

re-prOCeSS . iN (G) ene/R^{ate} : [From Dry-media to ‘organic complexity’]

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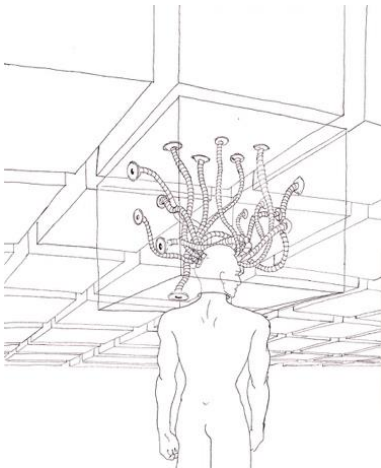
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Abstract

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 transcendental¹ 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-PROCES.S.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-prOCeS.S.iN(G) :

```
[richard.long, undo= "a line  
made by walking"];
```

This work is the first of the series, “re.prOCeS.S.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 a 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*.

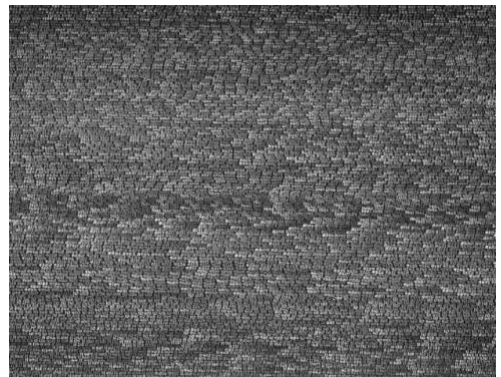


(*Img.2 Tanmay Banerjee, 2020*
`prOCeSS.iN(G):[richard.long, undo= "a
line made by walking"];)`

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

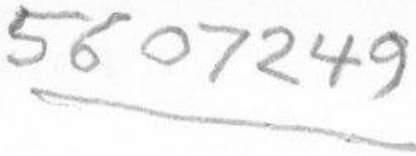
First, let us look at *Roman Opalka's* monumental lifetime's work, "1 – ∞" 1965-2011 where the artist begins his work by painting a sequence of numbers starting from 1, 2, 3, 4 and so on, using white pigment and using a "0" size paint brush. The progression of digits begins from the top left corner gradually 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.



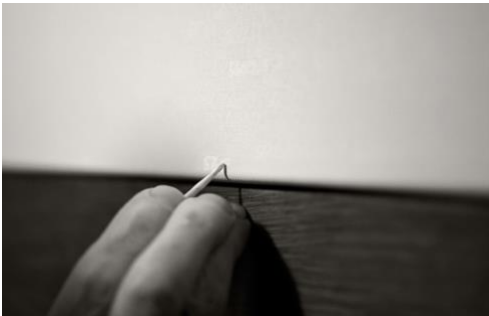
(*Img.3a – 1965-Detail 1-35327*)

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.

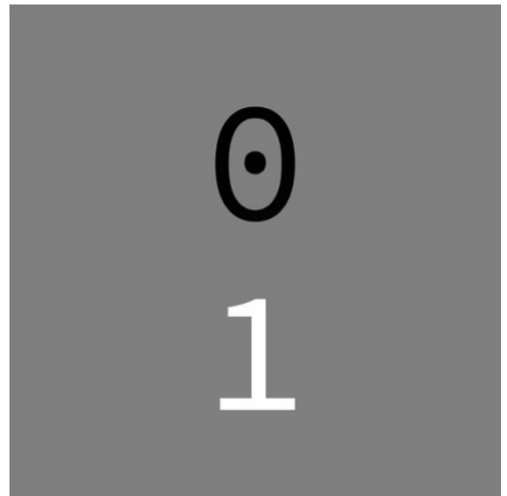
**3.1. re-
prOCesS . iN (G) ene/R^{ate} :** [roman.op

```
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 from 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*)

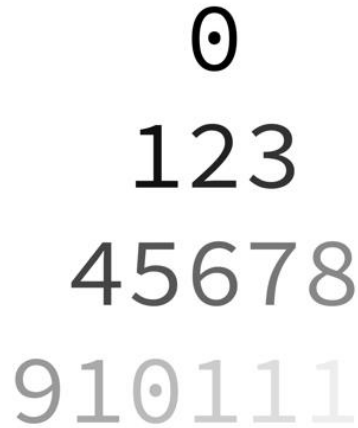
Similarly, in *Detail-02*, we have a 2bit integer = 4 colour values of grey, which means that a sequence of four digits are generated with "0" being pure black, with '1' and '2' having different grey tone values respectively and "3" being pure white. (see *Img.4b*) To generate a sequence of numbers ranging 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
```

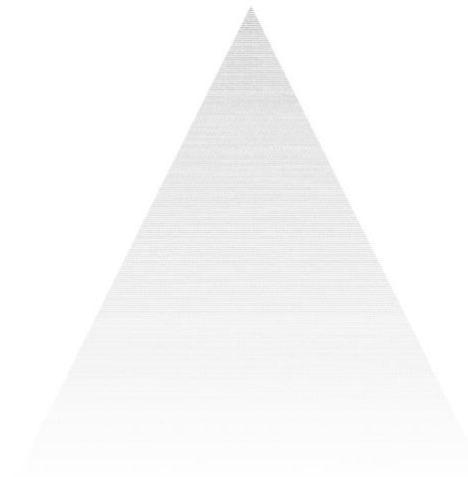
Therefore, generating a sequence of numbers from 0 to 121, provides 256 digits, each representing the 256 greyscale values. And so on in *Detail-05*, we have a 16bit integer that provide 65535 possible greyscale tonal steps from '0' (black) to '65535' (white); requiring to generating a sequence of numbers from ranging from 0 - 15328 (using the same formula above and modifying the value).


```

0
123
45678
9101112
131415161
71819202122
2324252627282
930313233343536
37383940414243444
5464748495051525354
555657585960616263646
56667686970717273747576
7778798081828384858687888
990919293949596979899100101
10210310410510610710810911011
1112113114115116117118119120

```

(*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.

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