental morphing methods, including programmable L-systems, to generate samples, clips, and maybe even entire new songs. The result is actually intended as a starting point for further research and experimentation.

2. Morphing in 3D animation

Morphing is a well-known technique to create objects and animations. In figure 1 and figure 2 are shown some 3D models created using different morphing processes.

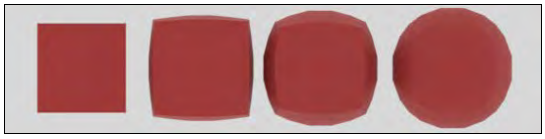


Figure 1. Morphing of a cube and a sphere with the 3DMax. Image of the author

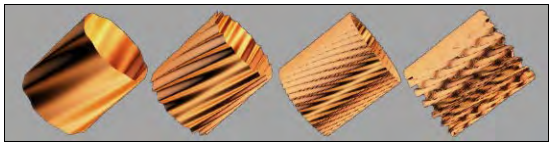


Figure 2. Using morphing to create 3D textures with generative software. Software and images of the author

3. Morphing with shape grammars and L-Systems

L-systems are recursive substitution processes that use a set of symbols and rules [4]. Symbols can represent complex audiovisual objects, geometric information and transformations like scale and rotate. L-systems are widely used to model natural forms, fractals and complex modular objects. In fact, L-systems can use different types of rules and functions to simulate the serendipity of natural forms (figure 3).

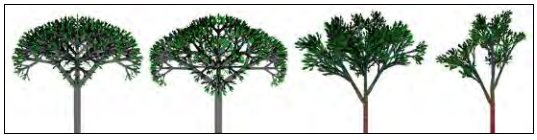


Figure 3. Tree models made with stochastic and parametric L-systems. Software and image of the author

Morphing can be easily implemented using L-systems and shape grammars in general, because the symbolic representation of objects using alphanumeric strings makes simple to interpolate and morph single objects and groups of hundreds or thousands objects as well. And it is possible to apply the morphing calculations to geometry, transformations, to single objects or groups in the scene, using different parameters and hierarchy structures. Stochastic and parametric L-Systems help to improve the music generation [5, 6] and the morphing process in many ways.

It is important to note that the interpolation is not about numbers, but rules, since L-systems' rules and strings of alphanumeric symbols share a common syntactic form that can be edited using other L-systems. Thus, the grammar of the L-system is the key to add the desired generative bias to the morphing algorithm.

Figure 4 shows the result of a morphing process using L-systems. The symbols and the rules that generate the blue spiral are interpolated with the symbols and the rules that generates the red stair like line. The morphing process creates a new grammar which rules and symbols generates the red and blue form of the right. This form combines the grammars of both parents and the morphing L-system process is controlled by rules and symbols of another L-System. A great advantage of the L-systems notation is its similarity to DNA (the molecule that holds the instructions for making all proteins), as both are strings of information that are combined in different ways.

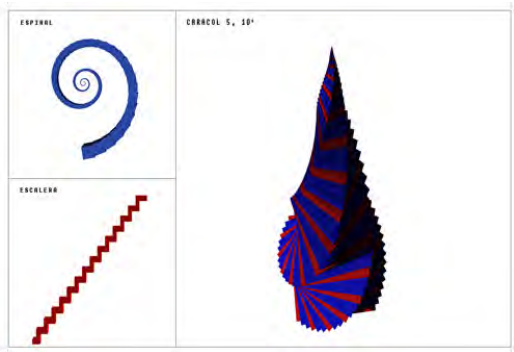


Figure 4. Morphing of 3D forms using rules interpolations. Software and image of the author

4. Musical morphing

Morphing is not usually used in music, with the exception of some specific tasks, like transitions of tracks between levels of a video game [3]. But the goal of generative musical morphing is the creation of clips, samples and entire scores (like EDM tracks) into another track or piece of music, considering morphing as a new kind of musical instrument.

The first approach is numerical, using MIDI codes for pitch, velocity and duration, and MIDI controllers to edit filters, the envelope, etcetera.

The second approach is with L-systems, since grammars make easy, using Mole's terminology [7], to represent "sonic objects" (pitch, loudness, duration) as well as "sonic cells" (measures or phrases) and to edit and interpolate their parameters. For optimal results, the two approaches can be combined. In the following section the fundamentals of generative music morphing will be explained.

4.1 Basic morphing interpolations

In any case, morphing can be done in three ways (figure 5). The first is to interpolate pitch and duration of the notes of score 1 with the notes of score 2, using MIDI code; I called this method "average mode" or "chemical reaction mode" (figure 6). The second is to alternate tones of 1 score with the tones of the second score; I called this method "alternate mode". It is possible to alternate single notes or group of notes in any order that you may declare in the rules. In figure 6 is shown some cases of average mode morphing interpolations.

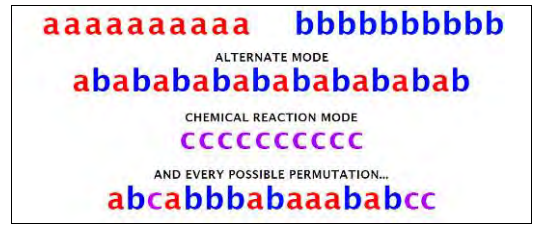


Figure 5. The musical morphing basic algorithm modes.

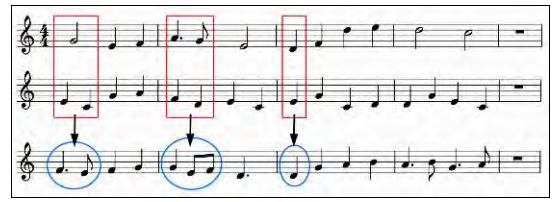


Figure 6. Morphing of pitches and durations with average mode. For instance, the G of the first measure (pitch 67) is added to the E (64) of the second score, resulting in F (65). The same with durations. Note that there are different valid solutions, even leaving the pitch unchanged.

The morphing process can be repeated many times using different parameters and re-morphing the morphing results, for instance, to create accompaniment or more voices. A sort of emergent melody and harmony may appear, as in the fourth sample provided with this paper.

Parents samples and alternate morphing Average Multiple morphing



4.2 Advanced morphing interpolations

Theoretically, the morphing calculations are straightforward, but in the real world it is necessary to consider a lot of exceptions that make the process a lot more complicated than it initially appeared.

4.2.1 Pitch and rhythm calculations

In the first place, the average of pitches and durations is not always mathematically correct. In fact, we must take into consideration that MIDI numbers are integers and other constraints such as scales and rhythm. This is easily understood in the following example:

Pitch 1 = 60 (C)
Pitch 2 = 65 (F)
Morph pitch = (60 + 65)/2 = 64, 62 or 63?
63 is not in the scale of C major.

The same happens with durations, if you want to respect the signature and rhythm. Thus, the morphing calculation parameters depend on many possible factors: harmony, counterpoint, movement or the actual chord progression. Eventually, computation could consider the neighborhood of any particular note. In this way the morphing process evolves like a cellular automata.

4.2.2 Score calculations

Now, the morphing process can be computed easily if scores match their number of tones, measures and length. But this only happens if you create your scores from scratch and in the right way (matching the abovementioned numbers). Using scores of other composers, we have to consider differences in notes, durations, scales and length.

Different problems arise considering morphing transformations of sonic cells (Moles, 1968), like measures, periods, phrases, genres (EDM, Gregorian chants, jazz…) and the score musical form (Iterative and reverting types, strophic types, etcetera). This can be very complicated if we are trying to morph music of different origins and traditions.

Another problem is the existence of other factors like portamento and expression, and also sound design. Here synthesizer come into hand. We can morph musical instruments, envelopes and filters using MIDI messages. Many synthesizers provide enough MIDI implementation to do this in real time. This is also possible using DAW and digital synthesizers, like Puredata in Ableton Live.

And finally, there is the problem of morphing different voices, for instance, with piano scores. The main difficulty is to match the morphing of the main voice (for instance, the right hand score) with the accompaniment (the left hand, or another instrument). This must take into account the morphing of the first voice or right hand.

Hearing the following samples clearly confirms the difficulty of this task.

Parents' samples

Alternate morphing



Bach.wav



Boccherini.wav



BoccheriniBachAI.wav

5. Developing the morphing process

Generally speaking, when experimenting with code, it is a good practice to keep things as simple as possible. In the morphing's case, a practical solution is to design the morphing process like an onion skin, in other words, using different layers and the hierarchy of Moles [5]. These are the super cell layer (genre, musical form, and structure), the sonic cell layer (periods, phrases, etc.) and the sonic object layer (pitch, velocity and durations). The top layer (genre, structure, etc.) provides values to the parameters of the inner layers, the last being pitch, velocity and duration calculations. Considering differences between scores, it is also necessary to split the morphing calculations in three steps.

The first is preprocessing, to adjust properties and values of different scores, such as the number of measures, the scale and the number of notes among others. The second step is the morphing itself, using the preprocessed data. The final step is post processing or postproduction, to adjust errors, harmony, rhythm, expression, considering different voices, or the main instrument with its accompaniment (Figure 7).



Figure 7. The MIDI morphing application layout. The first block of components lets insert the musical information of parent scores. The second block is to perform preprocessing operations, the third is the final morphing palette. Software and image of the author

6. Morphing with L-systems

The morphing calculations, as I have briefly explained, are not deterministic, since the result depends on rhythm, harmony or expression and their esthetic subjective interpretations. The point is that the software, to match individual styles, should provide the appropriate means to choose between different functions, options, parameters and values. In this sense, generative morphing could be implemented like a new musical digital instrument. But some actual limitations of L-systems' procedures make this task if not impossible, very difficult, as the next sections will explicate.

6.1 Improving L-systems algorithms

In the first place, standard L-systems do not provide enough control over the process, first if the user wants to create the score from scratch, and secondly, when it is necessary to modify the morphing interpolations and the properties of recursion, the main characteristic of L-systems. It is easier to understand one of these difficulties in the

case of 3D forms. Consider the model of Figure 8: every row of the model has different quantities of bricks, and their relative positions are also different.

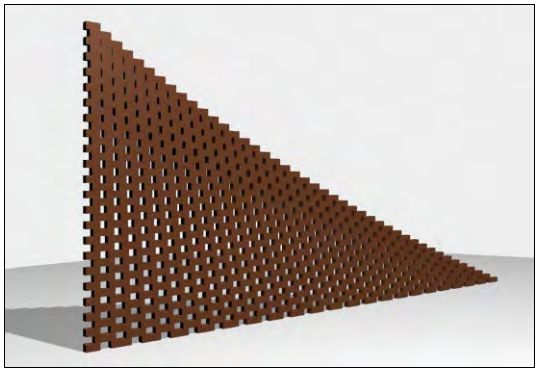


Figure 8. Easy to do with any programming language, impossible to do with a standard recursive substitution process. Software and image of the author

In fact, the values depend on the level of the row. In standard L-systems' grammars it will be necessary to create a rule for every brick and space for every row, which will make the grammar of the system too complex and the advantages of recursion to be lost. The same problems arise when manipulating musical information, for instance, to match velocity with duration, chords, with beats and so on.

You cannot solve this kind of problems even with timed, parametric or context L-Systems. So special programmable rules and symbols were developed and added to the standard L-System algorithms. To mention just one: *subL-systems*, which are full L-Systems (the children) inside another L-System (the parent). This way it is easy to build very complex modular objects made of objects that interact between them. A better description of these techniques is included in [9] and the software can be downloaded from http:www.digitalpoiesis.org.

6.2 Improving the interface

Now, symbols and rules can represent and compute musical and visual information simultaneously. This makes possible to morph colors with sounds, or to use images to morph music. The possibilities of creative experimentations are endless.

But, to take advantage of these possibilities, is needed a solution to cope with the complexity of information inside L-systems [10, 11] (figure 9). In fact, a full system must control and manipulate strings of thousands and thousands of symbols. In the case of music, this is too demanding, since every single piece of information counts for the overall beauty.

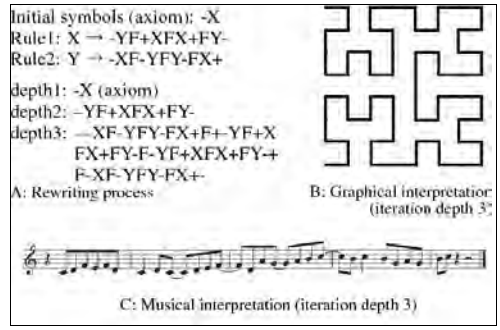


Figure 9. Musical L-Systems notation. Tsubasa and Kurosawa (2012)

For instance, the L-system musical notation should provide a decent interactive visualization of the score L-system symbolic representation, such as the position of the symbol in the scale and its tempo. The interface must provide interactive commands to read, play and edit the information of sonic objects (compare Figure 9 with figure 10).

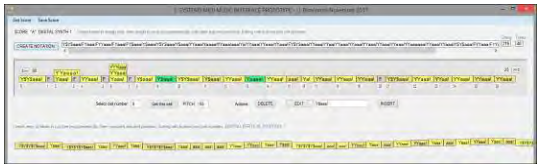


Figure 10. Sonic buttons can be clicked to read or play the pitch. Size represents duration, colors help to spot, for instance, tonic instances, pauses or strong and weak beats. The vertical position visualizes the ascending or descending movements. Software and image of the author

7. Musical morphing as a new instrument

The idea is to help the user create new scores with morphing algorithms in real time. The workflow should run in this way: first, the preprocessing computations. Then the instrument performs the morphing process using the input values of the user; this serves as a starting point. In the second step the user can edit and arrange the resulting score in real time, changing options and values on the fly. Controls are provided to edit the full score or any particular section, measure or note, for instance, to change the pitch, duration or both, for the entire measure, strong or weak beats.

By changing weights and other parameters, the user can create the music morphing step by step, in a natural and flexible way. In the final step the user can arrange the score to fix rhythm, harmony, tempos, since the options may give inconsistent tones that need to be fixed.

The editing and remixing section of the application will change the display accordingly to the actual task in progress (preprocessing, editing, or post processing). The playback section of the interface, to facilitate the production workflow, provides controls to play or loop the MIDI file like DAWS usually do, but adding options especially designed with the generative morphing in mind: loop changing modes automatically, loop changing only strong or weak beats or loop changing some specific part of the score. In any case the interface design process will be incremental, since useful options are discovered creating music and updating the layout on the go. Figure 11 and 12 show the L-systems score generator and the prototype of the morphing application.

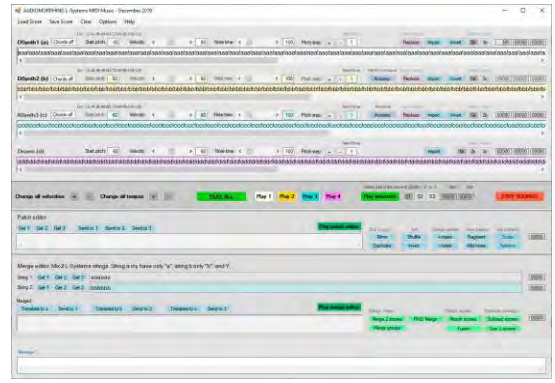


Figure 11. L-Systems generator interface. Scores can be saved as MIDI files and processed in the morphing module. Software of the author

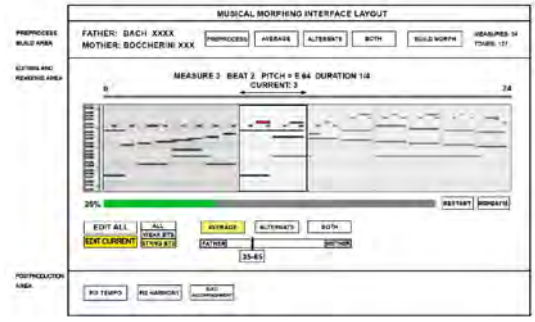


Fig. 12. Interface prototype for the morphing instrument. Design of the author

8. Conclusions

In this paper were described the basic concepts of musical morphing and instrument prototypes. The research is in its beginnings, there is clearly a lot of experimentation and work left to do that hopefully will be presented in the following conferences. So far, the following conclusion will share some insights and discussion topics that the research suggested:

a) The generative morphing process is an experimental instrument that will not always deliver beautiful music (experimental music in general is usually tough to hear…) , but it certainly lets extract interesting and unique clips, samples and patches to be used in standard remixing processes with DAWs. In this sense, it could be used as a sample generator plugin that expand the possibility of DAWs, somehow exhausted even considering the huge amount of products in the market [].

b) Morphing can be done without using L-systems, but the DNA metaphor makes the process simpler to design and implement, and more “generative” [12]. The modularity of L-systems grammars facilitates collaborative creative workflows. For instance, in the grammar can be combined rules of different authors, resulting in a sort of surrealist *exquisite corpse*.

c) The interface design is essential for morphing but also, but for generative art in general, because it makes the process transparent (rules and symbols are always in sight) and feasible for real time editing. The drawback is that the interface design and implementation need a lot of work, even more than the required by the morphing algorithm itself.

d) In this sense, generative grammars and morphing are instances of computational creativity that let discover and analyze in practice many concepts about creativity and Artificial Intelligence as originally posed by Boden [13]. For instance, generative versus combinatorial creativity. In comparison to neural networks technologies like GAN, generative grammars have the advantage of a better transparency and intelligibility [14] of the running processes.

e) From the artistic and educational point of view, it is very interesting to combine L-systems with and etnomathematics, like the digital musical yupana I presented in the last conference [15]. Musical morphing can be used to develop digital interculturality [16], since the morphing is about rules, and rules can embed natural computation and traditional creative techniques.

Bibliography

[1] Gunkel, D. 2016. *Of Remixology. Ethics and Aesthetics after Remix*. Cambridge: MIT Press.

[2] Carnovalini, F., and A. Rodà. 2020. “Computational Creativity and Music Generation Systems: An Introduction to the State of the Art”. *Frontiers in Artificial*

Intelligence 3: 14.

[3] Wooller, R. and Brown, A. (2005). “Investigating Morphing Algorithms for Generative Music”. Innocent, T. (Ed.) *Proceedings of Third Iteration.* Centre for Electronic Media Art, Australia, 189-198.

[4] Prusinkiewicz, P. 1986. “Score Generation with L-systems.” *Proceedings of the International Computer Music Conference*, pp 455- 457.

[5] Manousakis, S. 2009. "Non-Standard Sound Synthesis with L-Systems." *Leonardo Music Journal* 19: 85–94. Project MUSE muse.jhu.edu/article/363706.

[6] Rodrigues, A., E. Costa, A. Cardoso, P. Machado, and T. Cruz. (2016). *Evolving L-Systems with Musical Notes*. 9596. DOI: 10.1007/978-3-319-31008-4_13.

[7] Worth, P. and S. Stepney, S. 2005. “Growing Music: musical interpretations of L-Systems.” *EvoMUSART workshop*. EuroGP 2005, Lausanne, Switzerland, March 2005, 545-550.

[8] Moles, A. (1968). *Information Theory and Esthetic Perception*. Urbana: University of Illinois Press.

[9] Roncoroni, U. and Crousse, V. (2016). “Programming shape grammars and string substitution rewriting systems for generative art”. In Soddu, C. y E. Colabella (Ed.) *XIX Generative Art Conference Proceedings*. Rome: Argenia.

[10] Tsubasa, T and Kurosawa, K. (2012). *Automatic Melodic Grammar Generation for Polyphonic Music Using a Classifier System*. 9th Sound and Music Computing Conference (SMC2012), Copenhagen, Denmark.

[11] Tfirn, M. (2012). *The Musical Mapping of L-Systems*. Master thesis. Wesleyan University (Middletown, Connecticut).

[12] Karwaszewska, M. (2019). “Intermedial Score – Structural Filiations in the Context of Music-Literature Relations as well as Musical and Visual Relations”. In Soddu, C. y E. Colabella (Ed.) *XXII Generative Art Conference Proceedings*. Rome: Argenia.

[13] Boden, M. (2004). *The Creative Mind*. Nueva York: Routledge.

[14] Colton, S. (2008). “Creativity Versus the Perception of Creativity in Computational Systems”. *AAAI spring symposium: creative intelligent systems*, 2008 - aaai.org.

[15] Roncoroni, U. (2019). “Using the Inka's Calculator for Generative Art”. In Soddu, C. y E. Colabella (Ed.) *XXII Generative Art Conference Proceedings*. Rome: Argenia.

[16] Varma, R. (2006). “Making computer science minority friendly”. *Communications of the ACM*, 49(2) 129-134.



ARTWORKS PERFORMANCES

Center of (Varying) Gravity

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https://amaykataria.com



Abstract
Center of (Varying) Gravity draws from the visual language of fractal patterns to create a generative-meditative simulation of light. It takes its point of departure in the context of unpredictability and readjustment to devise a symbol of courage and motivation to face the varying uncertainty. Due to its mathematical nature, the simulation evolves with time while refracting a myriad of colors inspired from a Fuschia flower.

Work: https://covg.art
Duration: *Infinite, ongoing*

Email: studio@amaykataria.com

Key words: *generativeart, fractals, mathematics, impermanence, simulation*



Lotus Audio - Virtual 3D Music Driven Environments

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Premise



Lotus Audio is a web app for artists to create virtual environments that respond to music. Artists can create scripts written in JavaScript to create 3D environments and shapes which respond to music. The platform allows them to share their creations with users through the web app along with options for monetization of their creations if they choose to do so. Users can experience the artist's creation in the browser and can optionally have the experience in virtual reality (VR). They can invite others to join their virtual experience creating a social virtual space for shared audio-visual experience.

The app is designed for artists who enjoy making music visualizations as creative expressions. Possible audiences who may take interest are video artists, demo artists, musicians and anyone who enjoyed Winamp visualizations. It is research into platforms for digital artists which can extend utility for their creations. It allows multiple people to experience the visualization at the same time which adds a social dimension by default. Artists can monetize their works of art attributing a sense of value for the works created.

It also opens up a new mode of media to be thought of as something worth paying for. While video consumptions platforms have established centralized models of directing revenue towards creators, this platform tries to directly connect creators with consumers with only the technology underneath being the medium. A lot of ideas about its implementation have been inspired and built on principles of the decentralized web. The application has been previously used to create artworks for algoraves and a presentation for a conference about visualizing the physics of sound.

1. Concept

The application is inspired by the demoscene internet subculture which focuses on producing small computer programs that produce audio-visual presentations. The application is accessible via a URL on a browser and collaborators can easily create, view and share their creations within the app. The web app and some demonstrations are detailed below.

2 Web Application

App:
https://lotusaudio.herokuapp.com

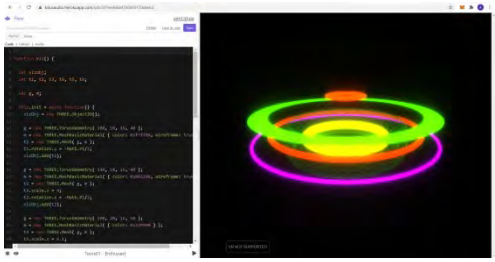
Git:

https://github.com/amitlzkpa/lotusaudio

The app uses several core web technologies. Users can visit the URL of the website on an internet browser. They will be presented with the list of public creations present in the gallery from which they can select to view the experience. When viewing the creation users can load music choices from the list supplied by the artist or pick a track of their choice. On starting the song the 3D environment comes to life, processing the music and creating the 3D experience in the virtual environment.

2.1 Creation

Artists create the 3D environment using Javascript. The geometry in the environment is rendered using threejs – a popular browser based 3D rendering library. The processing engine parses the artist's creation and injects the logic into the scene. The scripts are designed to conform to a basic structure which enables it being processed this way. The processing engine parses the audio file and passes it to the script for rendering. The audio is processing is done vis WebAudio API which does an FFT analysis of the spectrum and processed information is passed in a series of arrays to the artists scripts. The scripts are created in the browser in the editing mode which is very similar to the viewing mode with extra tabs and settings for configuration.



Script creation and editing screen.

2.2 Processing

The web app is a client side application which reads the visualizer script and a given audio file to generate 3D geometry. The script and the audio files are independently loaded from a URL. The audio file is parsed using the WebAudio API and passed to the script. Threejs is used to create the geometry and render the virtual scene. WebXR technology allows users to experience the 3D scene in VR.

2.3 Experience

A virtual 3D environment is populated with geometry as defined in the artists' script. All designs start with a fixed environment output by the initialization method on the file. Users can enter this environment for trying out the experience. When they start playing the music the geometry in the environment responds to the music. Designers have the choice to lock the animated content to be accessible only to paying users. Users have the choice to enter the virtual environment as a VR experience if they have a connected headset.

2.4 Sharing

All experiences being served as a web application makes it really easily to share experiences. Creations are shared over a URL and it's easy to share them by passing the URL. The scripts driving the experience are also viewable for everyone. Planned future development will include a way for creators to fork and remix designs. Users can also invite others to participate in a particular experience by sending an invite link. Invited participants join the same experience with synchronised music and environment but viewing the experience from a different vantage point in the virtual environment.

2.5 Monetization

The application currently also has experimental features to allow artists to monetize their creations using WebMonetization. WebMonetization is a new experimental way of monetizing content on the internet based on engagement. Creators can lock access to their content till the user starts depositing micropayments to an address specified by the creator. It is very simple for the artists to create a pointer where they can receive payments and just as simple for the users to start sending payments. It is based on a proposed W3C standard and the underlying infrastructure is directly supported by the browser.

3. Experiences

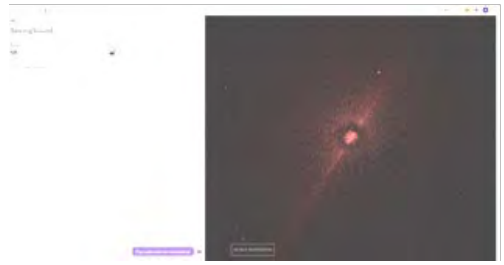
3.1 Wonderville Algorave, New York 2020

An experience was created for an online algorave hosted by Wonderville. Musicians and visualizers get together at algoraves to create digital music and accompanying visuals. Typically the visuals are rendered as videos made using music visualization software such as TidalCycles, Orca, Resolume etc. This visualization was created as a new technique to make such visuals where a 3D scene was generated procesurally which responded to music contributed by other artists.



3.2 Seeing Sound, CodeLand Conference 2020

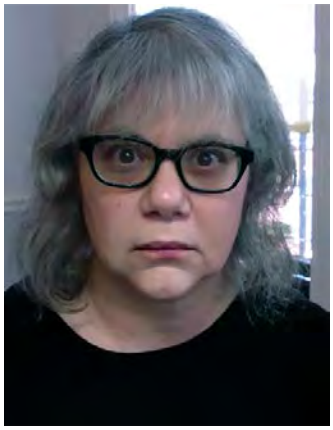
The visualization attempts to visualize the physics of sound by simulating its effect on freely suspended particles. It was inspired by prior work done in the field of Cymatics where the wave nature of sound vibrations is exhibited by studying the actions of vibrating plates on sand particles. The visualization takes the same approach by suspending virtual sand particles in a 3D environment and simulating interference effects on these patterns emulated by processing the sound via the app engine.



Two Synthetic Gardens

Artwork

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Abstract
These garden artworks come from a series of slowly evolving digital landscapes which are meant to depict the temperaments of various fictional characters. The Tuttle garden shifts from cheerful optimism to moments of frailty and self-doubt. Meanwhile, the Macker garden moves from a hermetic distance to generative self-expression. The gardens rely on a system of senors, deliberation, and reaction to generate their character states. They then model these states as visual elements on screen. This project draws on the work of Valentino Braitenberg to portray character as a dynamic system. Character is not a fixed set of strengths and weaknesses set against several obstacles in pursuit of some final outcome, this project imagines character as a generative process created by the ongoing computations of states, ot an ongoing strategy of perception, computation, adaptation, and response. This conception of character is not separate from more conventional views, but it emphasizes character as a pattern of reactions rather than a force acting within a field of possibilities.

Key words: complex adaptive system, Braitenberg, simulation, post-dramatic

Main References:
[1] Braitenberg, Valentino. Vehicles: Experiments in Synthetic Psychology. Cambridge, MA: MIT Press, 1986.
[2] Fuchs, Elinor. The Death of Character: Reflections on Theatre after Modernism. Indiana University Press, 2012.
[3] Gentner, Dedre, and Albert L. Stevens. Mental models. Psychology Press, 2014
[4] Puica, Mihaela-Alexandra, and Adina-Magda Florea. "Character belief-desire-intention agent model: Previous work and proposed architecture." International

Journal of Advanced Research in Artificial Intelligence 2, no. 2 (2013): 1-8.





Dot

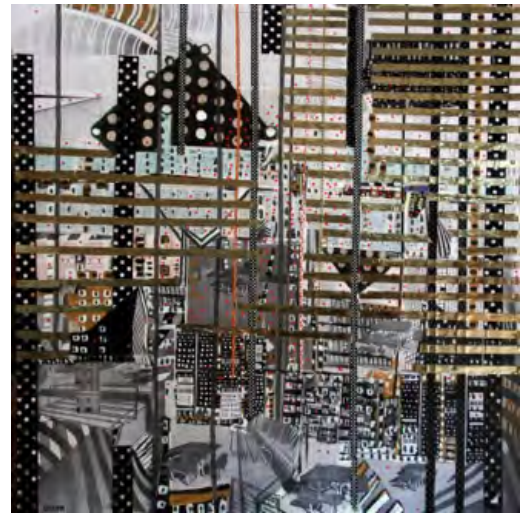
Artworks

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Abstract: **A Dot**

While taking a test or an exam on a rainy day our attention may be distracted by rays of sunlight conquering the grayness. We use dots to mark our answers, and suddenly we may realize how dots may serve other purposes: to organize, summarize, categorize, inform, order, and position, to say nothing about small dots of rain gathering on the window panes. The dots can imply some meanings, conclusions, or statements in an organized space. Dots can imply some meanings, conclusions, or statements in an organized space. Look at design, fabrics, logos, divisions, or material science. There are many dots in nature, on a ladybug, or a poisonous mushroom such as *Amanita muscaria*, sharing similar colors and patterns probably for different reasons. There are many bugs, flowers, and other plants and fruits, birds, fish, panthers, or many other animals with dotted patterns; we may even think of nuclear dots.



The title: Dot

email/address ursyn@unco.edu

Key words: Generative Art, Computer Graphics, Digital Media

Main References:[1] *The Art of Coding: The Language of Drawing, Graphics, and Animation*
by Mohammad Majid al-Rifaie, London, UK, Anna Ursyn, UNC, USA, Theodor Wyeld, Sydney, AU, Taylor&Francis 2020
[2] Graphical Thinking for Science and Technology Through Knowledge Visualization (Advances in Multimedia and Interactive Technologies) Anna Ursyn (Author), 2021 IGI-Global

Coming Together: LUG
A Generative Installation

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Abstract

This installation is a second collaboration between the first author, a coder-composer, and the second author, a dance/theatre artist. Triggered by the world-wide shutdown brought on by the COVID pandemic, the authors viewed the situation as an opportunity to comment upon issues of isolation, remote collaboration, separation, and potential convergence.

1. Introduction

This paper will describe the generative system (Sections 2 and 3), the artistic choices made in the movement (Section 4), and the role of collaboration in the work (Section 5).

2. Previous Work in *Coming Together*

Coming Together are a series of generative artworks in which the process of convergence by agents is the focus of the work, in the movement from random individualism to united ensemble interaction. As with most of the first author's creative research, the use of multi-agents are integral to the generative process; instead of attempting to create complex top-down systems for intelligent control or creation, imbuing individual agents with the capacity to make decisions and interact with other agents to create complex, dynamic, and emergent systems provides a bottom-up method that has been successfully used in games [2], sound art [1], and interactive environments [8].

Coming Together: Beauty and Truth (2010) utilised agents that had individual desires to generate repeating phrases that had a musically meaningful relationship to all other agent phrases. Agents moved towards a collective goal by listening to one another's output, as well as messaging one another. Agents altered their own musical output based

upon formed beliefs as to the other agent states. The end result was a negotiated solution that demonstrated a unique melodic, harmonic, and rhythmic environment that was arrived at collectively [3].

Coming Together: Freesound (2011) was an autonomous soundscape composition created by four agents, who chose sounds from a large pre- analyzed database of soundscape recordings based upon their spectral content and metadata tags. Agents analyzed, in realtime, other agent's audio, and attempted to avoid dominant spectral areas of other agents, selecting sounds that did not mask one another. Selections from the database were constrained by metadata tags describing the sounds. Thus, water sounds could trigger other water sounds, or agents could choose to oppose contextual references. As the composition progressed, convergence was further facilitated by lowering the bandwidth of the agent's resonant filters, projecting an artificial harmonic field upon the recordings that were derived from the spectral content of the recordings themselves. Finally, each agent added granulated instrumental tones at the resonant frequencies, thereby completing the "coming together" [4].

3. Technical Description

Like previous works in the series, *Coming Together: LUG* uses agent negotiation as a process. Aspects such as selection, duration of gesture, and processing are all fluidly determined during individual performances. The visual and aural result is one of moving from "band-limited" chaos to converging upon a single video and audio performance. We use the term "band-limited" because both audio and video agents are constrained in their individual presentations, and the perception of "the whole" can only be achieved through the combination of individual agents.

The five audio agents are essentially the "drivers" of the processes; it is their selection of constraints (equalisation, described later), and gestural initiation and duration, that the five video agents follow. Individual video agents – uno, due, tre, quattro, cinque – are locked to the identically named audio agents, so that audio and video agents remain synced.

The audio agents have access to a database of recordings made by four musicians: Joshua Hyde (Graz), saxophones; Alice Purton (London), cello; David Del Tredici (Montreal), trombone; Daniel Brew (UK), guitars. Performers were asked to improvise on a general theme of living during the COVID shutdown, and limit their improvisations to 30 to 40 seconds in duration; these recordings were then analysed for spectral content and segmentation. Five video agents have access to video recordings made by the second author, and are described below; no analysis is done on the video database.

At the start of a performance, all agents initially select a random item from their available databases, together with a segment from within it: because every segment has both a starting point and duration, this selection implies a gesture's duration as well. Agents then notify other agents of their selections. Throughout the performance, agents can choose to continue to present their selections, or move towards what they believe to be an emergent meeting point within the ensemble. For gestural durations, this is done through averaging of all agent values; for database

selection, this is done using an index that is randomised before each performance.

Beginnings of gestures are decided by a combination of a segment's duration, and the interonset delay between gestures decided upon by the agents, another negotiated parameter. During the performance, as agents converge on a single audio and a single video recording, gestural durations and interonset delays will begin to converge as well; in order to align actual start points, a background metronome that counts a variable beat structure (anywhere from eight to twelve beats), and the agents use negotiation to converge upon a single beat.

The initial random audio recordings are granulated, time-stretched, and heavily filtered through selected equalisation bands. The bands selected, using a Bark analysis [12], are based upon the audio selection – highlighting prominent bands within the individual recording, and are communicated to other audio agents. Other agents will attempt to select a recording – when they choose to do so – in which other agent's specific Bark bands are not as prominent, in an effort to avoid spectral masking. Initially, a single Bark band is chosen by each agent; during the course of the performance, this increases to five bands, which cumulatively fills out the entire 25 bands of the Bark spectrum.

The videos are presented on a monitor divided into five equal vertical segments/slices, and the video agents display their portion of their video; for example, the first agent ("uno") displays the left most 20% of its video, while the second agent ("due") displays the next slice (see Figure 1), and so on.



Figure 1. Video presentation of five agents, close to beginning of a performance

The agents initially process their videos by limiting the colour and sharpness, a process that parallels that of the audio agents. Over the course of the performance, colours are added until a complete colour spectrum is presented (see Figure 2.). Each performance seems to last between 10 and 20 minutes in duration.



Figure 2. Video presentation of five agents, close to end of a performance. Colours are complete, but starting points of gestures have not aligned

4. Dancing in the Neighborhood with LUG

I have characters that I inhabit for the purpose of creating kinaesthetic provocations towards emancipatory encounters. My 16 year old character LUG, donning an old overcoat and felt

hat and always ‘lugging’ and old leather suitcase, dances stories of displacement, longing, belonging and in-betweeness.

In this period of isolation, LUG and I wandered my neighbourhood; the warehouse district of Regina, Saskatchewan and each week we created a very brief improvisation inspired by a site that resonated with us. The works are in dialogue with fierce winds, new grass and blooms, ever changing graffiti and general grit and rust akin to this area. The themes that arose; islands of isolation, tunnels of despair, fierce need for rest not wanting to be just another statistic, longing for touch.

When contemplating this collaboration it was requested that more footage be provided to allow for a greater range of ‘play’ with the aleatoric sonic and visual systems that were being introduced. Instead of dancing the neighborhood I chose to take LUG to the coullies outside of Regina in a valley with a string of lakes. In -18 temperatures, we created slow motion scenes like a broad sketched line in the landscape. I decided to work devoid of narrative as I thought it would compliment the warehouse series and allow for a play between poetic narrative and elongated images. My criteria for choosing the sites remained the same, they needed to be simple and steeped in metaphoric possibility.

4.1 LUG in the Neighborhood

We were sent home with the rest of the world on March 15th.

We thought that this temporary isolation could be generative, refreshing, inspiring.

An invitation to re imagine ourselves. I live in the warehouse district and took to walking my neighborhood. It is truly industrial, not trendy industrial. I wake to the sound of delivery trucks backing up and trains grinding through with hoarse whistles relentlessly sounding. My only green space is a 150 year old cemetery spanning 3 square city blocks.

I walked and then would come home and sterilize our surfaces and then sit down to work in my many stations in the house.

My walking was different though.

I was not frantically watching the clock to see how late I would be for my next meeting. I was simply walking. This presence and attention to my neighborhood constructed a new lens and soon that lens was also my camera. I noticed stunning shadows and odd juxtapositions, curious combinations and expressive and yet forgotten architecture. I simply noticed….

Soon I had collected over 100 photographs and then these every day and yet exotic still captures began to knock on the door of the dancer and the dancer in me began to see these sites as fleeting performance locations for what later became a series of movement haikus.

I began to walk my neighborhood with an alertness that almost beckoned the perfect combinations of tensions, metaphors and textures. I would identify a possible site in the week and then let it incubate, calling forward the traits of a character that I have been improvising with for the last 16 years; LUG. LUG, donning an oversized overcoat and felt hat, carries an old leather suitcase which often conceals and reveals artifacts that change within the context and conditions of these improvisations. I know LUG well but am always surprised with the decisions that are instantly made within the moment of every performance. Although there is a melancholic tone to LUG, there rests a small sweet clown

and a tender hopefulness for comfort, safety and even joy.

I would take LUG and my videographer to an identified site on the weekend and decked in costume, I would 'play' in the site for about 10 minutes. I was always surprised how fast I could land on metaphors that integrated the long trailing coat, the hat, the suitcase and the small glass heart concealed within.

It seemed as though the site had been brewing in my body co-mingling with the familiarity of my performative character and my lived experiences. I was able to listen very deeply to what was present in this 'play' and combine in it with a kind of performative wisdom. What resulted was a series of 40 second performative captures that integrated the metaphors deeply embedded in the site. These metaphors become heightened in light of my Becketesque character that always conveys the complexities of displacement and longing and now is doing so in stark environments during a global pandemic.

In my work with LUG within a broad range of performance conditions throughout the world, I would always create a subsequent LUG LOG. I found that these improvisations often unearthed a sense of exposure and vulnerability and I needed to construct a reflective container that would allow me to understand more clearly the meaning making in this work and that could transcend the raw emotion it often generated. There is a price to pay in stripping expectations and preconceived frameworks in my approach to performance. This approach allows for an extreme immediacy and availability which can become a direct hotline to the heart and soul of an audience but the other side of this is the nakedness of the performer in a context whereby impulses can become reckless and bold without care for the safety, both emotional and physical, for the performer. The LUG LOG becomes a kind of reflective blanket to that nakedness and assembles that which is dismantled in the powerful event of performing. Both the surrender to this nakedness and the re assemblage are critical in the prospect of sustainability. If I truly allow myself to access life experiences during my performances I run the risk of cracking open dark spaces that have otherwise been protected and in doing so, create a lesion. LUG is a seasoned character and seems to have many years left and I would attribute this to the careful methods such as the LOGS that are practiced in attending to these resulting emotional lesions.

I performed in 8 sites in my neighborhood and the rest of my writing will be in the form of LUG LOGs that reflect on the choices and the meaning making I experienced in each of these 40 second performances. These brief performative containers necessitated an economy of choice making in order to find a succinct arc in narrative and these LUGS LOGS reflect this poetic concision.

Site #1

A stairway going nowhere

Arduously I climb the stairs with my trailing overcoat reminding me of my regrets.

I retreat to the door, or at least I thought it was a door but in fact it is a wall that I slam into. I turn in on myself as if to transform the wall to a door. Hoping for an opening, a new possibility. It does not come but opening my suitcase I feel the cool smooth heart within and know that the possibility I am seeking is coming from within. There is no door right now but there is possibility.

Site #2

Railings to protect and contain

"...the imagination is unleashed by constraints. You break out of the box by stepping into shackles." — Jonah Lehrer, 2019, as cited in [11].

I am entangled with my coat and the railing. Which is holding me back. I am doubling up on myself and am confused with my own repetitions and habits. Who/what is holding me back? If I let go of my ancient thoughts and gather new ones I can hover on the precipice of restriction and surrender.



Site #3

Islands of Despair

I found my island and climbed upon it. From a ship wreck it became a small savior. Pulling in what matters and leaving behind the rest. Fishing for the essential. Tracing my history and finding solace in the simplicity of the present moment.

Site #4

Lost in the Tunnel

This isolation, this stasis where suddenly we are thinking nostalgically about tiny airplane bathrooms, folding toothbrushes and inflatable neck pillows. We are propelled out of the world of travel, out of the possibility of touching those who are outside of our bubble. Our world becomes a close-up lens of small boxes and yet still we find the necessary heat.

Site #5

You will (never) be free

"For too long, information, opportunities, and resources have been constraints, they need to be the bridges" [7].

A beautiful abandoned brick building. The entire wall becomes the canvas for a fleeting proclamation through black spray paint " You will never be free". Despite the alluring aesthetic of disorganized font on red brick it was troubling for me to think about the site throughout the week. Although the setting for these performative haikus are gritty and dark there is always a little hope that glimmers even within the very brief time frame. How might I find this within this very definitive statement? I arrived in costume struggling with my coat in 45 kilometer winds and looked up to the wall to find the word never sprayed over. A gift, the wind the erasure became an invitation for surrender. The fierce wind stripped me of the weight of my coat , it flew away from me and with it the weight of always choosing the path of resistance. I was free.



Site #6

Dandelions in the suitcase

Space, like time, engenders forgetfulness; but it does so by setting us bodily free from our surroundings and

giving us back our primitive, unattached state ... Time, we say, is Lethe; but change of air is a similar draught, and, if it works less thoroughly, does so more quickly" [7].

The sensuous pleasure of nature. Not understanding social distance, the dandelions are abundant. Savoring the moment. Weary from the stark, bleak winter, the tender cracking open of light and warmth. Now rest and know that you are safe.

Site #7

A patch of grass

"To make biological survival possible, Mind at Large has to be funnelled through the reducing valve of the brain and nervous system. What comes out at the other end is a measly trickle of the kind of consciousness which will help us to stay alive on the surface of this particular planet."- Aldous Huxley as cited in [6].

I am navigating an electric box and white boulders to find a small patch of simulated grass. How do we get to these places where wrong and right live side by side? How and why do we set and play the games that we know do harm to self and others?

Site #8

Not just another statistic

"When love is roaming in our mind, looping in the deepest fringes of our heart, undreamt spaciousness emerges, repealing the constraints of triviality and letting stifling narrowness fade away. While our mindset is besieged by a revolving burst of emotion, our world is ultimately opening up" [9].

I know you are here and I am frantically searching for you. Even though everything looks the same I know I will find you. I do. I crumble to my knees with the sheer sorrow of knowing I have both found you and lost you. I leave you my heart as it precariously perches on the top of the gravestone, it will never fall. I promise you that.

4.2 LUG in the Coullies

I chose 4 sites in and around the lakes that rest in the Qu'appelle Valley in Saskatchewan. I was struck by the crisp turn to winter with subzero temperatures and biting winds and yet the ground was still insulated by a blanket of crisp golden leaves. It reminded me that we have in fact travelled through all seasons with COVID and that this promised short-term isolation, with the intention of flattening the curve, is entering a daunting new chapter as we slip into yet another elongated prairie winter. There is something foreboding and yet resigned about the way LUG carries the coat, the hat and the suitcase as he slowly contemplates the relentlessness of this desolate demise.

5 Conclusion

KR: As an improvisational performer I am always collaborating both with animate and inanimate influences. Previous in my description of LUG in the neighborhood I wrote about fierce winds and soft grass, unexpected graffiti additions and railings perfectly placed. These are all my partners in the performative event and completely influence my spontaneous choice making. Working with the first author guarantees both as he introduces his musbots and speaks of them in an almost endearing manner, imbuing with both admirable and frustrating human traits. So through these complicated systems that impact both the visual and the sonic outcomes of our presentation,

we are also bringing our own humanness as a necessary factor in the constructed event and this is pivotal to our meaning making and intentionality throughout the process.

AE: Composers have traditionally relied upon human performers to hear their music. I have long argued the benefits of working with generative systems, which allow coder-composers to create processes in which they can hear the results immediately, without the delay of having to find musicians to perform them. And while Coming Together: LUG is still a generative system that does not directly rely upon human performance, it would not have been possible without the close interaction with the second author. The work is a collective reaction to the bizarre situation that we all found ourselves living in 2020, and we both approached it from our distinct artistic practices. My agents do not (yet) have the volition to create an artwork in response to a worldwide pandemic, but they are a critical part of our collaboration and as such contribute to the complexity of our choices and responses to the world as we now know it. This disruption, this invitation and this incongruence can also become a catalyst to explore and galvanize human truths.

References

[1] Beyls, P. 2007. Interaction and Self-Organisation in a Society of Musical Agents. Proceedings of ECAL 2007 Workshop on Music and Artificial Life. Lisbon

[2] Binkley, T. 1998. Autonomous Creations – Birthing Intelligent Agents. Leonardo, 31:5

[3] Eigenfeldt, A. 2010. Coming Together - Negotiated Content by Multi-agents. MM '10 Proceedings of the International Conference on Multimedia, Florence

[4] Eigenfeldt, A. 2011. Negotiated Content: Generative Soundscape Composition by Autonomous Musical Agents in Coming Together: Freesound. The Second International Conference on Computational Creativity, Mexico City

[5] Eigenfeldt, A. 2018. Collaborative Composition with Creative Systems. International Symposium of Electronic Art, Durban

[6] Glynn, I. 1999. *An anatomy of thought: The origin and machinery of the mind*. London: Weidenfeld & Nicolson

[7] Mann, T., & Woods, J. E. 1995. The magic ... *Mann*, *Thomas*, and John E. Woods

[8] McCormack, J. 2001. Eden: An Evolutionary Sonic Ecosystem. LNCS, Advances In Artificial Life, LNCS, Springer Berlin / Heidelberg

[9] Pevernagie, E. 2020. Independently published

[10] Sager, S. V. 2018. Meetings, Volume Number 18. p. 40

[11] Sharma, T., & Mishra, P. N. 2019. Development of a scale to measure individual creativity constraints. *International Journal of Business Excellence*, *19*(4), 483-502.

[12] Zwicker, E. 1961. Subdivision of the Audible Frequency Range into Critical Bands. Journal of the Acoustic Society of America 33:2

AdNaan by Jacek Grudzień: An Intermedia Performance

Paper, Live Performance

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Abstract
The musical piece *AdNaan* by the contemporary Polish composer Jacek Grudzień was written in 2002 for solo cello and tape, specially commissioned by the accomplished cellist Andrzej Bauer.

The live performance art that will be presented at the conference is a synthesis of several actions: performing movement to the music, an interactive visualization of improvised movement inspired by the music and the interactive visualization.

Inspired by Jacek Grudzień's compositional techniques used in this work, the artists combine different means of expression, treating particular artistic gestures as stimuli that need a reaction. The performers, engaged in an ongoing dialogue, become intuitive transmitters and the cohesive force behind this work. Such an approach makes it possible to obtain feedback which, in a way, turns the project into a closed circuit of living and changing art.

The musical layer will be subjected to choreographic interpretation recorded in video form which, in turn, will provide scope for exploration in the visual environment, whose deformations and transformations affect the moving performance artist, who is at the same time a medium that affects the lighting and visual phenomena happening on stage. As a consequence, created is a picture of coexistent and collaborative bilateral planes, blurring the boundary between the initiator of the action on

stage and the role subordinated to the artefact in the making.

Choreographing this musical piece is a search for a spatial-motive means capable of expressing the dynamism of the ostinato figure organizing musical ideas throughout the form, as well as to reflect the accumulating sound planes occasionally contrasting with the persistent, lively ostinato.

The visual action plane consists of projections generated live by a VJ using computer software such as TouchDesigner and Resolume Arena. The abstract images being displayed react to the sounds of the *AdNaan* composition by changing and deforming. In these interactive endeavours, the artist searches for a way to express music through image, using the live animations as a means for controlling the lighting or lack thereof, exploring its movement. The visualisations, 'suspended' in the room, are also accompanied by the projection of the recorded choreography, which is displayed on the moving vertical strips of fabric.

The first tier of this project is its choreography. It devises spatial-motive means for expressing the dynamism of the ostinato figure and for outlining the build-up of timbral planes occasionally contrasting with the persistent, lively ostinato. This idea is illustrated by the movement of ten persons interpreting any musical phenomena emerging from the structure and sound of the piece. The video recording of the choreography performed is a starting point for subsequent creative implications.

The second tier consists of visual projections generated in real time by a VJ using the TouchDesigner and Resolume Arena computer software. The abstract imagery being displayed react to the sounds of the AdNaan composition by changing and deforming. In these interactive endeavours, the artist seeks a way to express music through imagery, manipulating the animations generated in real time as a means for controlling the level of lighting, exploring its movement. The visualisations 'suspended' in the room are also accompanied by the projection of the recorded choreography on moving vertical strips of fabric.

The third tier is the motive improvisation performed by the choreographer of the work. Her movement, inspired by the lighting and visualisations, simultaneously deforms the stage scenery, thus triggering the VJ's reactions to the performer's actions. As a consequence, a picture emerges of coexisting and collaborating bilateral planes blurring the boundary between the initiator of stage action and the role of the subordinated in the artefact in the making. The musical plane thus becomes a vehicle for in-depth analysis, translating the compositional technique used for creating this work. The purpose of all the assumptions made is to emphasize the interdisciplinary approach, which result is the creation of an aesthetic project.

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Keywords: intermediality, Polish contemporary art and music, body movement, music choreography, virtual reality, generative music, electro-acoustic music

General references:

Beata Oryl, choreography: *Francesca da Rimini* by Sergei Rachmaninoff; venue: Baltic Opera, Gdańsk, 2014

Beata Oryl, preparation of stage movement for the theatrical performance *Śmierć Byrona* (Byron's death); venue: Gdańsk Shakespeare Theatre, 2015

Beata Oryl, director and choreographer of the concert *Z miłości do niepodległej* (Out of love for the independent (Poland)); venue: Forest Opera, Sopot, 2018

Beata Oryl, preparation of music choreography for the concert *Musical language of selected cello compositions of Polish 20th and 21st century composers in movement interpretation*; venue: Stanisław Moniuszko Academy of Music in Gdańsk, 2019

Beata Oryl, Robert Turło, Adam Przybysz, *Soliloquium*, *Generative Art Science and Technology, Hard Journal* 2020, http://www.gasathj.com/tiki-index.php

Michał Garnowski:
Author of interactive video works on the Światłobiekty exhibition at the Centre for Contemporary Art Łaźnia curated by Robert Turło,

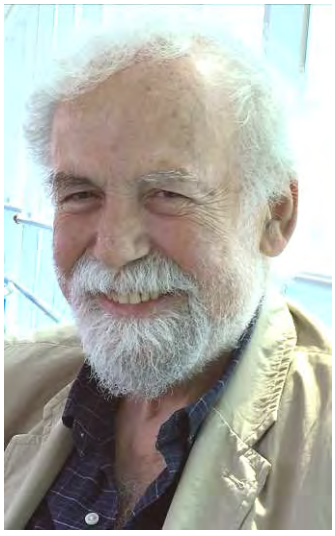
Author of live projections visualizing the concert of the Quantum Trio ensemble at the Vilnius Mama Jazz festival

Conducting veejaying workshops at Gdański Archipelag Kultury.

Author of interactive video works " Video Pictura", "Polish surrealism 3D"

Uniqueness and Time
Generative Art and Design, exploring poetics and dimensions in digital time

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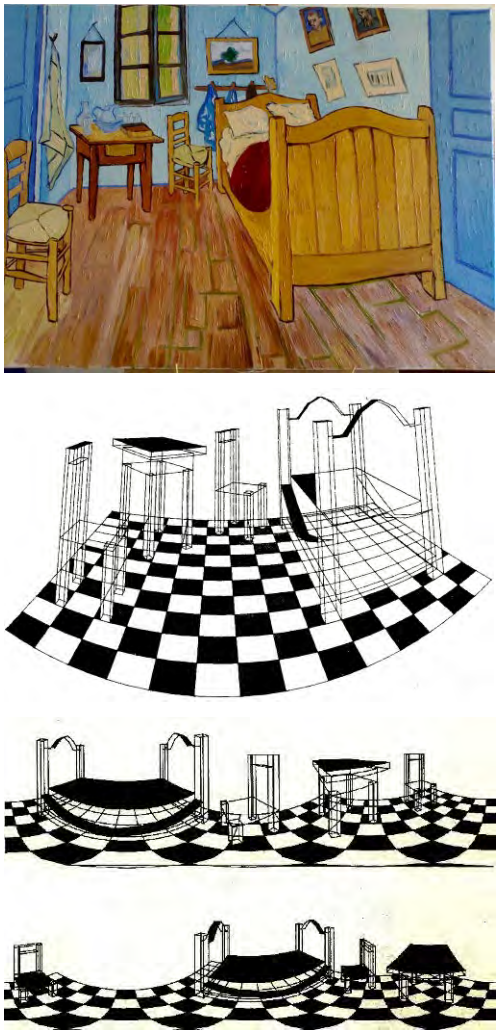


Celestino Soddu

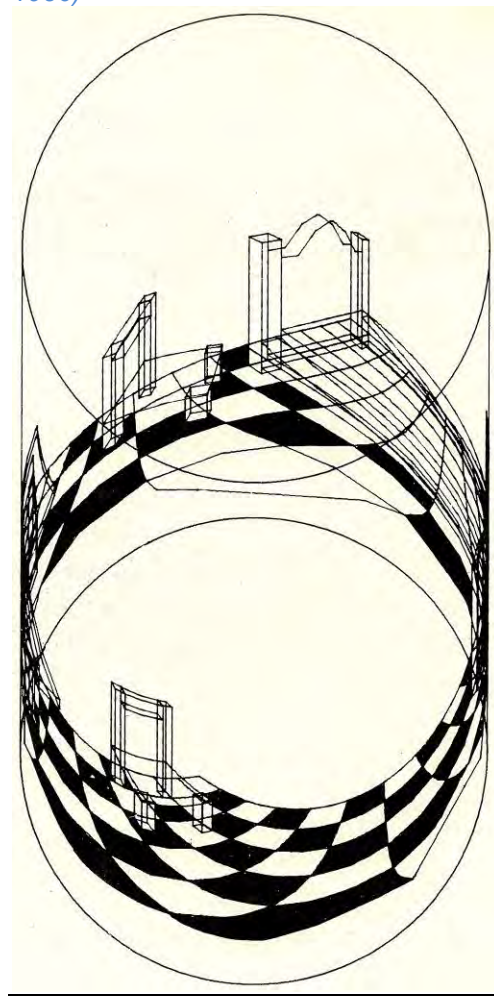
At the end of the seventies, starting from some considerations on perspective representation as it had been systematized by Piero della Francesca invention, I identified a possible path of discovery where the ***point of view*** was able to build, at once, the uniqueness of the possible outcomes and the variations of the same. I experimented these possibilities working on some algorithms able to build, verify and probe various advanced perspective representations investigating and trying to go beyond the borders of the one defined by Piero della Francesca. This was possible precisely because Piero della Francesca had defined a mathematical logic and a geometric process of perspective representation (see Globet by Paolo Uccello, recently attributed to Piero: C.Soddu, P.A.Rossi, "*Il calice di Paolo Uccello uno e senza limite*", (*the goblet of Paolo Uccello, one and without limit)* with a referee of C.L.Ragghianti, in "Critica d'arte" magazine n.8 1986.). Being a geometric and mathematical logic, it was possible to operate by constructing the related algorithms, bringing them to the limits of representation and varying them to access new possibilities.

The basis of these experiments was the transition to non-Euclidean geometry, identifying as one of the fundamental elements the interface on which the drawing is drawn. A flat interface, like a sheet of paper, leads to Piero's perspective, with its deformations at the edges and progressive variations if the point of view approaches the interface or crosses it. But various other interfaces such as a curved surface, a cylinder or a sphere not only lead to drawing drawings that appear to be constructed with non-Euclidean geometry but also represent

the first step for an anamorphic perspective image.

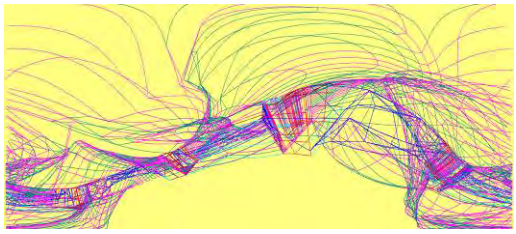


Van Gogh's Room is a painting constructed as a curved perspective. In the second image the perspective reconstruction. In the third image two 360 degree anamorphic perspectives and in the final image a representation of the structure of the cylindrical interface, as it is organized to fit the anamorphism of the possible views with the sum of the curves of the representation and the interface that cancel each other out.
(C.Soddu, The not Euclidean image, 1986)

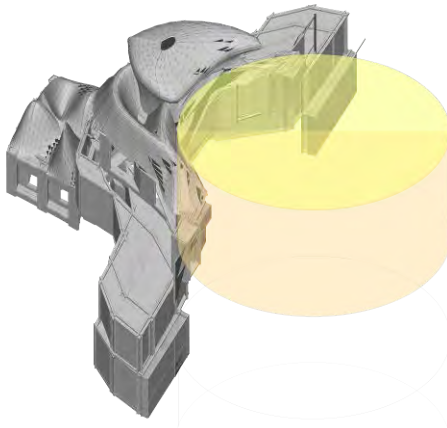


The anamorphism of these images becomes explicit when the double curvature, that of the interface surface and that of the drawn curved lines, cancel each other out. We look at a three-dimensional event from the point of view at the center of a cylinder and we trace in succession the points where a straight line starting from the point of

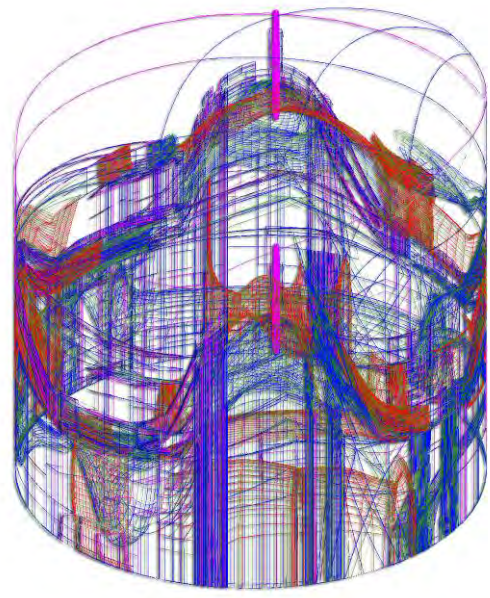
view towards the individual points of the three-dimensional event meets the interface of the surface of the cylinder (or sphere). These sequences trace curves even if, in the 3D model, they represent sequences of a straight segment. The anamorphosis happens when we realize that, looking from the defined point of view, the curvature of the cylinder and that of the drawn curve cancel each other out and the drawn segment appears straight at the sight.



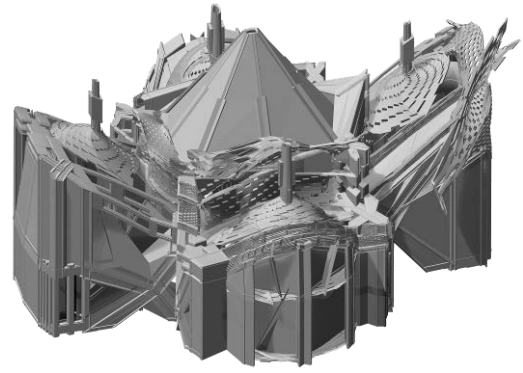
Anamorphic 360 degrees perspective of a generated 3D model. The model is inclined by 30 degrees concerning the interface axis.



An axonometric representation of half 3D model represented by using a cylinder interface in total hybrid perspective. The 3D result is a transformation of the original 3D model for fitting the cylindrical interface. The model extends its 3rd dimension outside of the cylinder. This could be used for transforming the 3D model into a not Euclidean space, or for using the 3D model in a bas-relief.

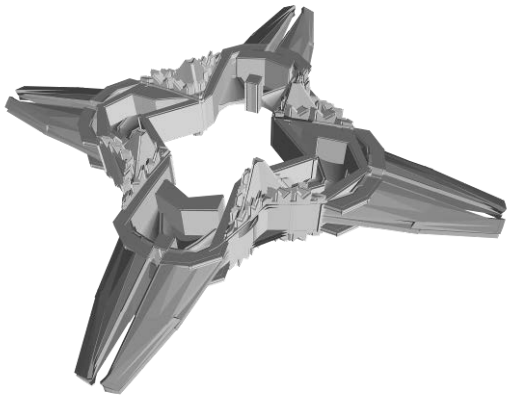


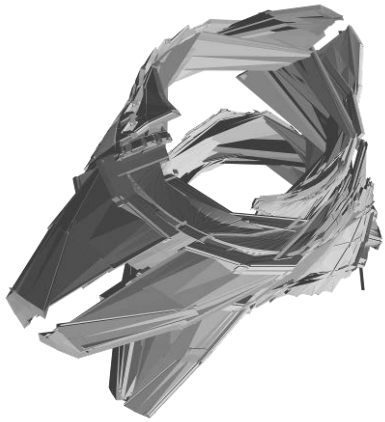
An axonometric representation of an anamorphic total perspective of a generated baroque castle. The image is in the cylindrical interface and the point of view is in the center of the cylinder. Following the 3D model of the castle.

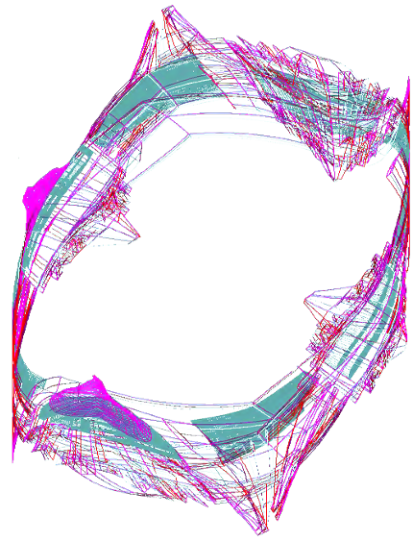


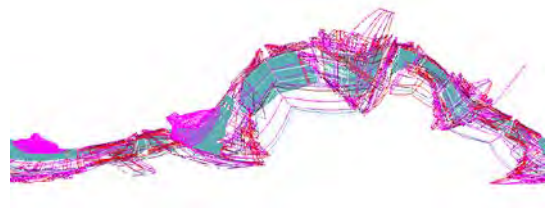
But this happens for only an instant vision. If we rotate our look, we find another perspective image where the same lines, due to anamorphism, move by rotating their arrangement. These keep the same straight configuration resulting from the mutual annulment of the two curves, the sphere or cylinder, and the drawn curve. This appears in the same way of the sequence of a film taken inside a parallelepiped space, where, as the camera moves rotating from one wall to the opposite one, the lines of the geometry of the space, for example, the lines of the walls meeting the ceiling, move to change their position.

Four images of the same generated 3D model, a U.F.O model.
In the 1st one, a simple render of the model. In the 2nd one, an axonometric view of a hybrid anamorphic representation when the volume of the model exits from the cylinder interface reconstructing the model as not Euclidean volume. In the 3rd one an axonometric view of the anamorphic perspective of the model inclined of 30 degrees. The perspective images are written in the cylinder interface. In the 4th image, another anamorphic 360-degree cylinder perspective of the inclined 30-degree model is drawn in a plane sheet. (unwrapped cylinder).









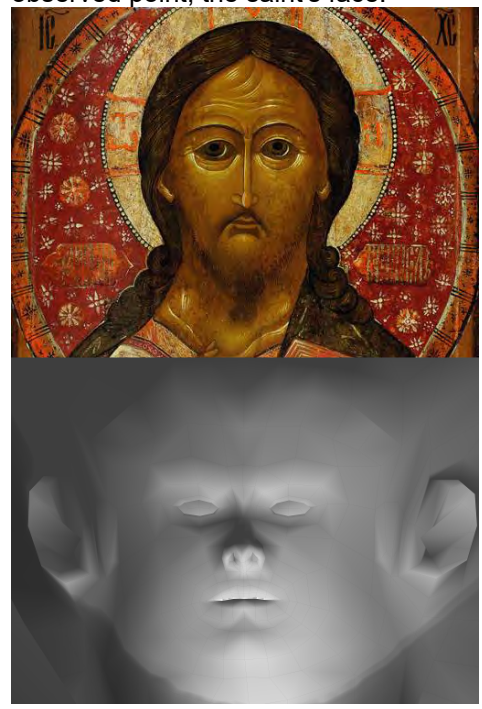
Precisely this consideration led me to identify, for each bundle of parallel lines, not one but two vanishing points. Between the two vanishing points can be represented as a straight line through a curve. In the cylinder-interface, the two vanishing points are the meeting of a straight line, which passes from the center of the cylinder at eye level, with the surface of the interface. The trace of the possible curves that join the two vanishing points represents the bundle of straight lines. This consideration led me to identify as non-Euclidean, the anamorphic cylindrical/spherical perspective representation.

The sequence of perspective moments and the uniqueness of the 360-degree anamorphic perspective drawing defines the first relationship between uniqueness and time. ***Uniqueness*** because each perspective represented in an ***instant*** is unique but identifiable as one of the possible representations of the three-dimensional event. In this, ***time***, as a factor that represents the uniqueness of an instant in the dynamics of the rotations of the look from the same point of view, becomes the generating element of the uniqueness of the generated image.

The uniqueness of each representation and the diversity concerning the others in the sequence is given precisely by anamorphism. It is not a sequence like the one that can be implemented by scrolling through the same flat image, as happens by filming a sequence of details of the same image. Anamorphism makes each perspective image, acquired by sight, profoundly different from the one that precedes it and from the one that follows it. It is not possible to approach them and reconstruct the total image, as happens with the filmed sequence of a flat image, even of a traditional perspective image. Each perspective event is different and unique.

The correspondence between a perspective image and the temporal moment also happens in other perspective representations. The algorithmic reconstruction I made of the typical perspective of Russian icons, Florenskij's inverted perspective, led me to consider these perspective representations not as the reversal of canonical perspective but as the reversal of total anamorphic perspectives.

While anamorphic perspective considers one point of view, the center of the sphere, and infinite observed points, the inverted perspective of Russian icons has infinite points of view and only one observed point, the saint's face.



A Russian Icon and a view from inside a 3D model of a head.

To make all this clear, it is necessary to refer to some of Florensky's observations, first of all, the consideration that perspective vision involves only the surface of the represented object, in this case, the surface of the saint's face, but not the interior of the represented object. Consequently, this surface, being without thickness, is identical when considering the view from the inside of the face and the outside of the face.
We have therefore arrived at the nodal point of this representation. According to my logical reconstruction, the perspective reversal is also the reversal of the surface of the saint's face. We can imagine that the construction of Florenskij's inverted perspective is that of a view from the inside of the saint's head to the outside, and the surface of the face, even if it appears as seen from the outside, is represented as seen from the inside.
Moreover, one of the characteristics of these representations is, for example, to be able to see very clearly the saint's two ears, which would not be possible if the view is from the outside but extremely easy if the view is from the inside of the head.
The result is still a single perspective image that contains all the views from every possible angle, all the views of all the faithful looking at a single objective, the saint. Thus, different temporalities merge into one representation.
Later, in the mid-eighties, when I started building my first generative software, I started from this experience on possible non-Euclidean perspective representations. The purpose was in fact to define a logical process capable of generating different events, but all recognizable as belonging to a whole, or better to an idea. Each event belonged to a different moment in time but all events, although different, were recognizable in the idea. In other words, I was defining a design process capable of building a species, an artificial species with the characteristics of natural species.
The recognizability of events belonging to the same species was structured in the logical process activated. The uniqueness of each event was due to time, to the instant in which the process was activated, to its birth. Since each instant is unique and unrepeatable, each event generated inherited this uniqueness and unrepeatability.
The generative process was built as an artificial DNA, as a system capable of performing the progressive construction of a complex event respecting, in every variation, the recognizability of the idea, the species. Genes were the multiple and parallel transformation logics that were selectively activated by the temporality of the moment of activation of the generative process. But all the transformation logics that could be activated were congruent to the subjective vision.

To manage the progressive construction of a complex event means building a logical process capable of performing by algorithms the design logic of architecture, a city, a piece of music.
It means defining a complex dynamic system with a structure that is not linear but adaptive to time. It is unthinkable that this system is born only reflecting an objective approach to problem-solving. This would lead to forgetting that every architect is a subject and that the uniqueness of each designer is the basis of the uniqueness of each designed event. It is no coincidence that all

architectures are different regardless of their quality. There is no concept of optimization of architecture to define the design logic. There is a quality in itself of each architecture that is born from the subjectivity of the designer and is made explicit through his subjective vision. The ability to make this vision explicit through the creation of works that can tell the character sought and that, of course, reaches the quality understood as the ability to respond to requests. Better, the objective of the design research is the ability to respond to the multiplicity of possible requests even of those that it is not possible to know before the design, since they could come from a possible user, indeed from the infinite possible users, also coming from a different time, of whom we do not know, and therefore it is not possible to objectively "analyze" their needs. On the other hand, working creatively to respond to infinite requests, also them that it is not possible to evaluable upstream, is the specificity of the designer, his creative ability.

I, therefore, built a complex and non-linear system that represented a design identity, a specific vision of the city and architecture, through algorithms capable of reflecting a subjective logic, an identifiable and recognizable poetics of space.

In this, my reference is once again Piero della Francesca who has modified the objective vision in the subjective one with the logical definition of perspective. The point of view, the subjectivity of the key to reading space, opens up a world in which, to the easy measurability, cataloging, and analysis of "objective" representations such as axonometry, is superimposed the possibility of logical management of complexity. This works up to the logical and interactive management of the same concept and representation of the infinite. This is only possible with perspective.

The complex system of "subjective" management of the design process, as it is structured in my generative software, aims to generate events capable of achieving complexity and recognizability of species. Moreover, and this has been a surprising discovery, this tool of organization of the subjective design logic has configured an innovation in the way of teaching design.

Teaching design having as a particular interest the point of view of every single student-designer has been the aim of my courses of architectural design and design at the Politecnico di Milano which, in the last twenty years, has been called generative design courses, both in architecture, engineering and design. With this, founding a new discipline that has been called generative design. With Enrica Colabella, we developed this didactic approach and expanded the aspect of generative design as a teaching discipline of design. This does not deny the fact that each project has a theme and that the results must meet the client's requirements. But the identification of the theme and the requests is the work of the client. The work of the designer is to start from these "opportunities" of design to make explicit the architectural quality of each design vision, referring to its subjectivity and cultural references. Transforming the past into the future, performing the instant, is the aim of the design.

The logic of generative design is to propose endless possible paths that make explicit, in their multi-laterality, the subjectivity of each student, his or her architectural and design vision.

The novelty was to identify and structure a communicable logic inherent in every process of design discovery. The same logic that I had structured with algorithms in building my software. Being a logic, even if it involves the subjectivity of each student designer, it can be communicated, adopted, and discussed didactically as the structure of the progressive process of discovery and increase of complexity of the project. The outcomes of this project work, as well as the outcomes generated by the software, are multiple. The results are possible variations of the idea, born from the same paths but activated at different times, then using parallel logics of progressive transformation, logics that were chosen, among a set of logic congruent to the subjective vision, responding to different temporal moments. The similarity with the anamorphic perspective at 360 degrees is explicit.

Each variation in the set of possible outcomes was unique and unrepeatable, as time is unrepeatable. All variations, as a whole, were capable of representing the idea that had generated them. Noting that this idea was not representable with a single result, even if this will be chosen as the result to be realized. Each variation is only one of the possible representations of the idea, only one of the possible facets that, in its uniqueness, represents one of the possible "points of view".

After all, this is the role of every single project: to represent one of the possible temporal moments of who designed it, but able to be recognizable as belonging to the architect's vision.

Piero della Francesca, and the Italian Renaissance has opened this path based on subjective logics of transformation, and not only on formal choices and their static re-propositions.

REFERENCES

papers:

Generative Art Geometry.Logical interpretations for Generative Algorithm
https://generativeart.com/GA2014papers/Celestino_Soddu_Generative_Geometry_2014.pdf

Logics of ImaginationGenerative Art performs a Style as Executable Proces
https://generativeart.com/GA2012/celestino.pdf

Generative Baroque Algorithms
https://generativeart.com/GA2011/celestino.pdf

Generative Design. A swimmer in a natural sea frame
https://generativeart.com/on/cic/papersGA2006/21.htm

Perspective,aVisionaryProcess:TheMain GenerativeRoadforCrossingDimensions
https://www.soddu.it/papers/NNJ_v12n1_Soddu_pp33-46.pdf

Poetic Logic
https://www.generativeart.com/ga2015_WEB/poetic-logic_colabella.pdf

books:

GENERATIVE ART & DESIGN Theory, Methodology, and Projects

https://artscience-ebookshop.com/ebooks_free/GenerativeArtDesignTheory_2.pdf

DIGITAL CIVILIZATION WHERE TREES MOVE
https://artscience-ebookshop.com/DigitalCivilizationWhereTreesMove_ebook.htm

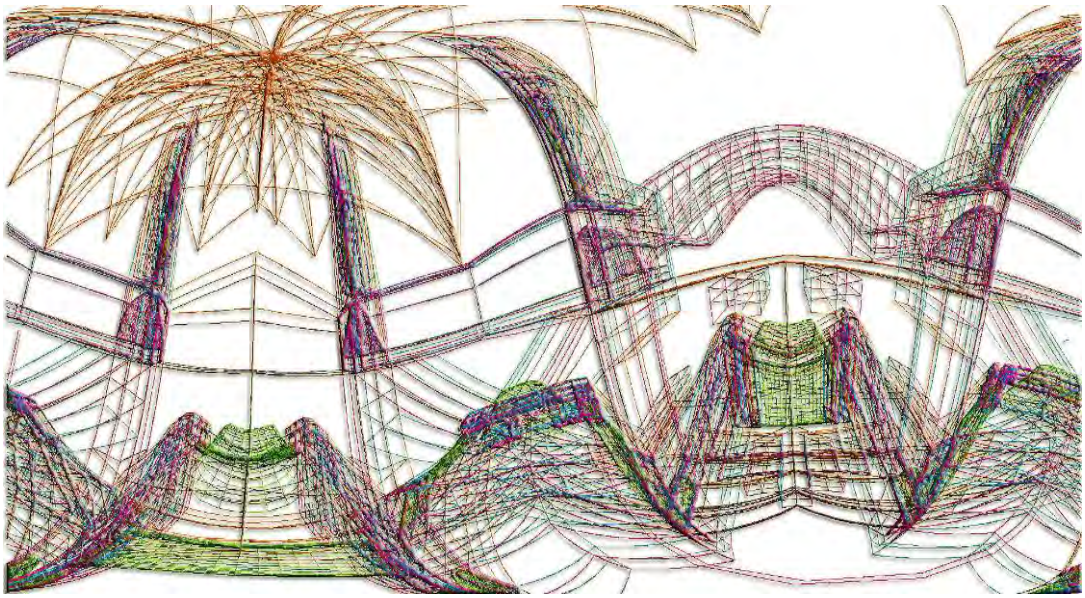
GENERATIVE ART - FUTURING PAST
https://artscience-ebookshop.com/libroGA_FPr.htm

Generative City Design Aleatority and Urban Species
https://artscience-ebookshop.com/ebooks_free/AleatoryCities.pdf

https://artscience-ebookshop.com/immaginenoneuclidea_book.htm

websites:

https://www.generativism.com/tiki-index.php
https://www.generativedesign.com
https://www.gasathj.c



L'immagine non Euclidea (The not Euclidean image, Italian language)

EDGE(S)
A GENERATIVE REALM

Didem Yalınay
İstanbul Bilgi University
Collaboration with **Seçkin Maden** – *Cemal Koray Bingöl*
Edge(s) https://vimeo.com/302762800



Edge(s) is a generative art installation that unravels the data based on refugee health issue in Turkey and materializes this digital information into a generative installation, which portrays a generative realm.

Before reading the text, please visit the video link for Edge(s) https://vimeo.com/302762800

Edge(s) emphasizes the power of each individual, and it is created with the inspiration on the united power of people. The main focus of our creative process was to show the effect of the solidarity of people with the aim of recovery.

As we all know, there was a huge refugee flux from Syria to Turkey since 2012. There is nothing more tragic than war, and people who are subjected to immense suffering. Edge(s), in this desperate situation, tries to give hope and turns our eyes to the effort that people make to enhance the recovery and well-being of immigrants.

Providing health services to refugees has been one of the prioritized issues. At this point, the language barrier was the main problem. Turkish Ministry of Health and the United Nations World Health Organization (WHO) ran a refugee health program in Turkey. To solve the problem of language, WHO took the initiative to start training for the health workers who came from Syria to accredit them to work in the refugee health centers. Today, there are seven training centers and 150 refugee health centers. The accredited Syrian doctors and nurses are being placed into the refugee health centers around the country.
Edge(s) presents the story since the beginning of the flux and mainly reveals the data of the Refugee Health Program from 2016 to 2018. At first, the World Health Organization started to send mobile medical facilities to the areas of

the refugee-related activity. Then, these facilities turned into health centers, which eventually became training centers. Edge(s) tells the story of the progress of providing health with the united effort of people within and around the Refugee Health Training Centers and Refugee Health Centers to approximately 1 million refugees.

This progress contains a complex relation of a network within local and international institutions. Networks are generally defined with nodes and edges. While nodes are the units of action, edges are the interrelation between the nodes. In network theories, 'nodes' refer to locations and institutions but to portray the data of the Refugee Health Program network we regarded people as the 'nodes' and as the starting point of the movement.
Deleuze in his comments on networks, states that "edges contain nodes." If the people are nodes, edges are their interrelations and interactions within and around the institutions. In the artwork Edge(s), possible interactions of individuals within and around the Refugee Health Centers are interwoven into a generative portrayal. Design of Edge(s) is in alignment with this statement.
In the realm of Edge(s), 'nodes' are contained by edges in a spiral-edged universe. At the center of this spiral-edged universe, 'nodes' of the network, namely, the 'people' stand with generic names from every nation. The 'edges' of the network correspond to the 'actions' that map these nodes onto spiral paths. There are four central spirals within the universe of Edge(s). When the edges are activated with lightening Edge(s), the generative realm starts to present the impact of recovery when people act together. In the realm of Edge(s), there is no hierarchical approach to people as doctor trainer or patience. The main point of Edge(s) is the encountering of people to portray the recovery.

Edge(s), as a generative realm, present the impact of recovery when people act together.
This generative realm offers an interactive experience that cracks the paradigm of our relationship with interactive interfaces and protocols of control. When you step up to the installation, it lights up a signal indicating that it detects you. However, it does not respond to you in a way that we observe in typical interaction models. By providing a synthesis of determinative and non-determinative algorithms, the work presents a generative narrative with a semi-random protocol.



In this generative narrative experience, the subject of refugee health is adapted into a data visualization scenario by generative coding in the central lines of this realm. In the photo we see this data visualization, which is created by generative coding with magnetic formulas (please read the details in technical

description).

Commissioned by UN-WHO (United Nations -World Health Organization) in 2018, Edge(s) exhibited in many venues such as Ankara-CerModern, Ted University, Akatlar Cultural Center, and more recently exhibited at Sonar Festival 2019 in İstanbul.

Edge(s) presents a concern to go beyond our approach to technology as a means to an end and bring forth the capacity of the computational environment. Our investigation is mainly on surpassing the limitations of interfaces, goal-oriented search mechanisms, and so-called interactivity. Through this perspective, Edge(s) can be considered as the outcome of the research that explores further possibilities of computational approaches in art.

The unique contributions of artwork Edge(s):

Transparent multilayered narrative design
Semi-random protocol to create a generative narrative
Reinterpretation of the paradigm of interaction
An informational generative environment without a search button
Visualization of data based on the refugee issue in Turkey with generative coding

Transparent multilayered computer design

Edge(s) emerged a unique design for a computational environment as an installation and a result of our will to show the impact of people as the nodes in a network. Additional to our main objective, its emergence followed many important matters on the computational environment, such as the ability to be multilayered, interactive, and transparent in terms of information and data. Our will to show the impact led to the transparency of information. And this transparency contributed to the realization of a unique design, namely, a multilayered screening.

A computational environment without a search button

Search button has a contradiction towards reaching the information and learning something new, by which you can only search for something you already know and can also follow the link of your knowledge. A computational environment without a search button can help you to encounter information, which you don't even think of or question, to encounter something unexpected.

Breaking the paradigm of interactivity

The process of making Edge(s) led us to deepen our inquiry on interaction with a computational environment that embodies information and data. This generative realm offers an interactive experience, which breaks the paradigm of our relationship with interactive electronic devices with a semi-random protocol. When you approach to the installation it lights up a signal mentioning that it sees you but doesn't respond in direct interaction we are used to interact with interactive environments. It works with half-control algorithms and presents a generative narrative with a semi-random protocol. To put into simple words it tells you the refugee health program and shows you the impact of recovery with the united power of individuals in a random way. Invites you to get the information by lightening its multilayered screening.

The most crucial aspect of this screening is that it generates a narrative with a semi-random protocol.

Technical description:

EDGE(S) is an installation made out of laser-cut plywood and plexiglass pieces. The artwork is 110 cm in both width and depth, and it has a height of 195 cm. The plexiglass layers on the top part of the installation are illuminated by the pixel LED stripes located inside of the bottom part that is made from plywood. The artwork encloses 11 meters of pixel LED's, two proximity sensors and three Arduino micro-controllers to control the light sources illuminating the plexiglass layers. Two micro-controllers are dedicated to drive the LEDs on the top surface, and the other one micro-controller is used to drive two led strips on the side surfaces with two proximity sensors. The micro-controllers are Arduino Uno R3 boards, programmed in Arduino IDE by the artists.

The maps that are positioned at the center of the artwork are computer-generated abstract forms of migration routes that Syrian refugees follow within the national borders of Syria and Turkey. In the generative system proposed here, two variables are introduced as the inputs of the growth pattern. A) the coordinate data (assigned as points) of cities, where WHO provides health service, B) the total number of patients cared, and health personnel trained between 2016-2018. In the production process of maps, we draw an analogy between the point coordinates of A and the centers of magnetic force fields. The presence of multiple points enables the uneven distribution of interlaced force fields, which determine the density of lines that connects one particular location on the map to the other. Technically, the algorithm calculates all possible combinations of connection between the points (A) and eliminates the lines according to the parameters gathered from (B). When a point with a higher number of (B) is on a particular line, that line is kept; otherwise, it is removed. Secondly, the system locates the intersection points of lines and morphs the paths by pulling the control points of lines towards the intersection points. Finally, the lines are distorted by a user-defined random seed value.

Notes:

Didem Yalınay - Artist statement

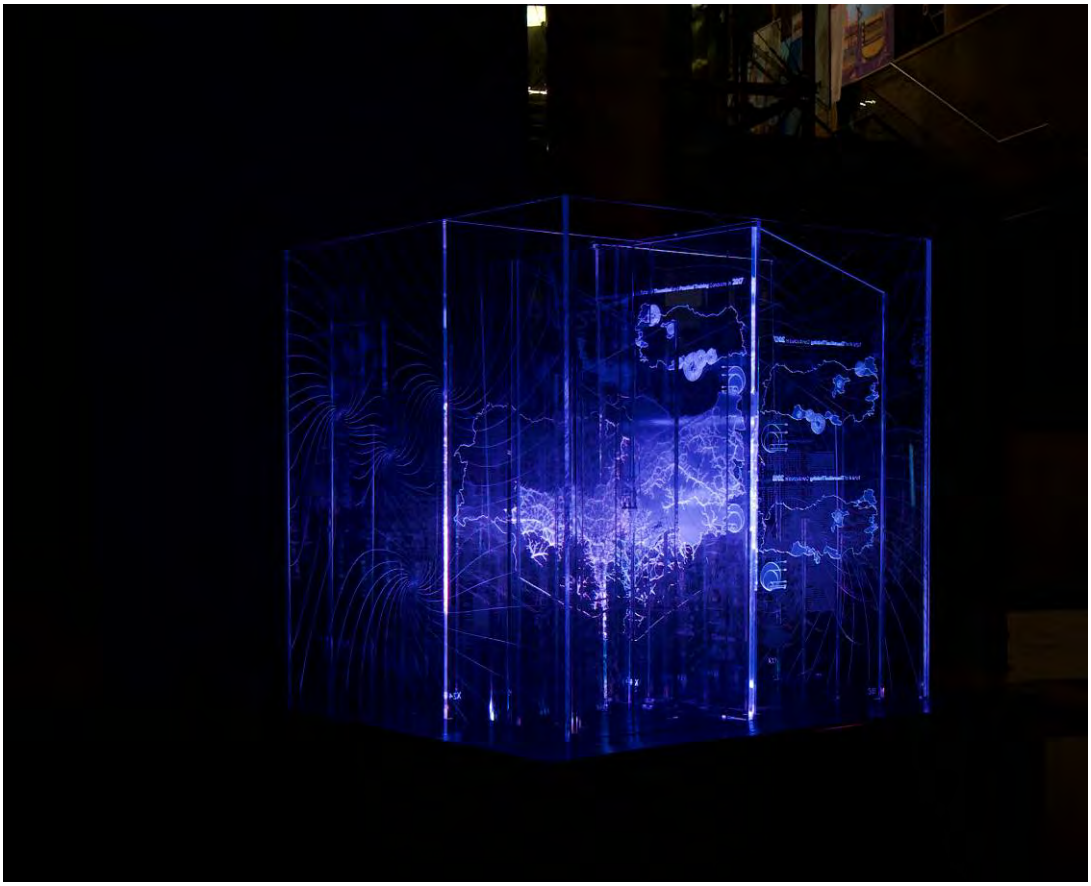
My practice combine episteme and techne. My artworks are driven by my academic studies. Edge(s) embodies the outcome of my study on network theories. Towards my PhD study I focused on network theories on society and my main statement was "people are nodes". The artwork "Edge(s)" emerged from my longterm study in the focus of the power of individuals.

I can put into words of my inquiries as: connectedness, transmission, power of encounter. My studies emphasize the aim to un-conceal the concealed. My objective is to pave the way for the new possibilities and hidden potential of technology. I work to create generative environments to explore the unknown and to experience the power of encounters.

didemyalinay@gmail.com

Key words: *generative portrayal,*

narrative, interface



VISUALIZED BIRD SONGS, Disappearing

Elisabeth Pellathy, MFA
Associate Professor of Art, New Media
Department of Art and Art History, University of Alabama at Birmingham, Birmingham, AL, USA



Elisabeth Pellathy

Into the same rivers we step and do not step, we are and are not.
-Heraclitus

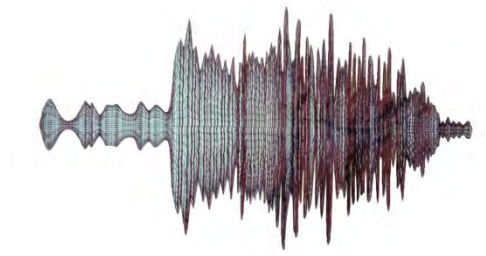
Sound in nature is transitory. As it happens, it cannot happen again the same way. To capture sound, as animal, as environment, as ecology, allows the memory of sound to remain.

Throughout history birds have been represented in the visual and literary arts. They have lived as allegory, as story, as representations of nature, and continue to illuminate the imagination of contemporary artists.

Using the dense audio resources found at the Macaulay Library at the Cornell Lab of Ornithology, the voices of birds are cataloged, collected, and charted becoming mechanical drawings representing the voices of top ten most endangered birds.

To capture, and make a permanent mark, on the fleeting nature of sound highlights the importance of what is disappearing. To provide a visible analogue to the invisible qualities of sound allows reflection on what our actions must become.

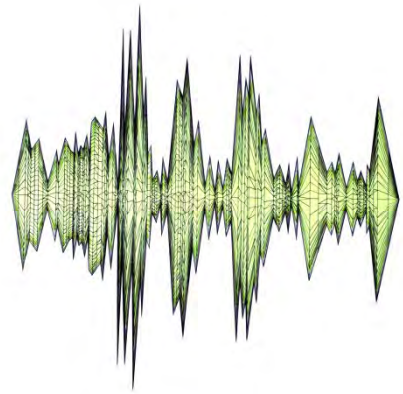
The pure visualizations of data possess a poetic quality, allowing the birds to become more than just numbers - instead an encounter with a frozen instant of time. Sound while present is represented.



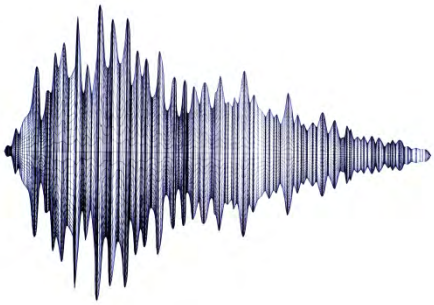
1. Giant Ibis



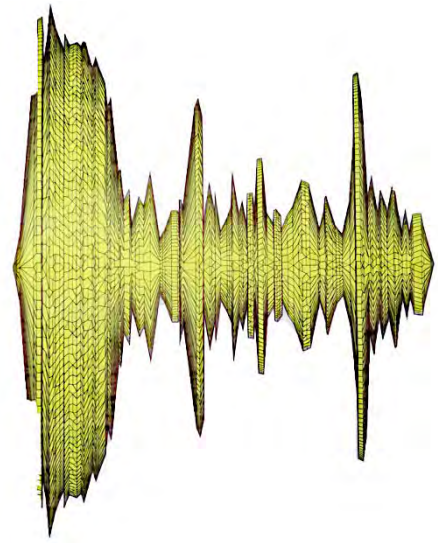
2. *NO SOUND, New Caledonian Owlet Nightjar*



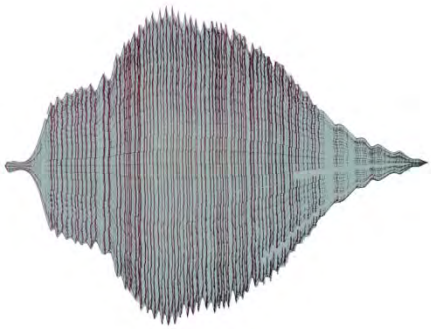
4. *Kakapo*



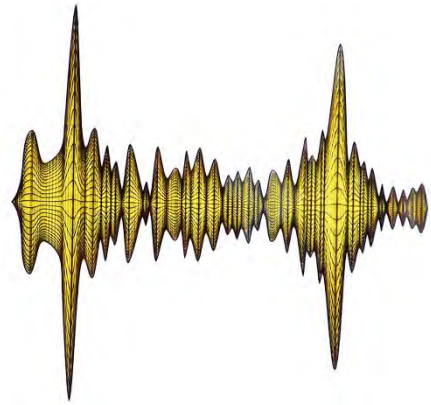
3. *California Condor*



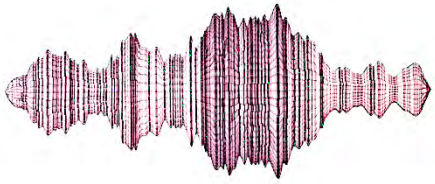
5. *Kagu*



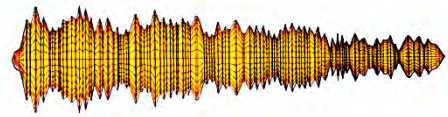
6. *Bengal Florican*



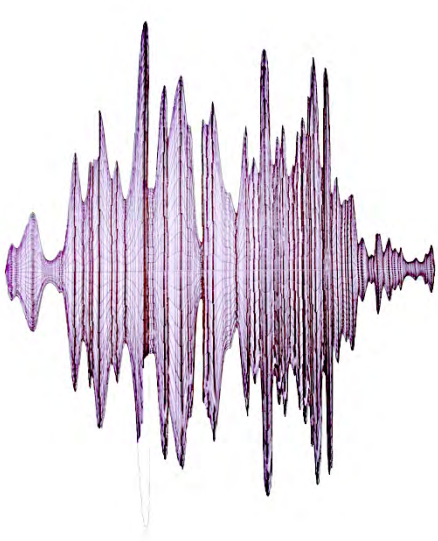
8. *Philippine Eagle*



7. *Forest Owlet*



9. *Christmas Island Frigatebird*



10. *Sumatran Ground Cuckoo*

All artwork is from the series ***Visualized Bird Songs, Variation II (Disappearing).***

Ten mechanical drawings made with archival markers and ball point pen on vellum. Size: 20 x 22 inches. Date: 2016-2018.

The bird songs are mapped in sound editing software, traced in the software Rhinoceros, and printed using a CNC machine.

Part I: Sound

Sound in nature is transitory. As it happens, it cannot happen again the same way. To capture sound, as animal, as environment, as ecology, allows the memory of sound to remain.

Part II: Bird as Language, Poetry, and Art

Throughout history birds have been represented in the visual and literary arts. They have lived as allegory, as story, as representations of nature, and continue to illuminate the imagination of contemporary artists. In 1177, Persian poet Farid Attar wrote the *Conference of Birds* [1] in which birds assemble in preparation for a spiritual pilgrimage to find a *simurgh* – a mythical bird, which represents ultimate spiritual unity. The title: *Conference of Birds* or *Speech of Birds*, quotes the teaching of the Qu'ran, which indicates speech was given to humans by birds. Within this poem, birds lead by the hoeppe- assemble: the nightingale, the parrot, peacock, and duck, partridge, homa, (a mythical bird), hawk, heron, owl, finch, among other birds. In this conference, birds transcend above other animals and provide guidance to humans.

The song of birds, the language of birds, has long entranced us and we use bird as allegory for our own voice, assigning musicality to their song. It appears, regardless of history or place, birds act as guides to humans, providing council and voice. Moving though time and history, in 1613 England, William Browne wrote Britannia's Pastorals, Concert of Birds [2]:

The mounting lark (day's herald) got on wing,
Bidding each bird choose out his bough

and sing.
The lofty treble sung the little wren;
Robin the mean, that best of all love's men;
The nightingale the tenor, and the thrush
The counter-tenor sweetly in a bush,
And that the music might be full in parts,

These birds read music, are lyrical, and have song. Their language reflects the notes on a scale. What other animals are given such amorphized qualities of voice?
Athanasius Kircher (1650) [3] noted different melodies for birds, believing all birds in nature sing in musical intervals. Both literary and visual artist have taken bird as emblem to represent a larger ideology – one that exists in "becoming-animal" [4] and transcending human. Becoming animal is not about truly living as animal, instead it is a call to higher perspective, a perspective that allows one to be as self and not as self – a concept investigated by Deleuze and Guattari, [5] as we watch animal, watching us, do we become-animal?

Part III: Bird as Sound Art

Sound art pioneers such as David Tudor and Alvin Lucier conducted s*ound experiments,* challenging expectations of creative work with sound as *music.* Cage, Tudor, Lucier, and later Pauline Oliveros were artists trained in classical composition, but explored sound "in-between" music. In reference to the environment, these generative soundscapes ignore traditional notions of musical allegory, and are rooted in recorded nature, distorted nature, and expressive nature. Oliveros describes her work as creating a "*tapestry of sound*: threads of *sound* that come and go". [6]
David Tudor moved fluidly between experimental sound, visual, and performing arts, and worked collaboratively with artists and engineers. His methodology of capturing sound in-situ, reworking sound in the studio, and then returning the sound as a new form, defined and inspired artists of the 21st century. In *Rainforest I-V (Variations),* [7] Tudor used electronic signal to mimic the sound of birds and other rainforest animals. Each sound "echoes the diversity of flora and fauna in the natural world, breathing and reverberating in constant commotion—a forest of sound." [8] The irony of this work, certainly evident in Tudor's time, is commonplace in the cacophony of synthetic nature sounds populating our world in the form of ring-tones.

Alvin Lucier, *Bird and Person Dyning (1975),* Lucier uses a fake bird, a Christmas ornament, to create heterodyning, which is feedback from two separate wavelengths of sound being mixed.

In 1987, Dr. Peter Szok produced the album called *The Unknown Music of Birds*. In this album bird songs are slowed down to reveal sounds that are more human than bird.

From representational birds, to electronic birds, to bioacoustics revealing a hidden language we traverse through expectations and arrive at new

conclusions. What does bird signify and why has it become trapped in our collective psyche? Birds are given a position close to humans in the hierarchy, their singing has provided a place for language to exist, for musical and electronic interpretation.

Part IV: Contemporary Art

In Wolfgang Müller's, *Séance Vocibus Avium,* (2008) [9] Müller enlisted a group of artists to recreate the calls of extinct birds. Each artist is assigned a particular species and then provided with historical documentation to help recreate the call as accurately as possible. This record, not only discusses the concept of becoming-animal, it also lives in a contemporary place of ecological issues. If our birds are disappearing and we can create only recreations through our own voice where does it situate us today?

Part V: Visualized Bird Song

In *Visualized Bird Songs, Disappearing* I use the dense audio resources found at the Macaulay Library at the Cornell Lab of Ornithology. The bird songs are mapped in sound editing software and then traced in 3D modelling software and 3D printed made into mechanical prints.

I began to think about this issue in a global sense – of the voices of the top ten most endangered birds are catalogued, collected, and charted becoming objects representing the voices of these birds. The birdcalls become more than just records - instead an encounter with a frozen instant of time. A visualized model charts the intangible and elicits reaction on the fleeting nature of what is here now, but may not last. A moment of reflection with individual species from endangered bird species possesses a poetic quality. This work serves as a catalogue of the disappearing, much like an 18th century wonder-cabinet. Thee display serves to rarify the object, contain it and isolate it.

Sound while present is not represented, as the sounds in-between become the "music". Like John Cage in his concert *4'33*," [10] I ask is it silence, noise, or ever quiet? How do we categorize sound? What rhizomic qualities can be added to the way we communicate and record the world? Do we have the ability to become-animal and transcend our everyday or are we rooted in the ringtones of recorded memory?

[1] Farid Attar, The Conference of Birds, Penguin Classics, 1984.
[2] Poem of William Browne of Tavistock, Vol. I, Britannia Pastoral, Internet Archives.
[3] Kircher's Nightingale, *Musurgia universalis* (1650), by the Jesuit polymath Athanasius Kircher (Book I, Chapter XIX).
[4] Gilles Deleuze and Félix Guattari, Becoming Animal. Oxford, UK, 2007.
[5] Ibid.
[6] The Pauline Oliveros Trust, paulineoliveros.us
[7] MoMA Inside/Out, MoMA Collects David Tudor's Rainforest V (Variation I), 2016.
[8] Ibid.
[9] Wolfgang Muller, Séance Vocibus Avium, Audio CD, 2008.
[10] John Cage, 4'3'' johncage.org

Il Canto di Calipso
Monologue for Digital Minstrel Automaton
Performance

Ennio Bertrand
digital artist
Text of the monologue: Giuliana Bertolo
Reciting voice: Eleni Molos
Multi-media installation: Ennio Bertrand
Year of production: 2020

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Abstract
The song of Calypso

As the ancient street singers who narrated heroic deeds or intriguing stories showed on a screen various painted scenes illustrating the plot, the Digital Automaton Minstrel illustrates moments of a story using a laser light beam. The speaking voice is transmitted by the very same red light of the Laser and forwarded to four objects / characters / actors who receive it together with the laser light beam and. By decoding it, they transform the light back into sound / word then diffused by a loudspeaker.

TECHNOLOGY

I have occupied myself with sound and poetry for many years, creating various and mostly interactive installations. To give some example of my previous works, I created the illusion of goldfishes singing or reciting poems in a large aquarium *Swimming Sounds, 2007*, I used the proximity or the breath of the fruitor to activate the recitation of poems by the avatar of some more or less famous authors *Soffio (Breath), 2011*, I had 144 speakers play as stimulated by the shadow cast on them by the *Lux sonet in tenebris, 1992,* etc.

Currently, after more than a year of research I have developed a technology to transmit sound, words and / or music through a laser light beam. The laser produces a beam of light, normally a red one which, collimated with an appropriate lens, will appear as a thin thread of colored light.

With special electronic circuits I could introduce sound inside the light beam, just like an electric cable carries electricity. At the beginning the light beam and the sound are processed by a transmitter uniting them. As it hits the

target, the light beam is intercepted by a receiver circuit which separates the sound from the light diffusing the sound through a loudspeaker.

THE INSTALLATION

The work consists of a kind of automaton placed in central position, equipped with a rotating mirror moved by an engine and governed by the computerized system that operates it. It deflects a laser beam in a virtually infinite number of recordable positions randomly chosen and placed around the automaton at a few meters distance, like actors acting on a stage.

In the fixed positions there are targets which undertake the role of actors, equipped with a light sensor and a loudspeaker: they extract the sound contained in the laser beam and broadcast it.

Each of the target/actor receive the appropriate sound content sent exclusively to it. In other words we will listen the voice and speech by the male hero exclusively from his assigned position, while the voice and speech of the heroine will be played and broadcast only by the receiver/transmitter assigned to her.

The *Song of Calypso* is spread over four objects / actors speaking about four different feelings, moods, passions, desires, delusions extracted from the text by *Giuliana Bertolo, Il Canto di Calipso*.

DRAMATURGY

After the experience of many interactive installations I created over several years of work, I became convinced that there are small “pieces of theater” in them, with their own unusual and perhaps new dramaturgy. So I tried to consider the various technological components of an installation as actors in a theatrical performance. Mechanical actors, with electronic bodies, digital hearts and software brains. Nothing could be further from the human physical appearance: the system is more in line with the assimilation of the living by

technology, be it digital, software, or al. There is nothing disturbing if content and narration are preserved. Actually, the witch in the woods who eats little kids running far from home never existed, this is not the reason for us to tell them.

Ennio Bertrand
enniobertrand@gmail.com

SOME TECHNICAL DATA

Transmitter

- quality of audio transmission: excellent
- vertical deflection of the laser: > 45°
- horizontal deflection of the laser: > 300°

Laser transmitter and rotating mirrow

- Laser pointing accuracy: +/- 2mm at 4mt
- Laser movement speed: > 3mt / s at a distance of 4mt
- auto calibration of the Start position
- memorization of the transmission positions for the horizontal and vertical axes
- virtually infinite number of positions
- 5mW red laser LED pointer type with integrated optics
- drives: with stepper motors
- electronic transmission circuit: proprietary

Receiver

- Laser sensor: photodiode
- Fresnel lenses for beam collimation
- electronic conversion circuit: proprietary
- power supply: autonomous with

Laser receiver and decoder

rechargeable lithium batteries

- signal output: audio for external amplifier
- transmission distance: > 15mt
- millimeter adjustment of the focus

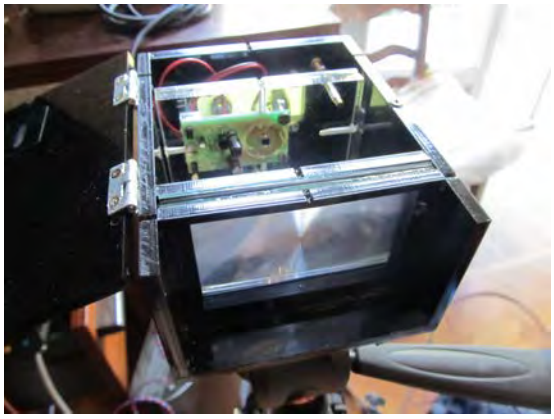
MICRO BIOGRAPHY

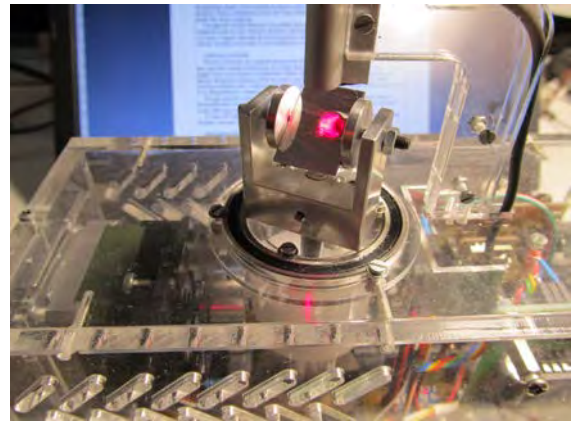
I am a visual artist, for many years I have invented digital systems for interactive installations with sound, light, movement, images, video.

I was a member of Arstechnica at the Villette in Paris and co-founder of the Arslab Committee in Turin. Works of mine were/are exhibited in Italy, France, Germany, Nederland, Japan.

I teach a course on Interactive Systems at the Art Academy in Turin and in Bergamo.

Laser receiver and decoder



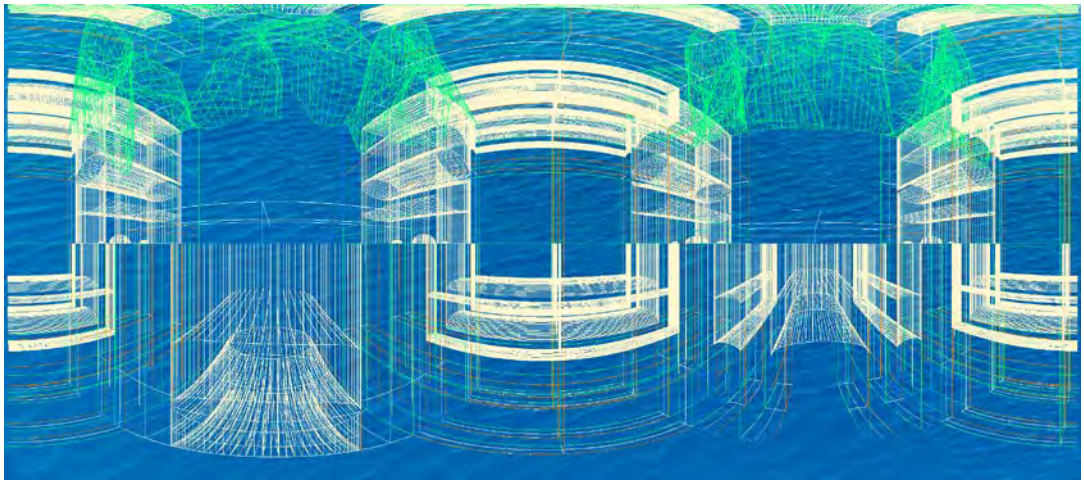


Laser transmitter and rotating mirrow

The *instant* performance
Poetry, Art, Architecture, Music

Performance

Enrica Colabella
Italy, Poetic text and voice,
Generative Design Lab, Argenia Association
www.generativeart.com
Celestino Soddu
Italy, Digital artist, Anamorphic 3D scenarios in total perspective,
Generative Design Lab, Argenia Associationwww.generativeart.com
Nicola Baroni
Italy, Cello digital composer, and player,
Conservatorio di Milano



Abstract

The instant …. *just a little crossing in the artificial sea of art*……
By Enrica Colabella

The main character of a GA process is identifiable in variations.
This concept of multiplicity strongly connects results to the organic status of Nature.
When " *the One becomes Many?"* Here is one of the great questions in Parmenides by Plato. So when does it change? It does not change when it is **unmoving** or when it ***moves***, nor does it change when it is in time.
"Is there the extraordinary state in which it should be when it changes?
The instant. In truth, this seems the meaning of the word instant: that from which the changes in the two opposite directions start. It is not from still stillness, nor movement still in motion, that there is

change; but it is this instant of extraordinary nature, placed in the middle between movement and stillness, and which is not in any time, what towards which and from which ***what moves in stillness and what is stationary changes in movement****."* (Parm. 156c-156e)
To gain this character is the main aim of this performance by connecting a poetic text, anamorphic scenarios, and generative fragments by cello from *the Concerto for violin and orchestra in D minor by Schumann.* Schumann defined the main theme as "***Geister-Thema",*** that is, *spiritual theme,* for the absorbed contemplative poetry that emanates from it. **For eighty-four years** the Violin Concerto remains **unpublished** and, except for some scholars, practically unknown.
The performance works starting from the poetry structure in a unique concept open to variations through the voice sound in a fragment after fragment as a multiplicity of results by following too impressions from the generations of digital 360-degree scenarios and of the alive music.

L'istante antico/The ancient instant

L'istante antico, essere plurimo in unicità, /The ancient instant, plural being in its unicity,
Fremeva tra le foglie in espansione: / Trembled among leaves in expanding:
Toccava l'unità della *natura naturans* / It touched the uniqueness of the *nature naturans*
Come fissità di un eterno instabile. / As fixity of an unstable eternal.
"Eppur si muove" urlò Michelangelo / *"And yet it moves"* shouted Michelangelo
Colpendo il suo Mosè sul ginocchio / Hitting his Moses on its knee
Per estrarlo dall'uguale tempo, fissato nella pietra come passo eterno. / For extracting it from the equal time, fixed on the stone as an eternal step.
Il precario è ucciso per sempre, / The precarious is killed forever,
L'unicità dell'attimo si fissa nel flusso naturale, /The uniqueness of the instant fixes itself in the natural flux,
Dove si specchiano variazioni con lo stesso pathos. / Where variations with the same pathos reflect themselves.
Specchi *curvi* infiniti. Trame di vita organica dove si flette / Infinite *curved* mirrors. Plots of organic life where flexes itself
Il raggio verde della vita sulla città curata nel cuore, / The green ray of life on the city attended in the hearts,
"Poiché ai tuoi servi sono care le sue pietre / "Since to your servants your stones are dear
E li muove a pietà la sua polvere." / And its dust moves them to pity. "
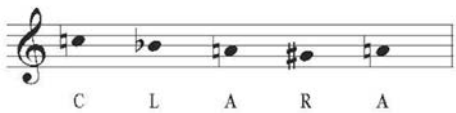
The instant in *anamorphic* perspective
By Celestino Soddu

The 360-degree total anamorphic perspective is a collection of perspective visions read from a specific point of view at the center of a sphere with the look that dynamically can sweep towards all points of the sphere.
The image is a 360-degree continuous curved perspective.
Every moment generates a traditional perspective, where straight lines are the result of the *anamorphosis* between the curved lines of the total perspective and the curvature of the interface, both the sphere and the cylinder.
The sequence of the traditional perspectives of the single visions therefore has the straight perspective

lines that move following the variable direction of the look.
Drawing multiple visions in the unit of time corresponds to the concept of the instant of Parmenides.

From cryptogram to algorithm
By Nicola Baroni

Melody arising from poetry is a core aspect of Schumann's music, whose programmatic ideals were expanded by his fascination with musical cryptograms. In this way Schumann sought for denotative connections between note-symbols and letter-symbols, giving rise to intense melodic contours acting as powerful *leitmotifs* as if they were characters appearing in different works, and reinforcing the perception of Schumann's repertoire as an overall cyclic unity. The descending melodic "Clara" motive, a recurring sign of musical narration, acts as a tangible presence of love evoking the true existence of his wife Clara and her musical, dialogic and spiritual aura.



Music cryptogram: Schumann's Clara motive

The obsession with music as a living presence, a search for hidden meanings more than a metaphoric language, led Schumann during the last years of his life to developing a strict dialogue with angels and spirits, suggesting him melodies and strongly affecting his mood[1]. Some scholars supposed a connection between the documented activities of Schumann as a medium during his mature age and the fatal mental disorders of his last years.
Upon the previously mentioned "Geister-Thema", strictly related with the "Clara" motive, Schumann composed the hymn-like piano chorale and completed the Piano "Ghost Variations" (WoO 24) just a few hours before attempting suicide (apparently rejoining the angels), and after that being admitted to hospital. The same "Geister-Thema" appears in the second movement of the Violin Concerto in D minor (WoO 23) written a few months before. Both these compositions were not published until after Schumann's death; Joachim, the dedicatee of the violin concerto, confided to Clara that he believed the concerto was the inferior product of an unstable mind[2]. A certain reappearance of strict ancient styles, a tendency towards simplicity and drastic formal changes, made the reception of Schumann's last works difficult during the second half of the 19th century.
The distancing from virtuoso styles, the emphasis on low registers, the ostensible harmonic fixity and the mono-thematic attitude of the Violin Concerto could be good reasons for the 20th century success of this work, in opposition to Joachim's embarrassment. In a similar way the Piano "Ghost Variations" show an obsessive adherence to the main theme, a structural fixity, followed by the tendency towards an overwhelming ornamentation, not so much elaborating the thematic content but perceivably deconstructing its soundness.
Following these stylistic premises the musical aspects of "The Instant Performance", aims to explore and expand some of the stylistic features

described above, by means of an installation-like interactive digital system in dialogue with poetry and generative visuals: the obsession with a theme, the voice of poetry expanded through algorithmic generation in real-time of sinusoidal melodies, melodies as cryptograms, the fixity of sound and structure, fragments/quotations from the Violin Concerto through the low registers of a cello, the use of short delays in order to enhance the dissonant "out of phase" dimension. The poetry-cello live performance is expanded through a dynamic interactive system created with MAX/Msp, filled with modules of sound analysis, autonomously generating sound atmospheres and quotations by means of *digital stylistic agents* programmed by Nicola Baroni.

The main idea of the performance, the multi-dimensional nature of the instant as movement in stillness, is built as a rhapsodic search for truth (the search for the imaginary Parmenides inside us): a journey within the lost Romantic unity of art and life.

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Nicola.baroni@fastwebnet.it

Keywords: instant, anamorphic, interpretation

Main References:

[1] http://www.generativeart.com/GA2016WEB/Colabella_GenerativeLine.pdf
[2] Celestino Soddu, "*L'immagine non euclidea*", Gangemi, Roma, 1986 www.artscience-ebookshop.com/immaginenoneuclidea_book.htm
[3] Schumann, Robert, and Clara Schumann. The Marriage Diaries of Robert & Clara Schumann: FromTheir Wedding Day through the Russia Trip. (Boston: Northeastern University Press, 1993)
[4] Reinhard Steinberg, Robert Schumann in the psychiatric hospital at Endenich, 2015 https://www.researchgate.net/publication/273953123_Robert_Schumann_in_the_psychiatric_hospital_at_Endenich
{5}Andreas Moser and Lilla Durham, Joseph Joachim, a Biography (1831-1899). (London: P. Welby, 1901)

DADA-SURR

Design of Coincidental Selection of the Sound and Image Verses Based on the Concepts of Dadaism and Surrealism.

Artwork- Video

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Abstract

This design is the study of providing compositional balance with audio-visual design made under the concepts of Dadaism and Surrealism of sounds and images chosen randomly from independent of each other's starting points. In addition, a trace of a symmetrical order was sought in the resulting compositional balance. In this study, digital video was selected as the design medium.

Three venues had been used in the video work designed. The first venue is the Sakıp Sabancı Museum in Istanbul. A short video was shot at the exhibition “a surrealist in Istanbul: Salvador Dali” at the SSM between September 20, 2008 and February 01, 2009, with special permission. The second venue is the design atelier in the İstanbul Yıldız Technical University, Besiktas Campus. Randomly selected strings of the poets that Sappho, Matsuo Basho, Pablo Neruda, Ezra Pound and Henri Michaux had been read randomly by Dilde Mahalli (Filmmaker), Arın Kuşaksızoğlu (Musician, actor) and Zeynep Arikan (Artist). Random video shots had been taken during the readings. The verses read has been considered as sound. The third venue was Çengel Art Center in Moda, Istanbul. Ten minutes of improvised music made by Hakan Okkır (Musician) with the cajon percussion instrument had been recorded. Finally, the editing of the video had been done by Ayhan Çetiner (Filmline Production Company) with coincidentally selected image and sound recordings.

The video, which is 1' 51" in length, had been completed in 2009. It had not been exhibited before.



Dada-Sürr, 2009,Video, 1' 51"

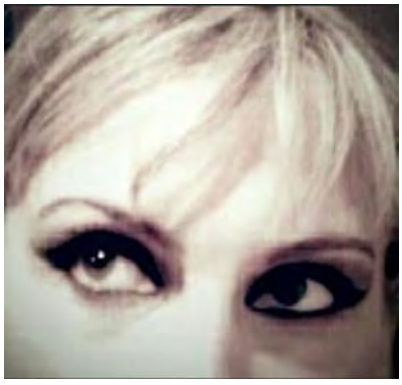
e-mail: fkiziltepe@eskisehir.edu.tr; aser@ferhankiziltepe.com

Key words: Surreal, DADA, Coincidence, Chaos, Sound Design, Image Design, Design Principles, Compositional Balance, Symmetry

ULTRAVIOLENTA/ ULTRAVIOLENT

Performance

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www.mackenzie.br
www.corpotexto.com
Hânia Cecília Pilan
Brasil, Instituto Federal de Educação, Ciência e Tecnologia São Paulo
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Maria Lúcia Nardy
Brasil, Designer and Illustrator



Abstract.
The performance "Ultraviolenta" by Ânima in crônica (performance group) is constructed under File Theatre principles (concept created by Wilton Azevedo and Fernanda Bellicieri, as described in the thesis "The body and text experience"). The concept encompasses the use of different layers of scenic, overlapping and hybridized discourses, based on the collaborative work of different artists, each one exercising their intention through a key language that, overlapped and exchanged, originate a new scenic discourse. An "in processing" construction, capable of generating meanings other than the ones proposed individually, creating aesthetic disruption. Thus, for the performance Ultraviolenta we start from the homonym chronicle (lecture discourse) to create, from its thematic that raises the reflection about the social problem of violence against women, an hybridized discourse (choreographic, graphic and audiovisual files) focused on software edition. The final speech is an art work that express, other than just layered different artists visions, a new conception of the central theme based on text and subtext that could only be translated by algorithm mediation.



illustration: Maria Lúcia Nardy Bellicieri

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Key words: Performance, Scene, Languages, Text, File Theatre.
Main References:
[1] Bellicieri Fernanda, “The body and text experience”, Mackenzie Presbyterian University, Brasil, 2016

Close Reeding (Neural Reprise)

Musical Composition

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Abstract

My recent album release Close Reeding [1] features my live sampling and feedback mixer improvisations with saxophonists (and one bass clarinetist). As a capstone to the album, and as part of my ongoing work in exploring machine learning error as a source of creative content, “Close Reeding (Neural Reprise)” is a neural-net-driven remix of the other tracks on the album. A neural network was trained by playing the previous eight tracks of the album in order, as they appear in the album, giving it a bark-scale spectral analysis of the music as well as the currently playing timepoint within the album. After training, the album was played again for the neural network, this time with it listening to the album and determining what time point in the album it was hearing. That value was used to drive another sound file player, which played the part of the album the neural net reported to be hearing at any moment. The training and the data provided to the network were such that the network made several close-but-wrong determinations, and so the second audio player was made to jump around within the album. This resulted in a remix of the entire album informed by neural net machine error, linking clips of eight different musical performances by their spectral similarities. Interestingly, a single pitch center emerges in the resulting recording.

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Key words: neural net, machine error

Main References:

[1] Jeff Morris, Close Reeding: A Digital View from the Inside Out [Music Album], Ravello Records RR8041, 2020, https://www.ravellorecords.com/catalog/rr8041/

AI_Jam
Living Wonderland
SkyWindow

(Artworks)
Topic: (Art and Music)

Jia-Rey Chang
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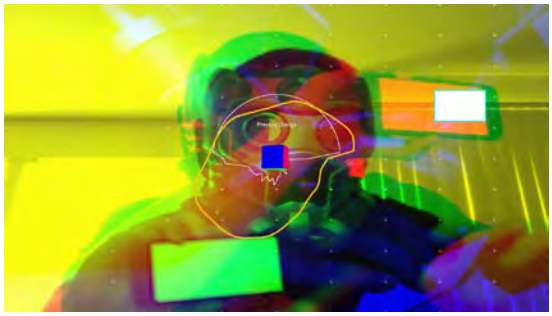
Jia-Rey Chang

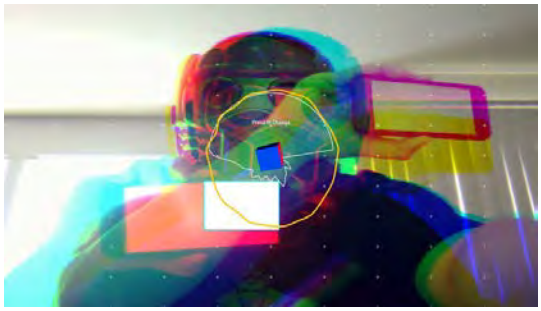


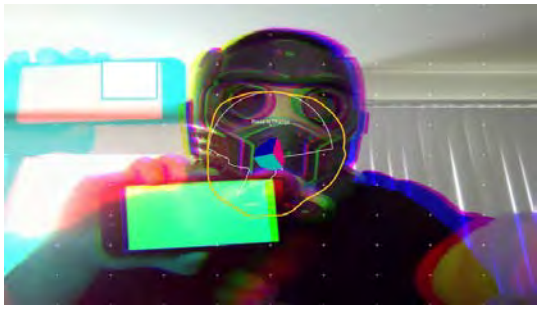
AI_Jam

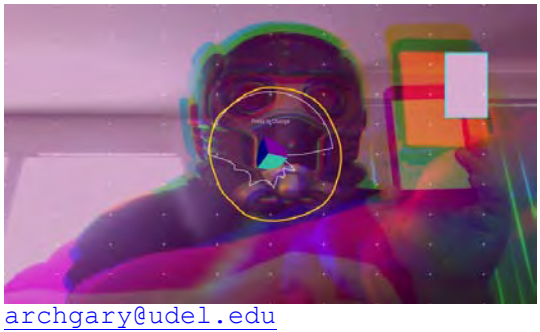
Abstract
AI_Jam is an audio-visual interactive web-based installation which people can use it as an instrument to compose sound together with AI simultaneously. The background drumbeat is generated by AI (Google Magenta) and the beat pattern can be switched by the audience's preferences. While the beat is playing in the background, the audience can freely drag the mouse to different positions on the screen to generate sound. By turning on the "color-tracking mode", instead of mouse-dragging, the audience can move a certain assigned color object (yellow in this code/case) detected by the webcam(tracking.js) in order to generate sound (Tone.js).

Seeking a stronger and closer bonding and finding the harmony between humans and AI to create a direct interaction for making music is the concept here. Imagine, the audience is just like a lead guitar player by dragging the mouse or move the color object to generate the melody, while Artificial Intelligence as a drummer takes parts in the rhythm. It attempts to lower the difficulty of playing the instruments and realizing the dream of jamming with AI without any sophisticated skillset. The whole piece is done with P5.JS (https://p5js.org/).
Video link: https://vimeo.com/434878576
(password: GaryChangUD)









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Key words: swarm, stereoscopic, interaction, generative music composition

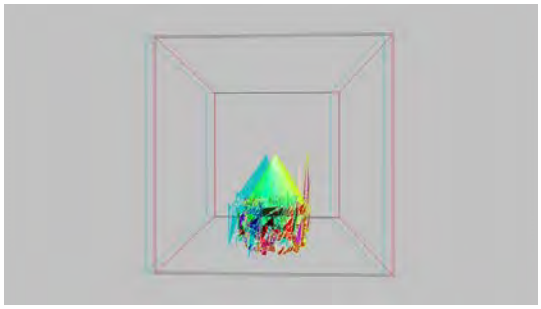
Living Wonderland

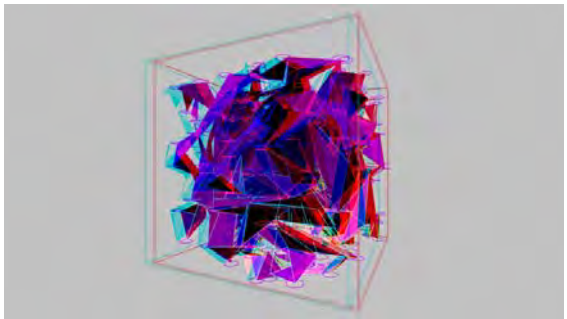
Abstract

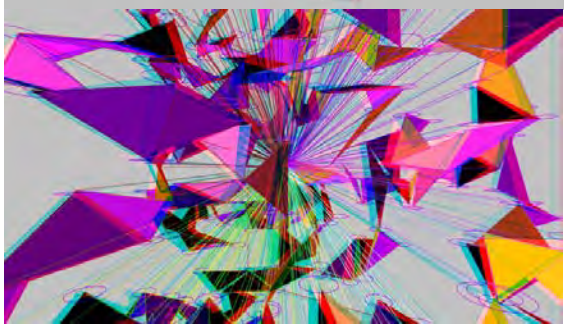
Living Wonderland “Living Wonderland” is a loop of a short 2-minute film piece that can be viewed with a VR headset as an immersive experience, with a pair of 3D glasses to have the stereoscopic effect, but still enjoy the colorful vision without it.

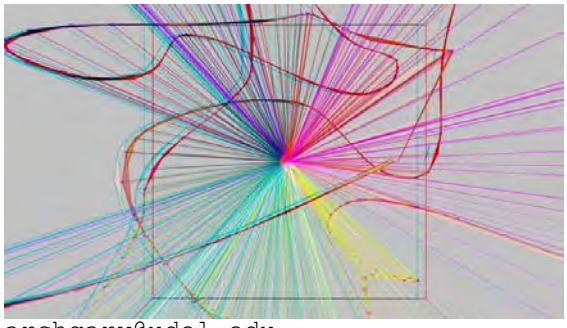
The entire piece is created by the scripts of code as generative art based on swarm behavior intelligence (creative coding). “Living Wonderland” not only metaphorically reveals our lust of craving for freedom but also illustrates the kindness embedded in everyone during this COVID-19 epidemic/quarantine period. No matter it represents the lust or the kindness of every human being, that Wonderland deep in everyone's awareness is just like a "living thing" eager to break through the "frame" of any pre(post)-set constraints, illness, and boundary to look for hope. However, we all know that keeping distance at the time will benefit the entire world. Our inner nature is drastically swinging between the furious thoughts(fears) and the peaceful mind, just like the heartbeat, just like this living wonderland.

Video link: https://vimeo.com/424888833 (password: GaryChangUD)









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Key words: swarm, stereoscopic, interaction, generative music composition

SkyWindow

Abstract

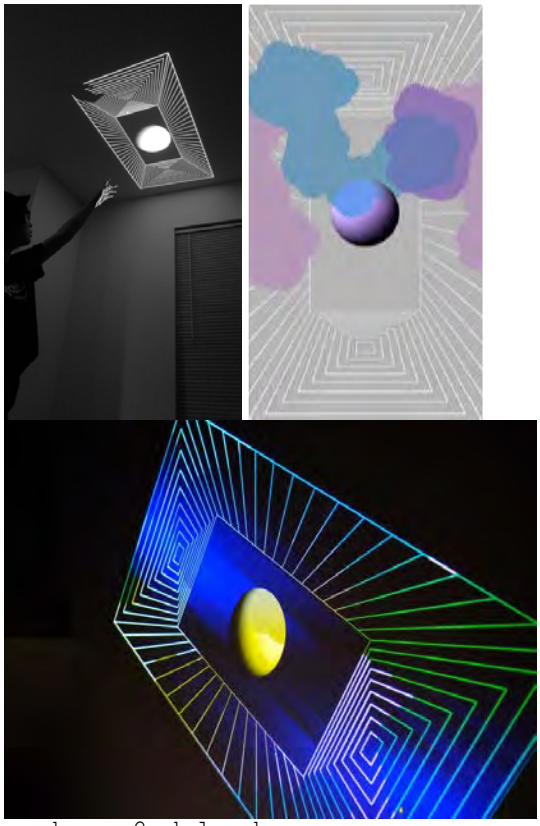
The concept of the “SkyWindow” comes with the idea of being a mental escape from reality, especially under the unprecedented time. Being quarantine in an entire enclosure space continuously for numerous hours and days, people are desperately looking for reliefs in any possible ways. Through the artist’s interactive design, looking up to the imaginary sky could be the most enjoyable solution to get the immediate comfort without going out.

The “SkyWindow” is an immersive and intimate experience with sky-like projections on the ceiling like putting a void hole to it as an interactive installation. A dark environment with the projected sky/universe on the ceiling intriguing the audience to walk closer underneath. Further, the visual graphic will induce the audience to reach out to their hands like touching the sky to trigger the raindrops and sounds falling from the “SkyWindow”.

The "SkyWindow" here metaphorically represents a piece of “hope” people can expect during the pandemic. No matter a planet far away in the dark or sunlight in the bright, it gives you unexpected joy and surprise in the design. Besides exposing under different spatial scenes, through this “SkyWindow”, waving hands in the air will trigger the (meteor) shower falling from the Sky which ironically implies the power of control that people have been losing it for a while under such an unpredictable moment. And the rain implicitly refers to wash out all the illness and sadness for returning the clean and

pure spirits.

Video link: https://vimeo.com/467863317
(password: GaryChangUD)



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Key words: interactive art, generative art&sound, Machine Learning, mental escape

Cartas para Amores Distantes: interaction among distant musicians

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Abstract

This article introduces artistic research connecting interpretative perspectives and the montage process of integrating a harpist, a classical guitar player and three singers in order to perform a novel composition during the COVID19 pandemic. *Cartas para Amores Distantes* could be understood as an architecture of longing created by the composer and five performers who were never in the same physical space and never played music all together. Thus, to elucidate such experience, the article is organized as a report on this artistic research. The text highlights the personal views and the

challenges shared and faced by the group.

1. Introduction

Following previous works presented at the Generative Arts conference *Descobertas* (2016)[1] and *The Ode to Christus Hypercubus* (2018)[2] [1], [2], we present here *Cartas para Amores Distantes* (Letters to Distant Lovers) for Harp, Classical Guitar, and Three Voices that was created during the social isolation, from June to November, 2020. It is part of *Cartas@todoCant*o (Portuguese for Letters to Everywhere or Letters to every chant) created by Manzolli also during the pandemic.

Performed by five musicians who did not know each other before the pandemic, the project aimed to break them free of the social isolation. In order to describe this experience, the article is organized as a report on this artistic research, see viewpoints on that approach in [3]. The next sections describe individual and musical motivations in the development of the musical interpretation connecting the composer and the performers' perspectives. Finally, the audio-visual montage is elucidated by presenting technical procedures and aesthetic perspectives.

2. Background

Facing the current social isolation and motivated to carry out artistic research to build an effective paradigm of musical performance, our project was started with the following questions: How is it possible to play music together while in social isolation? How is it possible while we are many kilometres from one another and separated by our countries' borders? How would we talk about music and find meaning while interpreting a novel piece? How and why would a person write a letter of longing to someone he/she has never met?

Starting with these seeds of an idea, *Cartas para Amores Distantes* was inspired by a photo of the *Ponte dos Laços* (Bridge of Ties) in Aveiro, Portugal (figure 1). This photo was taken during the composer's last visit to Aveiro before the pandemic. The bridge, and the ribbons of various colours tied to it, express lovers and friends' vows of love.

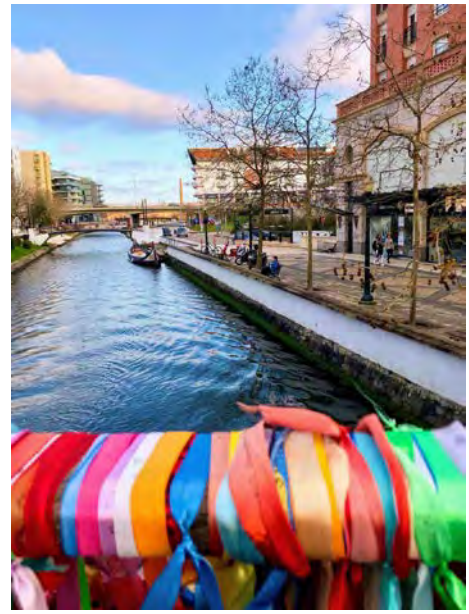


Figure 1: Photo of the Ponte dos Laços (Bridge of Ties) in Aveiro, Portugal.

The connection with the river and the waters that pass under the bridge is

[1] videos of Descobertas (2016) : https://youtu.be/bTqh313Dl-0 (full work), https://youtu.be/zCRq9zVPLew (trailer)
[2] electronic studio version of the Ode: https://youtu.be/Ks3X80TZkMs

expressed in the composition by four sections of letters: *Desejos Submersos* (Submerged Desires), *Querer a Distância* (Faraway Wish), *Sem Não-palavras* (Without non-words) and *Há poetas na esquina* (There are Still Poets on the Corner).

2. Interpretative Perspectives

Artistic research could be described through its experimentation, exploration and discovery to reveal artistic intentions and processes, underlying art production [3]. Here we have taken this approach to interpret a novel composition and also to reflect about the process itself. Therefore, this section presents the interpreter's individual perspectives and their understanding on creating and interpretating a novel work from distance. These perspectives were also presented in a video report available on the Internet[3].

The original poem introducing the first conceptual and inspirational guide is presented in Table 1. Jônatas added to the poem, his aspiration of building an interpretation for *Cartas para Amores Distantes* anchored in a true collaboration from a distance. *He said: "I believe that we can experience a very important interpretive process together. As a composer, I never thought the score was enough to describe any musical idea fully. It is a vehicle for mediation between two virtualized and encapsulated domains: the composer's imagination and that of the interpreter."* Therefore, the interaction among distant musicians reported here provided directions for capturing those individual mindset domains during an interpretative and collaborative process.

desejos submersos jônatas manzolli	submerged desires
a saudade nasce nos portões fechados e nas ruas vazias com olhares encalacrados: cadeados pendurados em desejos submersos nas pedras jogadas nas águas.	*nostalgia is born* *on closed gates and* *empty streets* *with closed eyes:* *padlocks hang* *on submerged desires* *of stones thrown into* *the waters.*
a saudade vive numa fita amarrada na ponte que liga as duas margens de uma ria.	*nostalgia lives* *on ribons tied on a* *bridge* *connecting two banks* *of a river.*
a saudade navega nos barcos que cruzam as águas com rastros que ferem o rio.	*nostalgia sails* *on boats crossing* *waters* *making traces that* *hurt the river.*

Table 1: Manzolli's original poem, the first conceptual guide.

For Angela, there were two major interactions in this process. First, there was the composer-interpreter connection in which it was possible to search for the better harp writing and sonorities to partner with the original musical ideas; second, the communication between both instrumentalists and the singers was focused on getting personally connected to one another. She said: "*even from a distance, the process allowed a construction of an authentic and shared interpretation of the music*".

Leandro said: "*during this pandemic I could actually feel how crucial the human contact and proximity is, specifically in this case, for making music and building an interpretation of a new composition*".

[3] video documentary on the interpretative process of *Cartas para Amores Distantes*: https://youtu.be/LQ3Ca8SldPQ

He was concerned that he would have a difficult time in every aspect of his life, but on the other hand, the project was a unique opportunity to explain how interpreters and composers had taken steps to make themselves feel closer together. Furthermore, Leandro added that "(the virtual meetings) *fulfilled us with refreshing new ideas of what to do, in the sense of how to interpret the music we were dealing with*".

For Sarah, developing this project during the pandemic was an exercise in creativity and imagination. It was a great challenge, because the group had never heard the composition before, since it was composed especially for the confinement caused by COVID-19. Traditionally, when a musician is singing and performing a work, there are always more people close by who are rehearsing together. Such a performance situation is much different from that of the present project in which everyone needed to imagine each other's musical ideas. But it was very gratifying to go through such experience, even from a distance, whether in a country or a city different from our own.

Complementary to that idea, Sarah also stated: "*it was interesting to see how the surroundings have made my perception of the piece very different from the other interpreters. It was very enriching because I got to know myself more as an interpreter and the others as well. Studying this composition during a difficult time for everyone was special and very important for that moment we are living*".

As we already mentioned, the work was inspired by a photograph of a specific site in the city of Aveiro called the *Ponte dos Laços*. It is a bridge connecting two banks of a ria, where couples and friends place ribbons with promises of love and friendship. Coincidently, the soprano, Ana Beatriz, lived in the city of Aveiro for five years where she received a Bachelor of Music degree. It is also the city where she met her love. Ana Breatriz said "*the origin of this work had great significance for me and at the same time it transmitted one hundred percent of the feelings we have experienced during the pandemic*".

Laura lives in Florida, U.S. while she hasn't met any of the musicians in person, she was able to meet with everyone via phone calls and video conferencing. As Laura became familiar with the project and got to spend time discussing it with Jônatas, Angela, Leandro, Sarah, and Ana, a beautiful community of friendship was created. Laura, Angela, and Leandro were able to rehearse *Sem Não-palavras* (i.e. the third musical letter) using the low latency music platform, JamKazam. The three of them connected visually using Zoom and recorded the video portion while rehearsing. Laura recorded her sound file with Audacity. Surprisingly, even though Angela and Leandro were more than 6847 km from Laura, the three of them were able to make music together at almost the same time. Occasionally, the internet connection between them fluctuated and the delay increased to 100 milliseconds and affected the sound quality. Even when this happened, however, they were able to adjust because Jônatas's music was so inspiring, they got along so well together, and they were so committed to his goal. Since the latency on Zoom was quite significant, after the rehearsal, Laura removed as much noise as possible from the JamKamzam recording and combined it with the Zoom video so that

the movements and sound would line up together.

Her view is that the project has accomplished the goal of making the members of the group feel connected to one another even though everyone has been isolated during the pandemic. Although they were far away from one another and from different countries. She said: “the way Manzolli’s music came to us has crossed borders and large bodies of water. We are playing together and rehearsing together and now we are all friends! I think that as you listen to this music, you will also feel less alone, more connected to each other, and to us. Also, this music is so extraordinarily beautiful”!

3. Audio-visual Montage

In this section we present how audio and video were recorded during the production of the first letter: *Desejos Submersos* (Portuguese for Submerged Desires). The technical procedures, aesthetic perspectives, and personal views are discussed in the next paragraphs. The video-performance of that first musical letter is available on the Internet[4] and can be described in four stages as described below and also in figure 2.

1) remote rehearsals through video-calls;

2) recording of the guitar, harp and voice;

3) audio mixing in a digital audio workstation;

4) video is added to the audio-track.

[4] Video-performance of *Desejos Submersos:* https://youtu.be/wAvwlsRslwo

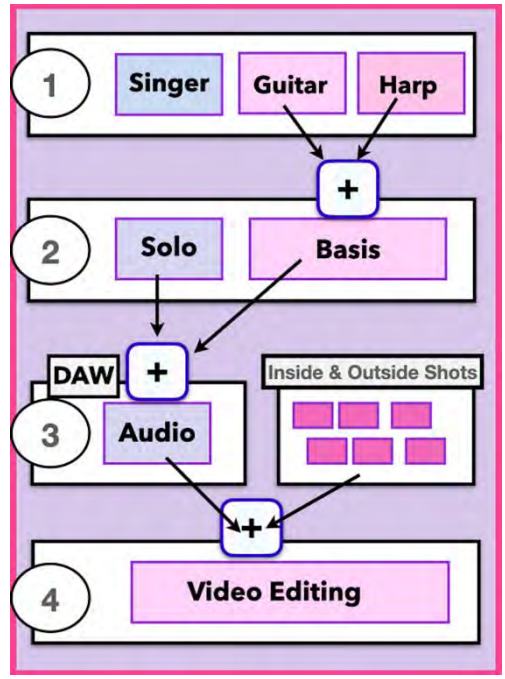


Figure 2: four-stages diagram of the process to produce the musical letters.

The technical process of building a performance from a distance that would be consolidated in an audio-visual media is not very hard to understand. One of the musicians should record first in order to provide a sound guide to the others. Most of time it is started with the bottom line, which would be a rhythmic line, a bass or a harmony. In our project, we recorded the guitar, and then the harp together. After that the recording was sent to the soprano, and she has recorded the solo part while listening to the harp-guitar guide. Finally, a digital mixing and, whenever necessary editing was done in a digital audio workstation.

It is possible to understand that previous experiences with different musical groups and musicians gave us the ability to produce a musical output by distance,

with no rehearsal or personal contact. With only with each person reading individual parts of the score, however that would be somehow, a dry and soulless interpretation of the music.

For this reason, we have developed new ways of communication, in order to know more about each other. It was done using technology to rehearse via the internet and we have developed efforts to reach a satisfactory way to fulfil musical and visual results according to our performative concepts. About that interactions, Leandro said: "*the human connection has been proving to be the most important point of all, even above the technical issues of the music*."

The soprano solo part of the first letter was performed and recorded by Ana Beatriz alone in her home office, as she said, "*on a beautiful sunny day*". The recorder was on a shelf in one corner of the room and she stayed in the opposite diagonal corner to avoid audio overblow. After several takes, she found the best recording to convey all of the feeling she wanted. Despite it not being easy to make music from a distance, as there is a lack of communication between the eyes of the musicians, Ana Beatriz, said "*I think, in this case, it has made us even more genuine in our way of expression so that we could register every drop of feeling"*.



Figure 3: video frame of the symbolic bridge that inspired the work.

Ana Beatriz went to the city of Aveiro, the birth place of this work, to capture some images and videos of the most emblematic symbols of the city, with the help of her boyfriend (figure 3). Furthermore, on a weekend when she went to visit her grandparents at the *Poço da Cruz* beach, Mira, she also had the opportunity to shoot the Atlantic Ocean: the very large natural obstacle separating herself from the other musicians (figure 4).



Figure 4: video frame of Poço da Cruz beach on the Atlantic Ocean.

The video conception of *Desejos Submersos* was based on the process of mimesis, starting from the significant presence in the lyrics (presented in Table 1) and the intention of creating bonds

even from distant locations. We made use of internal and external takes, from inside our houses and from open areas (such as the bridge, the beach and the window facing the open field), representing the feeling of real isolation at the same time that we felt the connection with each other (see figure 5). Differently from the internal takes, the external scenes show a contemplative body-eye direction towards the horizon (see figure 6).



Figure 5: video frame of the composer writing the music letters superimposed over the Ocean.



Figure 6: video frame of the harpist and guitar player's horizon view.

Using superpositions, slow transitions and degrees of transparency, we aimed to give a dream-like imaginative aspect to the video (see figure 7). Continuously involved with the process of creation, the composer's hand writing merges with the water traces made by the boat on the "ria" being, while simultaneously with the origin of the piece and the carrying of the nostalgia (i.e. *saudade* in Portuguese).



Figure 7: video frame merging takes from the composer and the guitar player.

4. Conclusion

The interpreters exchanged their musical knowledge and individual ways of understanding these musical letters using the Internet and social networks. As time has passed, musical ties have also become personal connections. *Cartas para Amores Distantes* reduced the physical, geographical, and emotional distances between these musicians. The musical message broke them free of the imposed social isolation. As this music is heard all over the world, it will also break through the social isolation that so many others have been experiencing as well.

Therefore, as we have carried out the interpretation of *Cartas para Amores Distantes,* we have projected the imagination of each of us while we have shared particular interpretive visions. Reporting such an experience, we aim to point out the inexorable unfolding

process of connections and shared meanings among composers, interpreters and listeners who constantly rebuild and unveil paths of musical expression, even from a distance.

ACKNOWLEDGMENTS

The Brazilian agency the National Council for Scientific and Technological Development (CNPq), supports this artistic research under the project (#304431/2018) Musical Creation and Analysis integrated by Cognitive, Interactive and Multimodal Processes.

References

[1] Manzolli, J., “Descobertas: Creativity as Libretto of a Multimodal Opera.,” in *Proceedings of the GA2018*, Florence, Italy, Dec. 2016, pp. 252–266.

[2] Manzolli, J., “Multimodal Architecture of the Ode to Christus Hypercubes.,” in *Proceedings of the GA2018*, Verona, Italy, Dec. 2018, vol. 1, pp. 252–266.

[3] R. Burke and A. Onsman, Eds., *Perspectives on artistic research in music*. Lanham: Lexington Books, 2017.

Extended Presence in *Cuerpo Cardinal*

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Abstract

Three percussionists and a composer located in Brazil and Argentina broke with social isolation to recreate a novel music piece. Starting upon an original graphic score written by Manzolli in 2007, the new work was performed with a bit of humor, featuring three women living the pandemic crisis. Using video montage techniques, *Cuerpo Cardinal* disrupted the bodily absence extending therefore the notion of spatial presence among three distant performers. The article introduces concepts and describes the creative process in line with discussions on artistic and technical challenges of that collaboration from distance.

1. Introduction

Cuerpo Cardinal, performed by three percussionists physically separated from each other, is presented here. The composer, Jônatas, lives in Brazil, and the three percussionists, Fernanda and Isadora live in Brazil, and Daniela, in Argentina. The new composition, recreated during the pandemic, is part of Manzolli's series of compositions to break with social isolation called *Cartas@todoCanto* (Portuguese for letters to everywhere or to every chant).

The article describes how the composer and performers worked together with the notion of extended spatial presence to create a bodily expressed percussive

work. In the next sections there is a discussion on three theoretical aspects connecting the musical and aesthetic perspectives of *Cuerpo Cardinal* followed by elucidations of the creative process and artistic research.

2. Background & Concepts

The first concept connected to *Cuerpo Cardinal* aesthetic proposal is the notion of multimodal performance which can be understood as an artwork articulating music, sounds, visuals, and movement in a coherent discourse, and interweaving different senses to immerse the spectator in a multisensory dialogue. This artistic viewpoint has already been introduced and presented in the Generative Arts conferences, previously.

Descobertas (2016), a multimodal opera, integrated dance[1], interactive video and dance in a stage with choir and soloists, and four instrumental ensembles was presented in 2016 [1]. Inspired by the Salvador Dalí's master piece we created the *Ode to Christus Hypercubus*[2] (2018) where the medieval organum was reconstructed with computer music techniques [2]. Recently, in *Viento y Mar* (2020)[3], an orchestral work with multimodal elements interweaved music, soloist percussion, and Flamenco dance was described in the special edition of the GASATHJ journal [3].

[1] A trailer of *Descobertas* (2016) is available at https://youtu.be/zCRq9zVPLew and the full work at https://youtu.be/bTqh313DI-0 .
[2] An electronic studio preview of the Ode is available at https://youtu.be/Ks3X80TZkMs .
[3] A full version of *Viento y Mar* is available at https://youtu.be/Q-647Gp0yi4. The compositional process is presented at https://youtu.be/8FNDHKkdmOo.

The second concept dialoguing with *Cuerpo Cardinal* is the notion of music theater. Also called experimental music theater is a 20th century music genre created in opposition to more conventional genres such as opera and musical theater; an avant-garde perspective within the instrumental and vocal music realm introducing gestures and movements with sound, costumes and other visual and theatric elements [4].

Finally, the notion of *Presence,* that has been studied in virtual reality research, also encompasses *Cuerpo Cardinal* conceptual views. Briefly, the VR literature defines Presence as the effect felt by someone when interact with and immerse in VR environments. Recently, [5] discussed how the notion of spatial Presence that can be defined as the feedback from unconscious cognitive processes that inform conscious thought.

Since the performers are separated and isolated from each other, we appropriated that notion of spatial presence to deal with the spatial isolation during the COVID19 pandemic. We creatively explored the virtual notion of virtual shared space among the three performers mindsets creating new paths for their movements, imaginative thoughts and music skills.

3. Creative Process

Manzolli's original graphic score was written in 2007 for body interaction among percussionists (figure 1). The score described how percussive musical gestures should be played in specific body locations: *north (head), south (waist and legs), east (right side of the body),*

and west (left side), as the work's title *Cuerpo Cardinal* (Spanish for Cardinal Points on the Body) suggests. But in the 2020 we are confronting with a new performance situation: interpreters are living in different countries or separated by geographical locations and cannot interact physically with each other. Therefore, in our project three musicians and the composer adapted the original score creating a new music theatre work to deal with that situation.

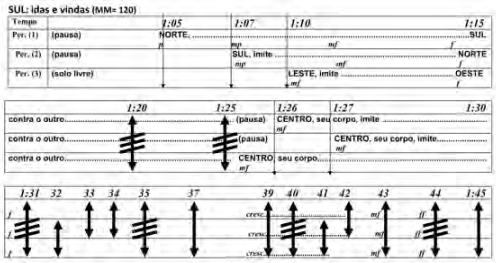


Figure 1: Manzolli's original graphic score indicating specific body locations.

In order to collaborate and work together, the process was divided into three stages as described below and in figure 2.

> *macro structural ideas: collective discussions on general concepts and ideas using online video calls;*
>
> *micro structural details: individual interpretations of three characters living social isolation;*
>
> *audiovisual montage: integration of the performer's previous recordings in a final audiovisual work.*

The project has begun with the challenge to overcome the concept of the original piece. Therefore, the sound production without physical contact was of great concern. Since later the videos should be recorded individually and independently, a second aspect to be studied was to find the right movement to indicate how each performer was interacting with her personal space in order to indicate the bided virtual presence of the other two.

In order to afford the final video montage of *Cuerpo Cardinal* (see figure 3), we created a video-score with graphic cues to be played in a computer screen or mobile phone during the individual recordings; there was a colored timeline to indicate metronomic marks in seconds. The video cues were very helpful to create the individual performances because they avoided to pay attention to the time pulse excessively, increasing freedom for their self-expression.

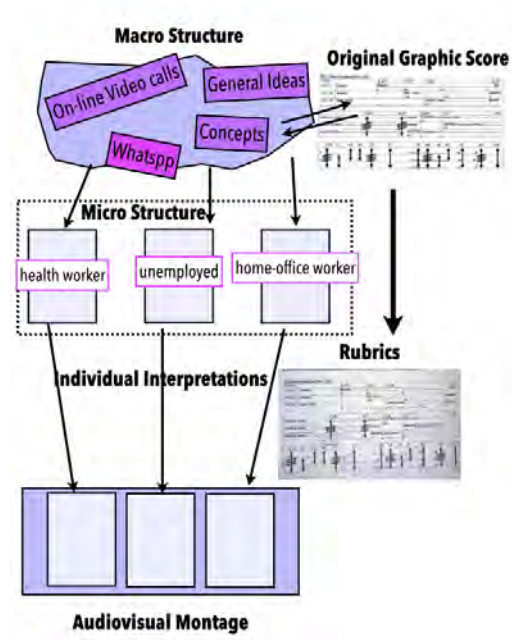


Figure 2: Diagram showing the three stages of the process to recreate Cuerpo Cardinal.

4. Video Montage

Firstly, the symbology assigned to the three characters and scenes were built during online video meetings. Secondly, individual interpretations were detailed by rubrics in the original score. Facing the pandemic moment, the new version of Cuerpo Cardinal was finally assembled in a video montage featuring three screens in parallel (see figure 3). The individual performances were recorded separately by each performer and the video metronomic guide acted as a kind of musical conductor therefore, the synchronization was done with the same time references.



Figure 3: Video montage of Cuerpo Cardinal showing the performers' visual integration and the three characters.

The original sound of percussion on each other bodies might have been replaced by percussion instruments, but we decided to emphasize the impossibility of touching each other bodies with scenic gestures. Under this perspective, we have decided to perform the same movements specified in the original score but within a scenic approach. Further, we have also decided to perform three women characters: *health worker, home-office worker, an unemployed one* (see figure 3, from left to right)

The individual narratives were therefore passed during a full day with synchronous time periods. With a bit of humor, we portrayed these three women living within the pandemic crisis. Each one performs their own daily activities and sometimes they feel themselves body drumming. When the day is finishing, a video call invites them to a percussion jam section: a possible Equinox of bodies and minds, revealing these women's dream along with other people whom also aim similar encounters in such difficult situation.

5. Discussion

The poetic concepts related to the *Cuerpo Cardinal* recreation was prior to the technical study of the score. Since we have made the first reading of the piece we already developed new ideas for body percussion and scenic gestures. These points interlaced with performance concepts have given space to many new elements emerging throughout the process, from macro ideas towards micro details (see figure 2).

As demonstrated in figure 3, we have inserted summarized rubrics on the original score reminding movements and scene cues, in addition to guidelines for body percussion. This approach followed the previous methodology discussed in [3] where we described the creative process of Manzolli's *Viento y Mar.*

Since the *Cuerpo Cardinal* recreation let us to perform with musical and theatrical

elements, a reflection was necessary to integrate those aspects in the whole composition. We have discussed about the three characters' short narratives and their personal contexts to integrate them in a multimodal discourse.

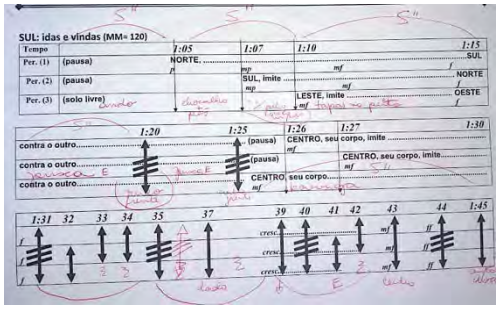


Figure 3: Notation on the original score describing cues for anticipating gestural and sound interaction.

It was necessary to imagine and project the whole piece, define movements, moreover to think about the individual and collective scene. Therefore, camera positioning was a very important issue. We worked this aspect together in order to achieve the desired interweave of movements when the three individual video recordings come together in the final audio-visual montage.

We were confronting a new experience since we haven't performed similar ones before. Traditionally, it is a bit difficult to work with body expression during musical performances, even for percussionists. Isadora said: "*So, for me, the connection of music with those very peculiar visual aspects, to unify body expression with scenic creation, was something very challenging, but also charming*".

Second important aspect was the composition of the three characters. Fernanda described her character creation as follow: "*I tried to imagine what would be a health professional during the pandemic crisis: her insecurities, anguish, fears, and longing of distant relatives".* Other aspects to be explored was the daily activities aiming to achieve the equilibrium, such as a simple morning stretch or a music practice that the character would like the most.

Daniela performed a home-office worker woman, isolated at home, living different daily situations during 2020, and so far from her true reality. In the first section of the piece, Daniela's character arrives from the street tired with a mask and coat. Then she had a moment of peace connecting herself with the inner world through meditation. Thus, music helped her to reach that state of mind incredibly well. During the afternoon, her character decided to exercise freely. Daniela described that "*almost as if she was following an internal choreography and feeling better and better*".

The day goes by, the work continues, and psychical exercises helped Daniela's character to release endorphins and increase happiness. When the night came, that woman managed to connect with the other two other women, using technology. Daniela said about that moment: "*then music returns and finally the character found a way to feel good, happy and happy in a very unlike year but full of reflections and an incomparable growth of the soul*".

6. Discussion & Conclusion

The recreation of *Cuerpo Cardinal* was anchored in a collective and individual artistic research process. General concepts, artistic contextualization and

ideas on musical unit and performance were jointly created during virtual meetings involving the composer and the percussionists. Nevertheless, specific features on musical interpretation were created by each percussionist, individually.

Moreover, the recreation of *Cuerpo Cardinal*, happened in a very peculiar situation, we are already under a social crisis that fulfilled ourselves with reflections, intense feelings, doubts, what could be almost described as a "tidal wave of thoughts".

Therefore, in the same manner as other artists we have sought different ways of expressing ourselves under confinement and social isolation. Thus, the interpersonal creativity of our group has transformed its course dynamically, grew, and became stronger even in the pandemic context.

A composer and three percussionists together, recreated this interesting piece that was originally based on physical close contact, which then became a beautiful and great challenge since each of us have been isolated in our homes. Since *Cuerpo Cardinal* recreation will not be performed on a stage, we decided to integrate the three videos recorded individually in a whole piece and that generated new needs and directions, and wonderful things emerged.

ACKNOWLEDGMENTS

The Brazilian agency the National Council for Scientific and Technological Development (CNPq), supports this artistic research under the project (#304431/2018) Musical Creation and Analysis integrated by Cognitive, Interactive and Multimodal Processes.

References

[1] Manzolli, J., “Descobertas: Creativity as Libretto of a Multimodal Opera.,” in *Proceedings of the GA2018*, Florence, Italy, Dec. 2016, pp. 252–266.

[2] Manzolli, J., “ODE TO CHRISTUS HYPERCUBUS Creative process of a multimodal performance,” in *Proceedings of the ARTeFACTo 2018*, Lisbon, Portugal, Nov. 2018, vol. 1, pp. 10–15.

[3] Manzolli, J. and Vieira, F., “Anatomy of the Creative Process in Viento y Mar,” in *Generative Art Science and Technology hard Journal, GASATHJ*, Milan, Italy: ARGENIA Association, 2020.

[4] E. Salzman and T. Dézsy, *The new music theater: seeing the voice, hearing the body*. Oxford ; New York: Oxford University Press, 2008.

[5] T. W. Schubert, “A New Conception of Spatial Presence: Once Again, with Feeling,” *Communication Theory*, vol. 19, no. 2, pp. 161–187, May 2009, doi: 10.1111/j.1468-2885.2009.01340.x.

Alternator.
a moving image art work including sound.

Topic: Lightning arc Drawing.

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Abstract

As a muse the history of lightning in the arts and crafts goes back many thousands of years. While the use of it in our modern world goes back hundreds.

From my perspective looking at and thinking about lightning must be as old as fire.
Lightning Arc Drawings is an idea to use electricity to generate art works from drawing with conductive elements including things.

A lightning arc drawing circuit involves a variable transformer, an AC transformer and a large back electrode and an artwork electrode.

The audio visual element of air breaking down in the form of corona, plasma and sound is spiritually loaded and offers fear and a very present danger.

In this artwork the Lightning arc drawing materials are made and found objects enlivened with high voltage. A coffee filter, being the most recently filmed, begins and ends the film, a hand made wire triangle and a few tin foil squares are also used in the film. I have layered older audio visual material, created in the same way. This showing of a novel and flexible medium for artwork has at its forefront the idea of light acting in time and space. Alternator1 is a composition of a selection of ' lightning arc drawings' sharing the complexity of corona and power arcs.

The generative ideas within the work are vast, corona- visually as a soft glow is created when air breaks down lowers the resistance and creates small tree-like paths for arcs to follow. Power arcs between the two electrodes create small explosions which in turn create small vacuums which then create a new path of least resistance. Nearly every arc is accompanied with a sound. With the sound although adjustments to tone and

pitch have been made, the sounds are generated by the electrical arcs so the blue colour is the loud noise.





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Key words: Electricity, Corona , Plasma , Drawing , Vacuum

Main References:

Bell, S., Enright, W., Tunstall, K., Bodger, P. (2007) Lightning Arc Drawings - Dielectric Barrier Discharges for Artwork. Ljubljana, Slovenia: 15th International Symposium on High Voltage Engineering (ISH), 27-31 Aug 2007. https://ir.canterbury.ac.nz/handle/10092/786

Cyberpunk Beginnings: SOS

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Abstract

This performance proposal features works for electric guitar, percussion, live processing and visuals performed by Mark Zanter, and Steve Hall of Marshall University, USA. Approximate time 10 minutes.

SOS integrates layers of algorithmically generated material, live signal processing, visuals, and live performance in a work exploring boundaries between machine generated sound(s), and human interaction.

Key words: improvisation, modular form, algorithmic composition, signal processing, hz

Introduction:

Cyberpunk beginnings: SOS is part of a larger project/work integrating algorithmic processes, live performance, improvisation, and visuals in a context that explores Cyberpunk themes, icons, structure/flow found in the writing of William Gibson, Philip K. Dick and influenced by the philosophical writings of Baudrillard, Lanier, and Featherstone. Though these themes and concepts have been with us for some time now, it is my belief that the age proposed in Cyberpunk literature—once a fantasy—will soon be upon us as AI, corporate capitalism, and the integration of biological physiology and machines (cyborgs) have increasing relevance in our day to day lives.

One of the themes in Oshii's *Ghost in the Shell* is that technological advances will occur regardless of their benefit to humanity, and thus humanity must learn to cope with technologies [1]. *SOS* and it's structure focus' more on coping or collaboration between the performers and the computer generated parts rather than various and very important ethical issues surrounding new technology and its use. Further, the simplicity and ordinariness of musical and visual materials used in the piece elevate the interaction of parts and performer reactions in performance [2].

In *SOS*, I have used algorithmic procedures to produce music notation, electronic sounds, and visuals that are

integrated into the whole. Elements are introduced individually at first, and then combined as the work progresses using increasing levels of interaction/reaction between the performers and computer-generated sounds. Performer roles vary, being more or less foregrounded with regards to the computer parts; in general, computer-generated parts become increasingly important as the work progresses [3]. Pitch, rhythms and tempi were chosen to afford congruence of sound, and high degree of flexibility for the performers in varied musical contexts.

Music composed for the performers uses a 2n additive sequence and rotational permutation using (c-e-f#-g-b) hemitonic scale [1] [4]. Fig. 1 shows the rotational scheme, and figs. 1-3 show its transposition and embellishment as it is transposed from c3-b6. In each example, 2n occurs once on each system, and the rotational sequence occurs over the course of four systems.
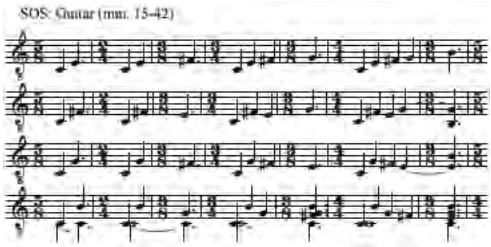


figure 1

Successive repetitions of the schema begin with pitches 2-5 of the scale (2n rhythmic sequence, pitch rotation sequence). As the schema is transposed, diminutions are employed mm. 80-200 heightening the expressive nature of the line as it moves into increasingly higher registers (e.g. figures 2, 3).
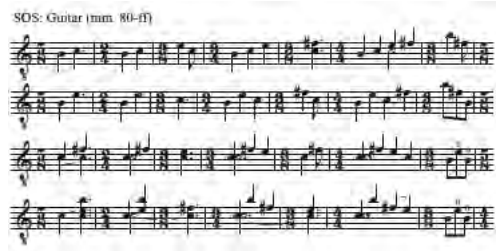


figure 2

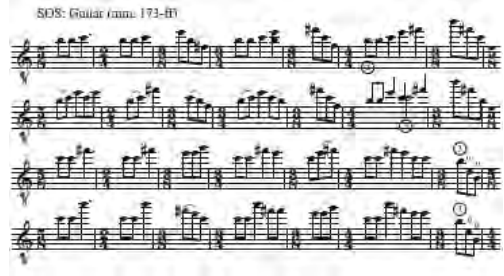


figure 3

Sustained pitches, chords, open strings and other devices were added to the guitar part making it more expressive and idiomatic for the instrument.

This composed music is performed with computer generated sound at a tempo relationship of 63/173.4 bpm. This relationship, 11:8, synchronizes the faster music of the performers with the slower pitches of the bass voice every 5.7 seconds; the length of one 2n cycle (16 beats). 11:8 polyrhythmic relationship creates rhythmic/metric tension between the performers and computer-generated sounds. This tension is resolved after m. 230 when all agents perform at a tempo of 126 bpm.

MIDI pitches and rhythms were generated in Max/MSP and played through synthesizers in Ableton Live [5]; which also performs additional signal processing. The Max patch contains four voices (STB) and percussion that send

MIDI data to Ableton. The patch dictates tempi, pitch, velocity, density and cardinality [2]. Bass and tenor use 63 bpm, higher density and lower cardinality, while soprano and percussion use 126 bpm, and wide-ranging density, and cardinality [3].

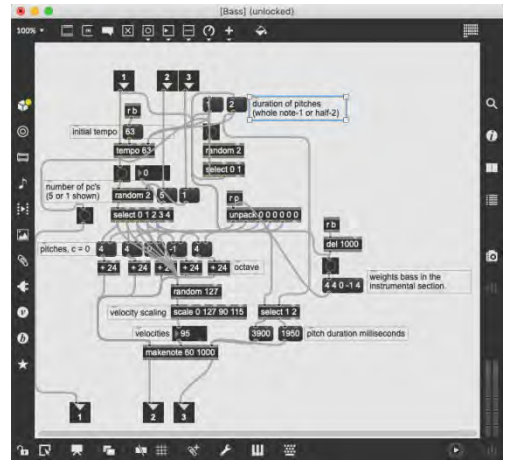
Pitches are generated randomly from subsets of the scale input to each voice. Bass, tenor and percussion sound first, with the written score. In this section bass pitches are weighted E-60%, B, C-20%. Pitch weighting causes the perception of a double tonic (Em, C) to emerge [6]. The tenor moves from low density and high cardinality to high density and low cardinality at which point the performers enter. In this section, the computer-generated percussion adds rhythmic tension playing off the music of the performers. At m. 230, the soprano enters, and gradually moves towards 83% density. Percussion density also increases here to 50%. Collections shown below are then triggered in sequence, at a rate dictated by duration of pitches in the bass. Closer examination of collections shows the following "chords": CMaj7-Em9-F#ø7(11)-Em9/G a sequence with many possible functional interpretations (figure 4).

At this point improvising performers are free to interpret pitch collections as harmonies or as groups of unequal four member subsets derived from the original pentatonic scale. Both approaches will render different results and the style of improvisation may closely emulate the computer-generated music, or venture into different territory at the discretion of the performer. The tempo in the section of the work is 126 bpm, and the quick rate of the soprano sounding with the slower tenor and bass creates the impression of fast arpeggios over a ground bass (c-e-f#-g).
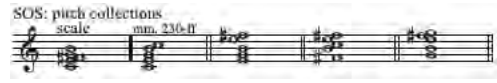


figure 4

Figure 5 shows the bass voice of the patch and objects that control output. Each voice uses a similar structure. Tempi and note value control the rate pitches are triggered while the random object selects the number of pc's [4] that will sound (5, 1 shown). Values 1-5 produce 100% density of 1-5 pc's, while values x>5 produce lower density (e.g. 6:5 = 83%). Note, durations are not specified except for the bass. Velocity scaling shapes accents for each pitch adding rhythmic texture to each voice. This is most noticeable in the soprano and percussion voices [7].



Visuals used for the piece were created by processing a photo in Max/MSP. Values for scale, hue, saturation, number of repeats, xyz rotation and waviness (LFO) generated the graphics from a photo of a common household object. The 2n series was used to change values

over time and in each section certain parameters take precedence.

Notes:

[1] 2n sequence relates to the number of pitches: 1+1; 1+2; 1+3 etc. Rhythms do not strictly follow. The last rhythm of each sequence is 1.5 duration of the others.

[2] Cardinality: the number of pitch classes.

[3] Slower and fewer pitches in the bass, faster and more pitches in the soprano and percussion.

[4] Pc's: Pitch classes.

References:

[1]https://www.scmp.com/magazines/post-magazine/arts-music/article/3040516/why-ghost-shell-greatest-and-most-philosophical (accessed, November 3, 2020)

[2] Baudrillard, Jean, and Lotringer Sylvère. *The Conspiracy of Art : Manifestos, Interviews, Essays*. Semiotext(e), 2005.

[3] Butler, Mark J. *Playing with Something That Runs: Technology, Improvisation, and Composition in DJ and Laptop Performance*. Oxford University Press, 2014.

[4] Silverman, Joseph H. *A Friendly Introduction to Number Theory*. Pearson Education Taiwan, 2004.

[5] Manzo, V.J, and Will Kuhn. *Interactive Composition: Strategies Using Ableton Live and Max for Live*. Oxford University Press, 2015.

[6] Drew Nobile, Double-Tonic Complexes in Rock Music, *Music Theory Spectrum*, Volume 42, Issue 2, Fall 2020, Pages 207–226, https://doi.org/10.1093/mts/mtaa003

[7] Rowe, Robert. *Machine Musicianship*. MIT Press, 2001.

V-Art
from photography to engraved art

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Premise



1. Introduction

Is there a relation between CAD/CAM systems for numeric control machines (NC) and Art?

It's possible to print images without ink?

Machine can create their own art starting from human art?

V-Art project starts from trying to give an answer to these questions.

2. The study

Starting as a developer for a big Italian CAD/CAM software house I ever been interested in mixing math systems and Art.

Developing a software is a moment of pure maths calculations, organization, and focus. Art can help those moments to be more personal and less stressful.



In November 2018 I start teaching "learn to code from Art" and in December 2019 I decide to develop a real software that can engrave every image with NC machines.

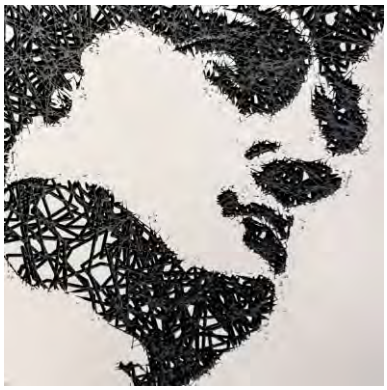
3. The V-Art project

The V-Art project start when I meet the company Filippi1971 s.r.l. and their special product VittEr®.

VittEr® is a panel composed by multiple layers of paper with differ colors.

Vitter® is used as a material to create furnishing elements in many sectors, so it is perfect for develop new design concept.

4. Algorithm concept



An image can be compared to a flat plane of a 2D CAD drawing. The X and Y coordinates are expressed by the pixel grid.

Then every pixel has an hide 3D Z value represented by the color.

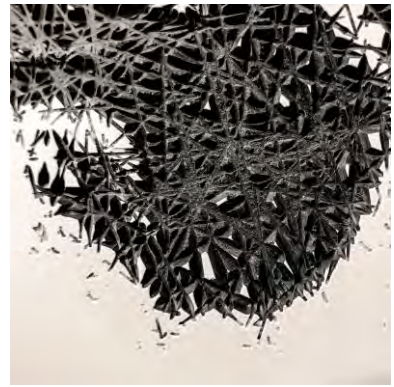
In fact, a color can be translated in a grey-scale value from 0 to 255 (RGB color space).

X, Y and Z value can now be used for literally speaking with a machine.



Every human understands commands if you use the correct words and language, for the machines we can use the same concept.

We can show to a machine first how to move, then how to work and at least how to create art.



I create many different algorithm (horizontal lines, vertical lines, curve, circles, rectangles, random…) that process every image in a completely new NC program.



VittEr ® it's not only composed by black or white papers, but we can use a lot of colors for add more complexity and possibility.

It's a new world for furniture decoration.

I start to explore this new world and I found a lot of interesting spot, I'm sure I will find more algorithms for create every time new generative Art from old art.



5. References

[1]V-Art – photoart project www.instagram.com/vart_photoart

[2]VittEr® product from Filippi1971 s.r.l. www.filippi1971.com/en/vitter/

[3]David di Michelangelo in Galleria dell'Accademia

Good for nothing (no. 1)

Artworks, Installation

Topic: Art, Film, Narrative

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Premise



Abstract
What are digital abstractions? For modern, abstract painting, the physicality of its material components corroborates its meaning: the substrate, the paint itself, or collaged elements questioned conventional relations between figure and ground. Perspective was key to understanding this meaning, as was the picture plane (corresponding to the surface of a picture, perpendicular to the viewer's line of sight) which fixed the object in time and space.

But the digital image has no physicality and the picture plane's status is toppled by the digital screen. The screen's nature is to show and to obscure. Its narrative structure demands the suspension of disbelief, as its form dissolves, shifts, and defers experience by placing sole emphasis upon our sight. It forever hypnotizes us, seamlessly eliminating its own qualities as a substrate. It owns the characteristics of a Zelig: forever changing, unstable in any context, and destabilizing context itself. Informed by photography, film, and every meme that ever was, the digital image shifts readily between aspects of each. Its meaning is necessarily slippery and hard to define; possessing a quality that makes it hard to pin down or make fit into a neat category.

Given this slipperiness, can we ever grasp the basic, tectonic components of the digital image? The bits and pixels of the screen do little to help our visual understanding of its relationship to one's perspective in everyday life. The seductive illusions and concomitant complexities of our online experiences have enabled an entirely new trompe l'oeil hell of phishing attacks, spoofs, and cross-domain tomfoolery.

Digital images, precisely because of their ambivalence towards the picture plane, forever slip from our grasp. Only as they recede from our mental, perceptual grasp do they reveal aspects of their construction. Rather than fight against this liminal quality, we exploit it.

Forever shifting, always shiftless. Stasis in short, on an endless joyride from nowhere to anywhere. How does one go about working with this shiftlessness? We began with a metaphorical toast to Herman Melville's crème de la crème good-for-nothing anti-hero, Bartleby. Images aligned with a scrivener of the postmodern age that can only tell us: 'I prefer not to'.

Good for nothing (no. 1) uses a tonal rubric to explore the space between an actual pixel and much larger, constructed illustrations of pixels. Its slowly changing, randomly generated surface traverses a path between a space that is discrete and digital, and one that approaches continuity. As this constructed image evolves, then devolves by erasure, each new lighter value takes over from previous square units—questioning our base, retinal understanding of the screen made up of pixels invisible to the human eye.

Beginning with a single, randomly placed, translucent quadrilateral, Good-for-nothing (pixilated) generates a palimpsest through replicating that original quadrilateral. The corners perform a 'drunkard's walk' through the two-dimensional grid of the screen, building up such that the screen will eventually go black. The black screen, or the promise thereof, leads us back to representing the void. Bottomlessness . A void that uses the light of the screen to become 'unlit'.

XTREME Recital

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Abstract



XTREME RECITAL is a multimedia show inspired by the *XTREME Life in Extreme Environments* exhibition (ESOF 2020 - Trieste, Aug 29th – Oct 11th, 2020). Our production stems from reasoning about human conditions in the extreme environment of Antarctica, and attempts to answer the question of who we become, visiting a harsh reality where our sins, dreams and senses, are heading to the better part of ourselves. By collecting word and visual documentation, natural sounds and related poetries are exploited to explore the striving emotional impact of life in such extreme condition. Four independent composers have been invited to write original works for piano, cello and electronics which, by means of innovative and compelling techniques, aim at facing with the conflict between Man and Nature and conceptualize, through the music, a possible solution. The harmonies of *Des pas sur la neige* by Debussy is the starting point for suggesting a unifying emotional atmosphere that is set up by the composers through relationships between concrete natural sounds and instrumental human gestures, research on remote perception, and generative algorithmic structuring. Using a minimalistic theatre approach, two actors join the musicians with dialogues inspired by the subject of the exhibition and an original choreography. The use of interactive technologies finally enhances the amalgam between all performers and the environment made of sounds and gestures, achieving a performance each element of which takes the form of a living dialogue.

1. Introduction

XTREME RECITAL is a multimedia show inspired by the *XTREME – Life in Extreme Environments* exhibit [1], which took place in Trieste from August 28th to October 11th 2020, and was part of the activities of Science in The City – ESOF 2020. Partners of the exhibition were the

Italian Institute of Astrophysics (INAF), the National Antarctic Museum, the Regional Speleological Federation – Friuli Venezia Giulia, the University of Trieste, under the patronage of the European Astrobiology Institute and the Italian Society of Astrobiology. In a follow-on multimedia project, a group of scientists, musicians and actors collectively designed and shaped a multilevel performance in which natural sciences, music, theatre and interactive systems blend together in an innovative way. As pointed out by Oscar Schlemmer, cofounder of the Bauhaus School: "The stage is the arena for successive and transient action" – a main space for the dynamic confrontation of different artistic approaches and the living evaluation of theories and relationships [2]. Placing itself within the vast panorama of interactive artistic production in which creation, performance, perception and action develop on a common level and nourish each other on their respective contents, our project takes inspiration from concrete natural phenomena to achieve a new form of synthesis between science, humanities and art.

- What do Speleology, Antarctica and Astrobiology, three apparently distant contexts connected by the extraordinary resilience of life in extreme conditions, have in common?
- What sensorial and emotional experiences impact a human being venturing inside such extreme environments?
- How do modern technologies – be they concrete music, multimodal gesture interaction, or algorithmic composition – lend themselves to creating a scenario suitable for effectively communicating such a message?

Our research project attempts to address these questions by combining scientific knowledge, stage direction, music performance, poetry, dance, and multimedia interactive technology to create a unique space of cognitive confrontation.

2. The XTREME Project

2.1 Scientific context

The purpose of the EXTREME exhibition was to illustrate the main features of extreme environments and the conditions for life to thrive in hostile habitats, as well as for our species to adapt. It presented to the public the strong connections between Antarctic, Speleological and Astrobiological research, usually told as disciplines in their own right and not as three forms of exploration with partially overlapping purposes, methods and history. Topics included survival technologies spinning out from Antarctic research (Fig. 1) to space exploration, plans for underground space colonies on Mars or on the Moon, and the search of extremophiles on Earth – the very special organisms living deep and dark underground who can shine a light on the extra-terrestrial life that maybe, one day, we will meet. In the exhibit, the audience could compare the history of the Antarctic and speleological explorations, as well as ancient and modern iconographies of Antarctica, Speleology and extra-terrestrial environments. Those present were able to learn that the cryosphere and the underground environment, despite being terrestrial, offer good prototypes for the exploration of Mars, the Moon and the icy satellites of our giant planets – such as Enceladus on Saturn or

Europa on Jupiter. By taking a look at the ways humans devised to survive in those environments, participants could finally face the problem of extreme survival and exploration.



Figure 1. *XTREME exhibition, Antarctica.*

2.2 The performance

Inspired by one of the themes of the exhibition, our performance starts from the analysis of scientific and historic documentation, as well as from the direct experience of one of us, to develop metaphorically the interaction between the Human and the Nature in *Antarctica*. Using a minimalistic theatre approach, the four performers – two musicians and two actors – create a symbolic space on the stage where any movement, musical sound or pronounced words form a unique amalgam of artwork that reproduces and mimics human survival in such an extreme environment. Through interpretation and readjustment of Samuel Taylor Coleridge's *Rime of the Ancient Mariner* and acting of some excerpts from Giacomo Leopardi's *La ginestra,* we study how the Human changes in such an imaginary journey where – on a stage dressed in a white cover and equipped with a glass of water with ice – we try to answer the question who we become, visiting a harsh reality where our sins, dreams and senses are heading to the better part of ourselves.

Music performance equally develops the theme of interaction between the Human and the Nature through a set of musical miniatures, specifically composed for this project and performed here for the first time. The main source of inspiration is the Debussy Prelude *Des pas sur la neige,* a complete performance of which will be presented at the beginning of the show. "A leaden, grey, sunless sky looms over a scene made all the more gloomy by a thick blanket of snow. Over the snow a solitary traveller tiredly drags his steps, while a poignant song of pain and sorrow is heard, seeming at times to break off in a strangled sob" [3]. This song expresses heartfelt compassion for the desolate melancholy of the snowy scene, and recalls at the same time the lament of a traveller who treads with heavy steps towards his death.

Each miniature of the suite is a reminiscence of the Debussy Prelude, be it an elaboration of the musical material – a rhythmically constant ostinato evoking the underlying impression, combined with a melodic line carrying its emotional substance – or a paraphrase of the evoked atmosphere and meaning. Compositions have been dedicated to the two musicians involved in the project, the pianist Erica Bisesi and the cellist Nicola Baroni, as well as to the whole XTREME Ensemble.

U são as neves d'antão? Taking up the theme of a fifteenth-century ballad by Francois Villon, an elegy on the passing time, **Mauricio Dottori** conceived his piece starting from his own experience as a geologist. Getting inspired by the sensorial experience of exiting the tunnel of a deep mine and in analogy to the current pandemic situation, this delicate

and expressive piece for cello and piano – a cry to escaping beauty – evokes the atmosphere of a world that slowly heats up and melts.

The composition takes reference to the "footsteps" outlined in the Debussy Prelude, devising a snow landscape that shows up after coming out of a cave. From this piece, Dottori takes the first two chords and a rhythmic cell. But unlike Debussy who, albeit in a non-conventional perspective, retains some references to tonality, he conceives such elements as mathematical sets related to each other by serial operations, according to infinite possibilities. In other words, although the musical source material is less abundant than that in Debussy, mutual relationships between different elements are far more numerous. From a timbric point of view, the amalgam between the two instruments is intensified by crawling the piano strings with the bow. This technique also enables production of deeper, full-bodied – almost abysmal – sounds, as a metaphor of the evoked scenario.

The poetic idea of **Marcela Pavia**'s *Antarctica* is that all living beings, be they humans or animals, when dealing with extreme situations, reveal their deepest nature. Such extreme situations dissolve the layers of human "civilization", making primordial emotions from the limbic system come to the surface. In a counterpoint of gestures, concrete electronic sounds and obsessive musical figurations, this composition for cello, piano and electronics deals with the theme of the transition from chaos to order as a paradigm of the transformation which affects the Human after confrontation with the limits imposed by the Nature.

The piece begins with purely gestural elements, with a prevalence of electronics. A little at a time, different musical figurations emerge, shaping the electronic sounds. A repeated note stands out, which resolves to an ascending second – a reminiscence, albeit with a totally different meaning, of the generative motif of Debussy's *Des pas sur la neige.* The more chaotic order, or less ordered chaos which characterizes the first part, gradually switches to a more ordered situation. In the first part, the so-called *extended instruments* are employed, i.e. acoustic instruments are played in unconventional ways: by pinching the piano strings, by producing longitudinal glissandi with the cello, etc. These techniques return very special and unusual sounds, which are combined with the electronics to evoke the requested atmosphere. Electronics is made of concrete sounds (whales, snow footsteps) and instrumental gestures, which contribute to the processing of the electronic material. In the second part, gesture turns into recurring obsessive figurations, shaped through the spatial movement and dynamical control of the cello by means of an algorithm. Then, such figurations are no longer processed further; they just leave their echoes in the electronic background until its dissolution at the end. The anchorpoint for the poetic and musical discourse is that, in extreme conditions, all beings are similar to each other in the expression of their emotions because they are closer to the intimate essence of their own nature. As a consequence, extreme situations necessarily lead to transformation. In *Antarctica*, it does not matter whether such a transformation will be positive or

negative: the only thing that matters is that it will inevitably take place, beyond any moral consideration.

Such a contrast is further stressed out in the miniature by **Massimiliano Messieri**, *Il futuro in ogni istante – Fantasy for cello, electronics and piano on Debussy Prelude "Des pas sur la neige"*. "Writing music for Antarctica could be considered a paradox since, as far as I'm concerned, my knowledge of such an environment is not empirical but only based on documentation. Consequently, when composing my piece I had to be led by imagination, guessing at a human being standing at the centre of Antarctica. To achieve the goal, I looked for pre-existing historicized sound material in assonance with the primeval question: *Why to write?*" Human beings are deleterious for Earth, as they take advantage from it without carrying any respect. However, reality is merciless: the Earth could easily live without humans, but not the other way around. While scientifically proved to be the most intelligent animals in the world, "human beings look to suffer from dementia": men need the Earth with all its elements to survive; however, they are doing their best to suffocate and destroy it. *Il futuro in ogni istante* aims at exacerbating such a paradox through a conflictual interaction between the cello (the Earth) and the piano (the Man).

The compositional principle is based on the MMSE (Mini Mental State Examination) test for evaluating the chance of dementia in human beings [4], which is currently adopted by the Italian Society of Gerontology and Geriatrics. The Theme is made of an Antecedent – which corresponds to the musical object, and a Consequent – which represents a memory of the same. The Development illustrates the relationship between memory and forgetfulness through the ability to remember the musical object. As an Antecedent, a pre-recorded performance by Erica Bisesi of *Des pas sur la neige* has been deprived of some parts, and is re-proposed to the same interpreter who listens to the music on headphones and is asked to perform a memory task: whenever the sound is missing, she has to reproduce her own interpretation by heart. The less accurate she is, the more the sound of the cello is deformed. Cello performer is Nicola Baroni, who also developed the patch in Max/MSP (Fig. 2). In the future, we plan to extend the algorithm to include interaction with emotional body responses, as monitored by sensors' motion capture. The composition exploits the difficulty in keeping concentration on short and long-term memory during performance action, a task involving multimodal interaction of three senses – hearing, sight and touch – to return an original, science-based interpretation. Besides scientific aspects, *Il futuro in ogni istante* is a self-standing composition both in its guise for solo cello and live electronics, and for cello, electronic device and piano, where the pianist plays in turn the role of a controller on the electronic device. The piece does not admit an unique interpretation, but is open to a multitude of performances depending on the emotional state and mnemonic rendering of the interpreters: whenever exactness will be achieved, the outcome will be identical as that for solo cello and live electronics – as in a classical score where time evolves without any external feedback; but whenever an action by the pianist does occur, a reaction by the system ensues,

that will modify the future of each individual involved in the performance.

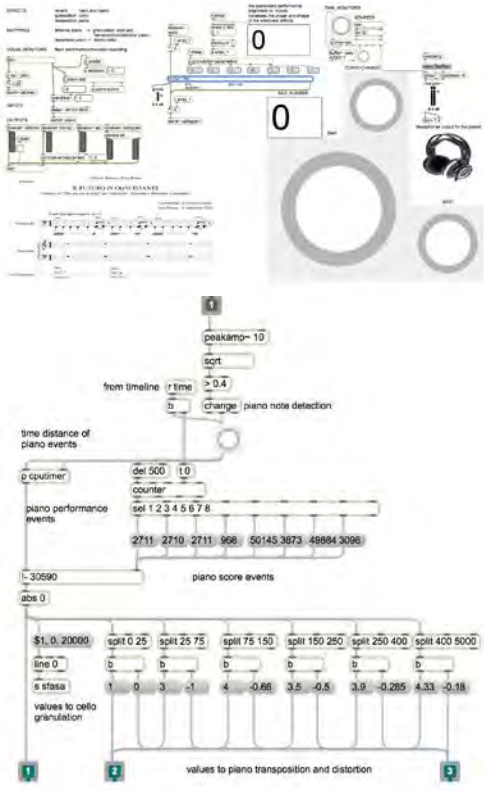


Figure 2. *Il futuro in ogni istante, interactive system by Massimiliano Messieri (software design arrangement by Nicola Baroni). Upper panel: Modules for cello granulation and piano transposition and distortion; Monitor and flashing metronome for the cellist. Lower panel: Sound analysis module. The amount of "rubato" in the piano timing affects the electroacoustic response.*

The central part of the performance arises as a dramatic trajectory of interactive sound fusion between actors' voices, the sounds produced by the two musicians on the stage, and a responsive digital electroacoustic system. The interactive design, which marks this part of the narrative, builds up the musical composition in real time *Crossing Rhapsody* by **Nicola Baroni**: again, a situation of straight conflict between Man and Nature is highlighted. The digital interaction is based on audio analysis, by capturing densities, vocal traits and expressiveness of the four performers carrying out the written text and the musical shapes outlined by a timeline (Fig. 3).

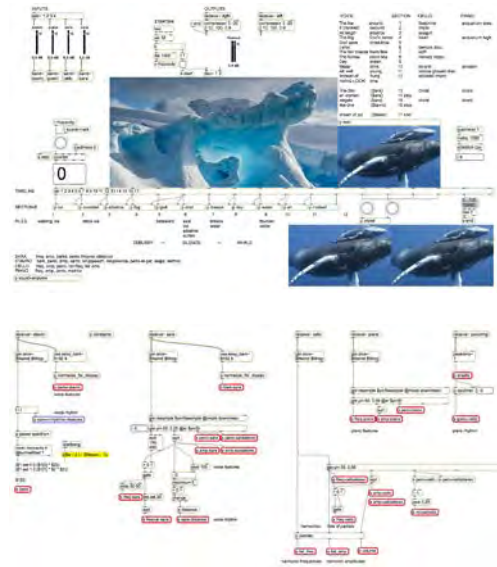


Figure 3. *Crossing Rhapsody interactive system by Nicola Baroni. Upper panel: I/O, timeline, sequence of abstractions for the different sound transformations and file triggering, sound analysis module, and poetry cues for music performance alignment. Lower panel: Crossing Rhapsody sound analysis module. Piano and cello performance and actors' voices are analysed in real-time, in order to extract timbre / frequency features and rhythmic densities / regularities from each performer; these values are then mapped for regulating and modulating the qualities of the electroacoustic output.*

The performance features, monitored by the digital system, are functional to accentuate electronic processes of intermodulation and fusion between the sounds produced by the live performers, as well as to integrate the relationships between their presence on the stage, some selected pre-recorded natural sounds (water, physical alterations in the ice, animals living within extreme climatic environments), and some musical reminiscences live recorded from previously performed pieces. This interactive composition is designed with Max/MSP. *Crossing Rhapsody* is interactively fed by the actors describing the state of being immersed in an ocean of ice and water, radically distant by any familiar environment: a state of fear, disorder and hostile settings. The music live interaction foregrounds the hallucinatory distance between "household" music and the disrupting concrete sounds of remote natural locations.

The last miniature, *Infinity 428,* is a piano composition conceived by **Marco Giommoni**, and is based on mathematical models of non-dodecaphonic serial development (Nørgård's series) and other numerical series. It takes advantage of the flexibility and completeness of "Opusmodus", an IT tool and interactive composition environment that allows addressing topics of considerable complexity [5]. The pitch profile is derived from the development of the first 428 terms of Peer Nørgård's "infinite series": a numerical progression model that applies to the intervals of an arbitrary series of pitches a set of transformations, like inversions and expansions, providing the set an "open hierarchical organization", e.g. a "form" which leads back to fractal geometry [6]. The following two aspects of a same concept of fractal geometry well illustrate such an open hierarchy: self-similarity and scale invariance. The first aspect corresponds to the fact that "micro-structure" can always be traced within "macro-structure"; the second highlights that each structural level is re-proposed several times on a different scale. The starting set for the Nørgård series is a group of 5 pitches belonging to a diminished seventh chord (C – E flat – F sharp – A – C). Rhythmic grouping, on the other hand, arise from the division of a metrical unit (of 1/4) into five different prototypes (of 1, 2, 3, 4 and 6 events each), so as to obtain just as many isochronous groups. Once the isochronous groups are generated, their linear arrangement in a sequence of 428 units occurs for random selection.

The piece is structured into three main sections, followed by a Coda. Each section consists of an identical sequence of pitches with different grouping profiles. Pauses, on their part, contribute to piece segmentation by introducing an appreciable asymmetry between the sections (Fig. 4). As for the distribution of the pauses, Giommoni uses the series of "happy numbers", defined by the following mathematical formulation: starting with any positive integer, such number is replaced with the sum of the squares of its digits; the process is repeated until one gets 1, or enters a loop that does never include never 1 [7]. The numbers for which such process returns 1 are called *happy numbers*, while those that never give 1 are *unhappy numbers*. *Infinity 428* takes into account the first 68 happy numbers of the series, i.e. those numbers that are included in the interval [1 – 428]. They identify as many positions where the corresponding pitches tare

replaced by a pause of equivalent duration.

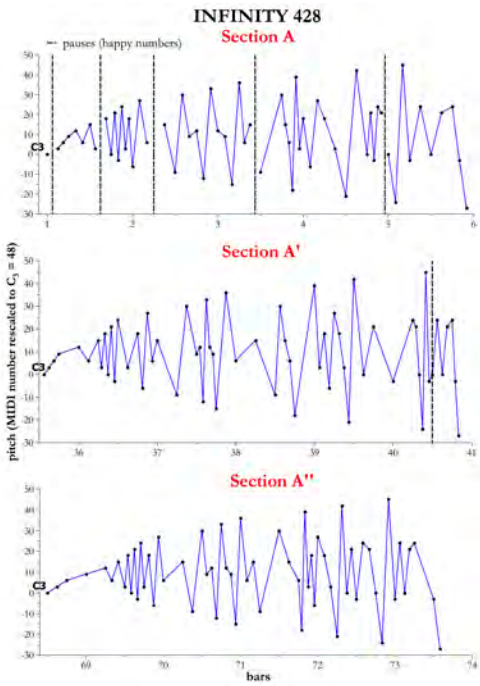


Figure 4. *Relationship between note pitch (expressed as MIDI number rescaled to C_3 = 48) and duration for the first five bars of each of the three main sections of Infinity 428 by Marco Giommoni. Note the different grouping profiles and pause densities.*

The overall result is double: the relatively rigid compactness of the infinite series contrasts with the random distribution of the isochronous rhythmic groups and is, at the same time, segmented by the pauses (Fig. 5).

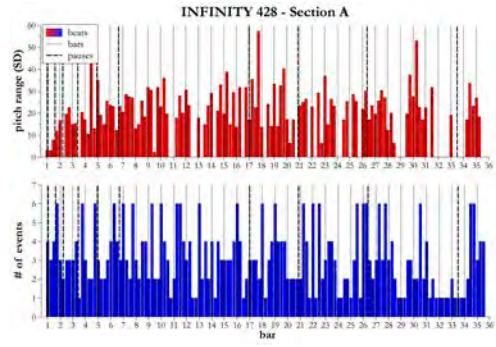


Figure 5. *Pitch range and score event density profiles for the first section (bb. 1-35) of Infinity 428 by Marco Giommoni. Pitches are expressed as MIDI numbers rescaled to C_3 (48), and pitch range is measured as the standard deviation of pitch at each beat.*

This results in a molecularized sparkle of sound particles rotating like a mirror around an imaginary centre, which reflect themselves like a gibigiana on reflecting walls – perhaps belonging to imaginary ice caves without a "vertex" and a "bottom" – as well as to the hypothetical "depths of the soul" evoked by Coleridge's *Rime of the Ancient Mariner.* Perception of such a "sparkling effect" is induced at the same time by wide register changes and alternation of very diverse grouping figurations. By attempting to establish a semantic association, we might relate this effect to synesthetic perception of light reflectance: the higher in case of large register shift and dense sound granulation, the lower in the opposite case. This argument may provide a plausible explanation for the aesthetic assessment of this piece, as provided by some listeners, as "a continuous juxtaposition of white and blue".

3. Discussion

The project presented hereby foreshadowed itself as innovative from different points of view. Beyond originality in the overlap of different, sometimes contrasting, approaches to music performance and composition, as well as its intrinsic high degree of interdisciplinary, we expect to provide a significant contribution to the area of interactive performance thanks to a specific synergy between natural sciences, humanities and artistic creation. Indeed, the inspirational theme, i.e. human survival in extreme environments, was not only the subject of the independent scientific study that led to the exhibition; it also offered concrete insights both for music composition and for the theatrical installation. If, on the one side, natural sciences nourish applied sciences – which, in turn, work for the benefit of performance, in a circular process, the theatrical and musical direction – both of which involve artists who are at the same time researchers in natural sciences, is conceived with the precise purpose of communicating, in full compliance with the aesthetic canons, the deeper message of the exhibition.

Ice and water… A man lost his way because he committed a crime against Nature: an extreme environment and a severe reality. *Alone, alone, all alone…* Such pure and bright scenery, but so scary and mortal at the same time! How could you survive in a place where only few forms of life can survive? And, if you survive, who you will be? The same person or someone else, a better version of you, capable to sharpen your senses to extreme, your desires to a shout, your feelings to new meanings in your everyday life? How a person goes beyond her/his limits to survive? Whether we survive because the severe Nature allows us to benefit from Her generosity, it is a quest of finding our own authentic being. When a drop of drinking water becomes your only need in oceans of water and ice... Are you alive? Is that you?

By combining acting and performance of different elaborations of Debussy's Prelude *Des pas sur la neige*, our performance proposes an original resolution to the dialectical conflict between Stepmother and Benign Nature: *La ginestra, o il fiore del deserto*, lives in desolate places without surrendering to the force of Nature, and resembles to an ideal man who rejects any illusions about himself and does not invoke from Heaven an impossible help.

3. Conclusion

Our research project lends itself to several applications and future developments. First, the organicity and inner coherence of the musical suite makes it spendable in concert halls and musical programs. Second, we envisage a possible impact on science and theatre education, involving young generations of students to deal with interdisciplinary according to new motivations and perspectives.

In the future, we plan to extend the project by including also the other themes of the exhibition, that is, Speleology and Astrobiology. We will develop the interaction between Man and Nature in caves and – albeit for the moment on an imaginative level – habitable planets. The one-act we are setting up is a storytelling of the history of humankind: we will come back to the first inhabitants on Earth in the caves, move through the quest and discovery of new lands in the 16th and 17th centuries – namely, expeditions to explore new continents as Antarctica, and

culminate with nowadays space exploration and questioning about origin and distribution of life in the Universe.

Audio-video recordings are available at the following link (from December 2020): https://www.youtube.com/channel/UCePz_709RK52ljDGc6LnFpw

References

[1] XTREME: Life in Extreme Environments. https://scienceinthecity2020.eu/en/2020/10/08/xtreme-life-in-extreme-environments/

[2] Schlemmer, O. (1972). *The Letters and Diaries of Oskar Schlemmer.* Tut Ed. Translation by K. Winston. Evanston, Illinois: Northwestern University Press.

[3] Dell'Àgnola, G. (1986). *Technical-Interpretative Edition to Debussy – Preludi per Pianoforte*. Translation by K. Silberblatt Wolfthal. Milano: Curci.

[4] Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-Mental State". A Practical Method for Grading the Cognitive State of Patients for the Clinician, *Journal of Psychiatric Research, 12 (3),* 189-198.

[5] https://opusmodus.com/

[6] Au, Y. H. (G.), Drexler-Lemire, C., & Shallit, J. (2017). Notes and Note Pairs in Nørgård's Infinity Series, *Journal of Mathematics and Music, 11 (1),* 1-19.

[7] Gilmer, J. (2013). On the Density of Happy Numbers, *Integers*, *13 (2),* 1-25.

Upside Down The Rabbit Hole

Generative Networked Performance

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https://www.robertspahr.com



Abstract

'Who are you?'

'I – I hardly know, sir, just at present – at least I know who I was when I got up this morning, but I think I must have been changed several times since then.'

'What do you mean by that? Explain yourself!'

'I can't explain myself, I'm afraid, sir, because I'm not myself, you see.'

- - Lewis Carroll – Alice's Adventures in Wonderland

Using the 19th century novel, *Alice's Adventures in Wonderland* (or *Alice in Wonderland* for short) as a starting point for an investigation into the isolation and disarray forced upon the world by the global pandemic, this generative networked performance will ask the question: "Who are You?"

In his book *After The Future*, Franco 'Bifo' Berardi refers to the 'the slow cancellation of the future [which] got underway in the 1970s and 1980s.' He is referring not to a direction of time, but rather a psychological perception. Berardi also suggests we are stuck between globalization and global war, between identity and capital and we seem to be incapable of producing radical change. Berardi is describing my own sense of time. Standing still, no forward movement, no progress.

The pandemic forces us to a grinding halt as the emergency break of capitalism is pulled. Stillness, uncertainty, and loss. Post-traumatic stress. Post-traumatic growth. Realignment.

These ideas are explored in relation to my own identity and memory as I use generative processes which rely on the latency of the network as well as repetition to potentially wake us up to the fact that change is happening and it is time to decide who we are.

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Key words: Identity, Memory, Post-traumatic stress and growth, Networked Performance

Main References:

[1] Lewis Carroll, "*Alice's Adventures in Wonderland*", Macmillian, U.K., 1865
[2] Franco "Bifo" Berardi, "*AND Phenomenology of the End*", Semiotext(e) / MIT Press, Cambridge, MA, 2015
[3] Franco "Bifo" Berardi, "*After the Future*", AK Press, Oakland, CA, 2011

Clouds and wind.

live performance

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Abstract

In this short film video, I try to express the vision of natural weather noisy, creating the meaning of landscape and its change. To make the movie, I documented movement atmospherically in the mountain on the high 2000 m. Next, I used some generative action by computer tools to express the new meaning of landscape. Finally, I made a video performance that illustrates my painting process action on live. The painting is creating in the context of a generative art movie made before. I put colors on canvas in an automatic movement, creating my abstract painting on the inspiration of clouds and wind I discovered in the mountain. My painting action has become a part of video performance, which generates my presented art's expression in live performance. The soundtrack of the performance is the sound of the mountain wind.

email/address
s.wojtkiewcz@pb.edu.pl Key words: art, graphic, painting, architecture, generative design,

Main References:
[1] Hartmut Bohnacker, "Generative Design", Princeton Architectural Press, New York, 2015

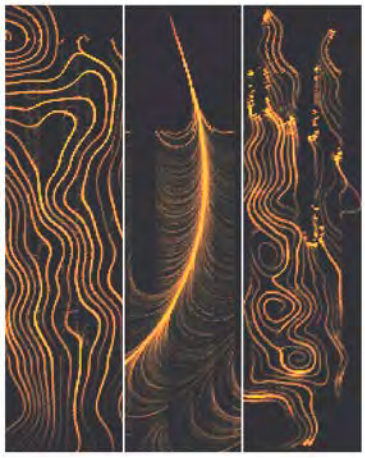


Concrete Ephemerality

(Artworks)

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Abstract
Concrete ephemerality is a project designed to capture something that was once transitory and seeks to create something concrete from it. With ever more tracking and aggregation of our digital lives, online identities that were once transient and fluid are becoming more fixed by forces outside our control. We seek to visualise what our digital identities might look like to these forces as a “fingerprint”. Concrete ephemerality is created by taking standard online identifications and merging them into a unique form.

Method
We begin with a credit card number and from that we generate a linear barcode (as seen in figure 2) which then grows across a flow field. This flow field is created with a noise seed generated from an md5 hash of one of the 10,000 most popular passwords leaked online. This noise seed is generated by summing all the values of the ASCII characters. We realise that this can result in many values in the same relative area, but this is just a first attempt at a larger possibility.



1 CE final output



2 CE final output with barcode visible

We believe that in spite of the output being beautiful, but there is ample room for improvement as this is only a beginning.
This could easily take input from many different online spaces such as social media and could become a live display of one's online persona.

Key words: art, design, identity, fingerprint, flow

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