


TITLE Intuitive Generation: Rationalizing the "Irrational"
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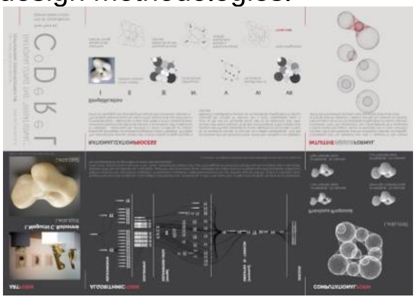
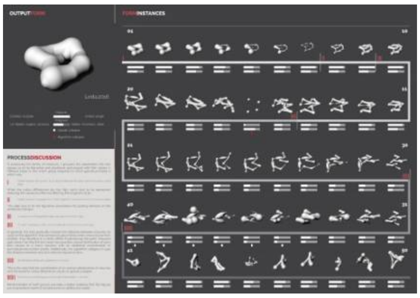
Abstract
In the early 20th century, the organic paradigm has invariably been recorded as an individualistic, subjective and intuitionist process that escapes systematic analysis and rationalization, further banishing the organic from the realm of the rational and the objective. Today, the once hermetic processes of organic form are seen to become increasingly transparent as studies in complexity and computation develop. The historical unfolding of the organic tradition increasingly yields towards rationalization and formalization, as the formalist methodologies used in computational design research ease the understanding and control of complex forms and provide for a rigorous discussion of once intuitive topics.
Against this theoretical background, the paper presents a research undertaken at a graduate experimental design studio at METU, Department of Architecture (2014, 2016), consisting in testing a possible rationalization/formalization of the so-called "irrational" organic forms in modern art by the introduction of a computational content adding to their original biological content. To this end, the studio scrutinizes artworks that are deemed to be produced in the organic paradigm through intuitive approaches, testing them in the formal medium of the mathematical, considering various aspects concerning the Gestalt principles of visual perception. Focusing specifically on Isamu Noguchi's "Leda" (1942), various conceptualizations of form logic are produced through cognitive and mathematical reverse engineering aiming to aid the understanding of formalist aspects in organic and intuitive methodologies that challenge the very formal approaches mandated by generative design methodologies.

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Keywords: organic, intuitive, formal, rational, irrational

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Intuitive Generation: Rationalizing the "Irrational"

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The paper presents a research undertaken in Spring 2016 at the *Computational Design Research Lab* (C^{o}D^{e}R^{e}L) at METU, Department of Architecture.[vi] C^{o}D^{e}R^{e}L has been established in 2005 and ever since has been aiming at developing projects that display a critical interaction between conceptual and applied/computational aspects of design research for the production of genuine architectural modes of thinking and expression. This exploration of design situations and strategies always comes with a theoretical/historical agenda, that looks for antecedents or precursors to current computational issues and forms in the early modern period.

Mechanic/Rational vs. Organic/Irrational

The theoretical/historical agenda for the Spring 2016 experiment followed after the observation that organic forms are increasingly populating the formal catalogue of contemporary architectural experimentations working in the realm of recent computational design technologies. This observation on what might be called a revival of organicism has been recast in historical continuity with the early modern organic tradition that failed to compete with the mechanic paradigm at the beginning of the 20th century. The famed conflict between Hermann Muthesius and Henri Van de Velde during the 1914 Conference in Köln as part of the first exhibition of the *Deutscher Werkbund*, known as the early modernist mechanic-organic debate, accounted for the double footing of modernism in two different conceptions of space and form, a modern bipolarization which opposed the so-called typical, rational forms of the mechanic paradigm to the so-called irrational, organic forms. We proposed to recast recent computational organicism in theoretical/historical continuity with this early modern organic tradition, in order to highlight and reassess this formal tradition that had been obscured during early modernism but resurfacing today.

The mechanic paradigm was made operative in the first decades of the 20th century with the shifting of emphasis to industrialization. Standardization would not only typify architectural production through mechanical means but would also justify the adequacy of serial production to an emerging mass-society, as well as to a formal activity which equates typical forms with the rational and the standard, and privileges them with respect to organic forms. The organic paradigm, on the other hand, presents a challenge to this modernist normativity defined by serial production and typification. Organic formal processes cannot be governed by the normative logic of standardization; they are open-ended, unpredictable and self-generative, placing emphasis on singularity, on the becoming and incompleteness of form. Organic formal processes are grounded in an intuitionism and vitalism which resist objectification and typification. Being incompatible with serial processes of industrial production, organic forms would inevitably fail the test of their serial self-reproduction, leading to the victory of the mechanic paradigm. The mechanic-organic debate invariably records this negative anchorage of the organic in modernist thinking, as a counter-modern instrument denouncing mechanic normativity and the modernist definition of the organic stands as a crisis of mastery over the formal process and product. (Mennan, 2003).

This incompatibility further extends into a basic distinction between the mechanic and the organic; while intelligibility in formal processes is invariably associated with typical, standardized forms, the organic is banished from the realm of the rational and the objective, as an individualistic, subjective, intuitionist process that escapes systematic analysis and rationalization. Colin Rowe (1994) notes that this reference of organic form to subjective license and individuality sets the elementary dialectic between the mechanic and the organic paradigms, which further translates into the rational/irrational opposition. Indeed, early organic forms overflowed intelligibility and attempts, such as D'Arcy Thompson's, at reducing the complexity of natural forms into mathematical intelligibility could not succeed because of deficiencies in computational methodologies. Mathematical tools and topologico-geometric models were still insufficient at the beginning of 20th century for the subordination of the organic to a computable and determinable behavior. Today, the hermetic processes of the organic are seen to become increasingly transparent as studies in complexity and computation develop. Organic form, which used to escape definition as intelligible structure, is becoming rationalized and objectified with an ever increasing computational content, one that is supplied by advances in computer-aided methodologies and procedures used in the development and control of form. In architecture and design, these methodologies allow for new and complex formal explorations, enabled by an increasing use of formal languages and of quantitative/computational tools. The formal catalogue of computational architectures brings forth a new expansion of the visual repertoire by the introduction of neo-organic forms as the understanding of complex systems progresses. This return of the organic now overturns its failure in the mechanic-organic debate, a failure which has also obscured its art-historical understanding. The neo-organic returns with an augmented computational essence that adds to the first biological essence of the modernist organic tradition. Indeed, the organic owes its revival to this double essence which marks the shifting interface between the hermetic and intelligible aspects of its formal processes. From early modern to recent instances, the historical unfolding of the organic increasingly yields towards rationalization by way of a growing formalization. We can then think of an anachronism in the case of early organic forms, which, prior to contemporary studies on complexity and computation and in the absence of formalization, could not withstand the modernist demands for rationalization. The once irrational organic now assumes a determinable behavior by way of an ever growing accuracy to translate form into computational languages, allowing for a rigorous discussion of once intuitive topics (Mennan, 2003).

Project Work Description

Against this theoretical background, the studio engaged in testing the possibility and limits of a rationalization (formalization) of the so-called "irrational" organic forms in modern art by the introduction of a computational content. To this end, the studio scrutinized art works that are deemed to be produced in the organic paradigm through intuitive approaches, testing them in the formal medium of the mathematical, and considering various aspects concerning the Gestalt principles of visual perception. Then focusing specifically on "Leda" (1942) [Figure 1], an artwork by Isamu Noguchi, one of the most influential sculptors of the twentieth century, various conceptualizations of the work's form logic have been produced through cognitive and mathematical reverse engineering, aiming to aid the understanding of formalist aspects in organic and intuitive methodologies that challenge the very formal approaches mandated by generative design methodologies.

Figure 1: Noguchi, Isamu (1942). *Leda.* Alabaster, 10-1/4" x 18-3/4" x 18-3/4" (26 cm x 47.6 cm x 47.6 cm). Isamu Noguchi Catalogue Raisonné. Web. Last accessed: 29 March 2016.

The conceptualization of Leda is conducted as a series of combined experiments which only focus on the form and its perception, disregarding its art-historical context. The author of the form, its materials and techniques of production have been discarded in favor of form in investigating the aforementioned rational-irrational dichotomy.

Conceptualization of Generative Models

Studio participants have been asked to 'reverse engineer' the given art form, namely to explore different possibilities through a parameterization process aiming to define a formal and customizable model for generating the original form of Leda. The defined model should not merely provide a three-dimensional digital replica of the artwork, but have a feasible number of parameters which are to be used in generating and controlling form. The intention was to design a model which outlines a 'form logic' that is 'rational' and pregnant to a series of forms, namely a family of instances. One of the output instances of this computational model was to be the three-dimensional digital representation of the original artwork.

The art form has been treated as a specimen, and scrutinized in terms of its geometry and integrity. Participants were urged to associate the given form with the Gestalt laws of visual perception (similarity, proximity, common fate, continuance, closure) that were previously exercised, as well as with the various mathematical concepts of curvature such as sine waves, logarithmic curves, hyperboles, or solid operations of translation such as bending, twisting and stretching. Hence the experiment started with questioning the nature of the object's inherent mechanism, in other words, the series of formal instructions that would lead to its generation. The answer to the question would be an interpretation of the perceived form, in a reduced, abstract, and reproducible manner that in turn invokes multiplicity and mutability. Such interpretation should be clear and well-defined, stated in a series of clear, simple unambiguous instructions that are translatable to the formal domain of computational methodologies.

It can be noted here that it is still challenging to provide for a formal definition of organic forms even in the current articulated state of the computational paradigm which is expected to allow for greater complexity and manipulation over computational models. The reason for this lies in the inherent ambiguity that arises from multiplicity in the interpretation/ perception of form. The multiplicitous character of form undermines the perception of such organic forms with complex curvature, demarcating their limits in further understanding or representation of form. Reverse engineering which would result in a full formal description of the artwork becomes a challenging venture since the internal mechanisms that lead to the creation of such forms may not be fully transparent. In a different perspective, the aim of reverse engineering is to provide for multiplicity through a customizable and mutable model; but reverse engineering is itself undermined by the unintelligibility or ambiguity arising from multiplicity in the perception of form.

Noguchi's Leda is a cryptic and not easily graspable object that presents itself as an efficient choice to test and challenge the dichotomy between formal and intuitive aspects in the creation or generation of an art form. Throughout the course of the studio, students proposed multiple and unique interpretations and computational models for Leda, among which we present and discuss here four distinct instances.

The common workflow in computational methodologies is that form is generated from zero to many dimensions. An example to this is Burak Ercan's conceptualization of Leda [Figure 2]. The model considers the closed circular shape of form as the main constitutive element. The circular frame is morphed by weight vectors at spots where section curves are used to define the outer frame of the form. The model is successful in producing variability since form generation is not constituted by equal divisions but through more complex procedures such as graph mapping in order to fit the curvature of the original art form. Accuracy is reduced when there are less cross-sections and vectors to manipulate, where increase in such factors results in a bloated model, thus deficiencies in workability. Definitions of the cross-sections and the vectors which induce the master circular frame are intuitive decisions supported by mathematical operations of curvature.

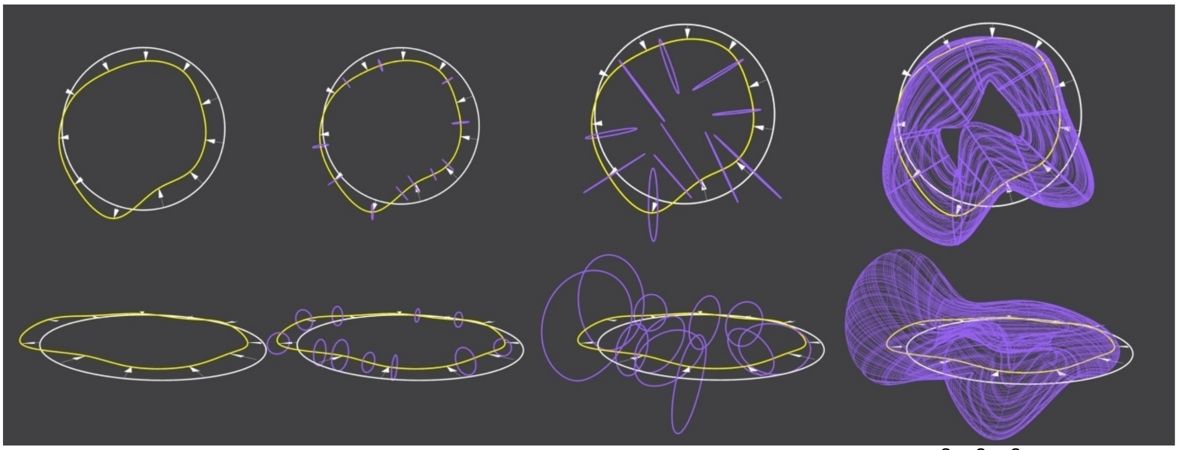

Figure 2: Ercan, Burak (2016) *Digital conceptualization of Leda*. C[o]D[e]R[e]L

Duygu Tüntaş's reading of the artwork [Figure 3] is a combination of subtractive and additive operations where additive operations provide the main mass of the form to work with and subtractive methodologies work on the provided mass to produce cavities. Both additive and subtractive methodologies use spheres in varied sizes as the atomic entity. In this sense, the model is akin to the craft of sculpting. The spheres are located intuitively correlating with the original form of Leda, while the formal mathematical operations of the model answer to changes in the model and generate form. Sphere sizes are the most prominent factor in deviating form in Tüntaş's work.

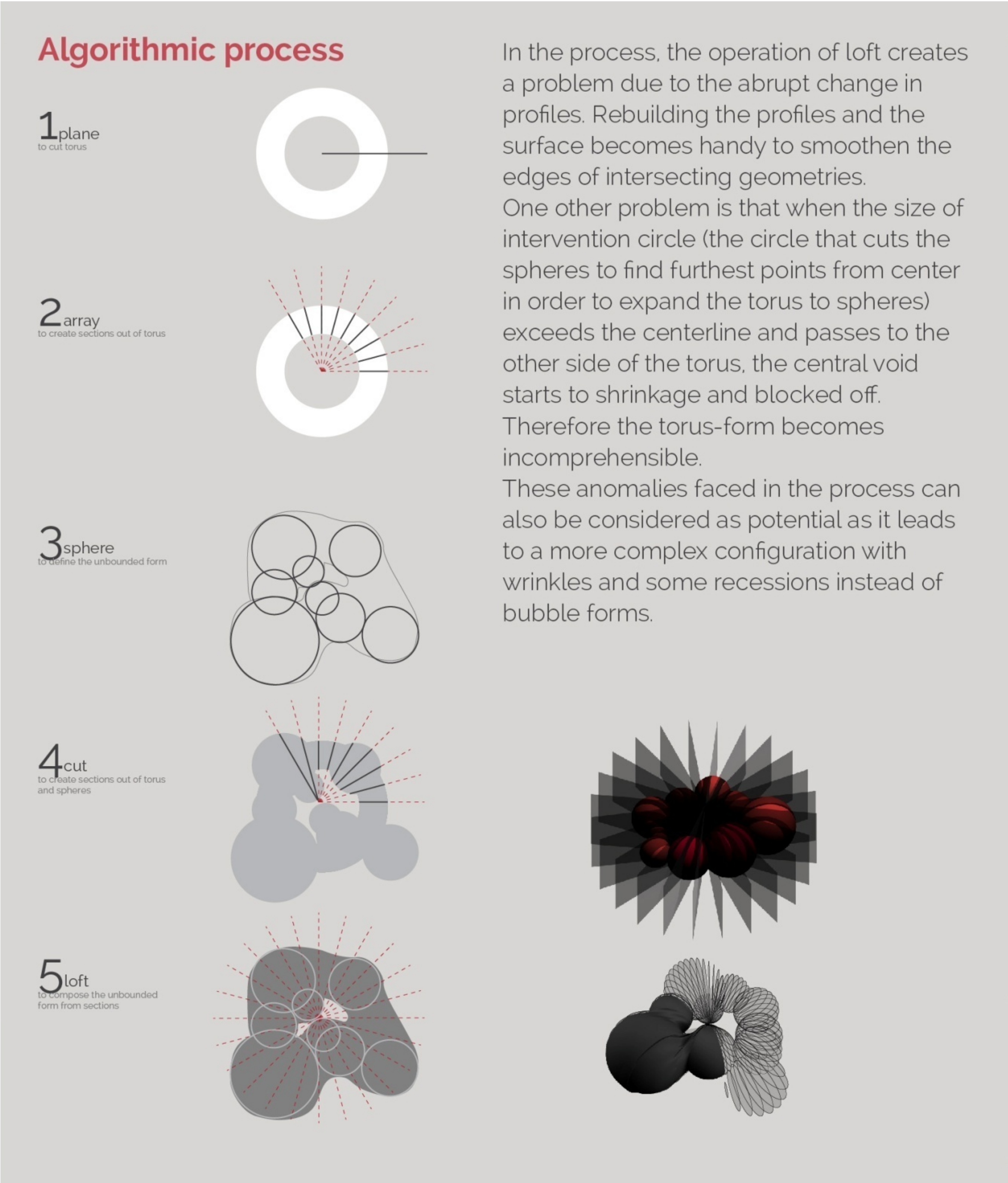

Figure 3 Tüntaş, Duygu (2014) *Digital conceptualization of Leda*. $C^{o}D^{e}R^{e}L$

Another interpretation of Leda that takes additive approaches as a primary operation uses cross-sections either to squeeze or pull [Figure 4]. Ensar Temizel's Leda is interpreted as an elastic form, shaped around a master circular frame with pull-push sections that correlate with the original Leda's complex form. The model can be considered as an amalgamation of morphing techniques seen in Ercan's proposal, and constructive operations exhibited in Tüntaş's work. Temizel's model is rather strict in generating form, namely the overall variability is reduced, but rather local differences are easier to achieve, a characteristic which is prominent in Noguchi's Leda.

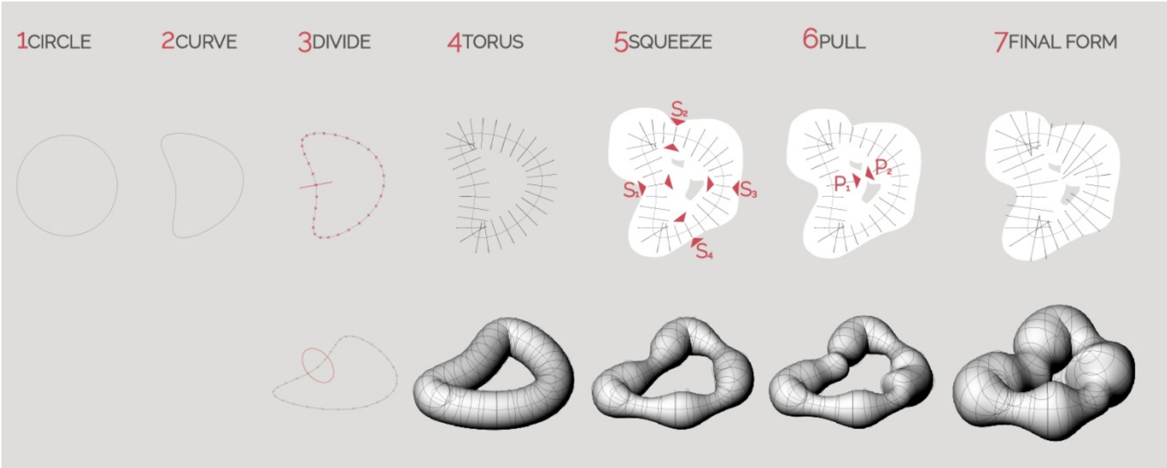

Figure 4: Temizel, Ensar (2016) *Digital conceptualization of Leda*. C^{o}D^{e}R^{e}L

Finally, Ömer Faruk Alp's Leda presents [Figure 5] a different reading about the model in terms of its relational structure. The model pursues the form logic through interrelations of its atomic parts. Similar to Tüntaş's work, spheres in varied sizes are considered as building blocks of the model and by merging their surfaces with controlled tension in the surface, form is composed between carefully connected spheres. Alp's model is successful in generating an immense variety of forms where combining parabolic surfaces between the spheres becomes the signature of the model's family of instances.

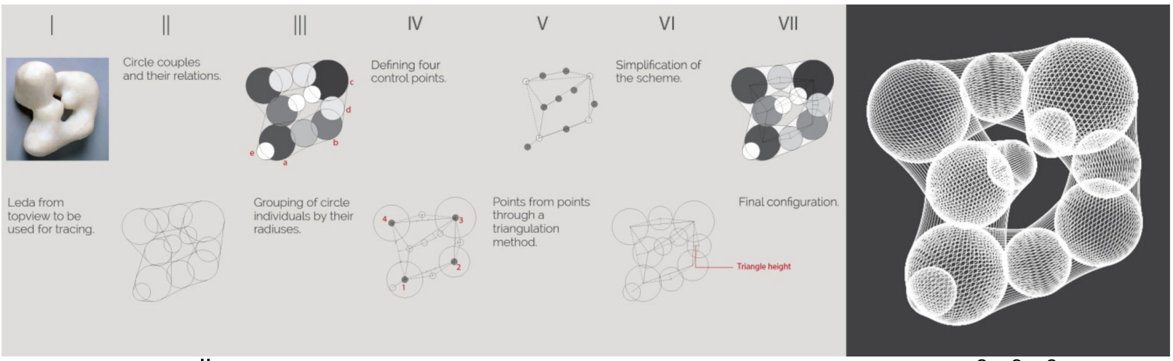

Figure 5 Alp, Ömer Faruk (2016) *Digital conceptualization of Leda*. C^{o}D^{e}R^{e}L

One of the most interesting results of this quest for rationalization is in the abuse of the resulting computational model and the mutability this brings to the domain of art and design. Each computational model has a degree of mutability which provides for variance in form. Some of the models are more variable, where some are stricter and not able to provide for multiple results. Multiplicity in generative computational methodologies is powered by generalization and abstraction, aspects which are mandated by formal procedural requirements in digital computation; these are also aspects which provide for deviation in standardized procedures. In order to achieve an abstract and generalized model reduction of information in the model, a reduction of unnecessary specificity and detail is required. The resulting model is a mutable entity that is pregnant to multiple outputs with reintroduced but configurable specificity. Indeed, reduction and abstraction provide for mutability, but without proper articulation, the resulting model may lack of accuracy in the outcomes.

In successful models created by the participants, proper tweaking of parameters in the generative model led to instantiation of accurate three-dimensional representations of Leda. The digital original Leda is merely one instance of a form logic that is pregnant to an infinite number of Leda's. The family of Leda's [Figures 6, 7, 8, and 9] are topologically the same as they are outputs of the same computational generative relational model, though perceptually they differ significantly: They are different in appearance but identical in essence. This is a distinctive advantage of generative models: The model's multiplicity, a factor which resides in the reading of the original art form as well, provides for a different reading of the original artwork.

Figure 6: Ercan, Burak (2016) *Family of Instances*. C^{o}D^{e}R^{e}L

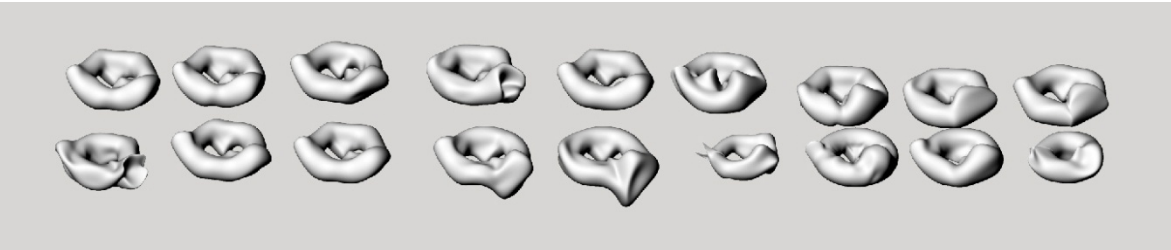

Figure 7: Tüntaş, Duygu (2014) *Family of Instances*. C^{o}D^{e}R^{e}L

Figure 8: Temizel, Ensar (2016) *Family of Instances*. $C^{o}D^{e}R^{e}L$

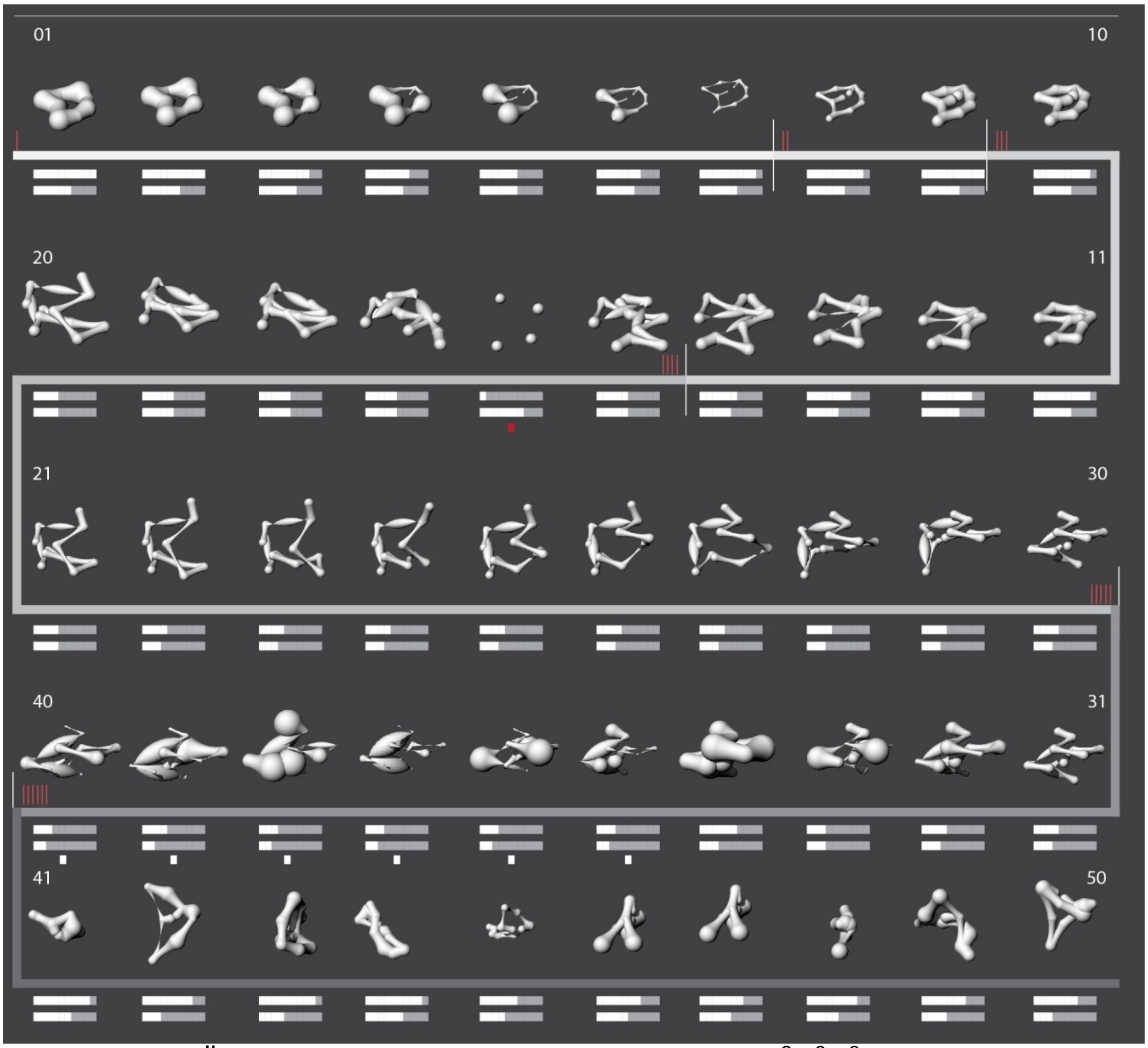

Figure 9: Alp, Ömer Faruk (2016) *Family of Instances*. $C^oD^eR^eL$

After the parameterization process has been completed, participants have been asked to analyze and reflect upon the intuitive and formal layers of their models: In other words, they were asked to make a distinction between rational and irrational aspects of their work by analyzing the form-logic inherent to the model and parameters which are used to control the generation of form. This distinction leads to an alternative definition of a genealogy for Leda which arises from a renewed interpretation. Hence, the generative model demarcates different genealogies of Leda which relies on formal descriptions, exhibiting renewed interpretations about the artwork. Furthermore, the distinction of formal and intuitive aspects of the genealogy allows for the testing of form through its genealogy defined by an infinity of instances. Hence, the model is tested to the extent where form becomes irregular, unrecognizable and disassociated from the original form.

Conclusion

The distinction between different aspects exhibited in the formation of a generative model defines a new emphasis on formal and intuitive approaches in design. Formal methodologies require clarity and unambiguous descriptions to work, hence a controlled dissemination between formal and intuitive aspects in the model. Although such dissemination may exhibit a rupture between formal and intuitive layers of the generative model, there is a new level of integration and greater control over form with renewed emphasis on the relations between rational and irrational aspects of design. What studio works present in common is that form generation is a formal procedure where control of form is rather intuitive and that parameters for controlling form are defined to answer the intuitive urges of the designer/interpreter.

The quest for rationalizing organic and so-called “irrational” art forms is seen to bring forth a multiplicity of interpretations with different form-logics and different levels of accuracy. There seems to exist a limit to formalization in every reading, one that is usually defined by the reading itself and usually correlates with the degree of accuracy in translating the actual form of the artwork. The works produced in the studio suggests that personal perspectives, or a degree of relativism, is internal even to formal procedures. Such co-existence of intuition and formalization needs to be acknowledged in order to resist an overarching formalization that might constrain the development of creative thinking.

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[1] Arch 585 Computational Design Research Lab (C^{o}D^{e}R^{e}L) : Graduate experimental design research studio at METU, Department of Architecture, Ankara, Turkey, developed in 2005 by Prof. Dr. Zeynep Mennan. Critics for Spring 2014 and 2016: Zeynep Mennan, Egemen Berker Kizilcan. Students (2016): Baran Ekinci, Burak Ercan, Burcu Köken, Ensar Temizel, Nadide Gür, Ömer Faruk Alp and Duygu Tüntaş (2014). We would like to express our gratitude and thanks to all the students who have shared this experience, enriched with their creative contributions.