



AI ORGANIC COMPLEXITY in GENERATIVE ART (Paper)

Topic: Generative Art theory, Architecture, Design

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**Abstract**

Generative Art works by creating a process. The executable process as software is the generative artwork. The aim of the process is the executive representation of a peculiar idea, as subjective creative vision defined, at abstract level, with the help of symbolic algorithms.

The results of this processes show the idea through generated multiple scenarios. These variations, all together, tell the idea in its possible and multiple facets.

This type of result is of great personal satisfaction because the designed generative process is a creative engine as a mirror of own human creative approach. It produces an endless sequence of events belonging to the infinite possibilities of performing a same idea/vision.

The generative AI engine that I designed is really very communicative because it is able to focus the idea in its potential future also. In this way, it is possible to represent the idea as an abstract concept that is independent from the various used forms.

Precisely for this reason, the generative process is able to fully communicate the identity and peculiarity of an artist, architect, designer and musician. The possibility to create and, later, recognize the imprinting of the artist is, therefore, one of the most important aspects of the Generative Art and of its results, very closed to AI singularity.

The idea is to imagine a progressive process where the starting point, the past, the pre-existing events will progressively disappear making room for possible new scenarios. This must happen because one of the characteristics of the generative process is the non-linearity.

This is essentially due to two factors: the *interpretation*, often tendentious favouring specific points of view, and the *parallel coexistence* of multiple generative processes whose transformation actions are progressively reciprocally contaminated during the processing time, like in a chaotic system (René Thom).

The algorithms that must be developed to manage this process are in the field of Artificial Intelligent systems. The great advantage of the generative approach using artificial intelligence is in abandoning the constructive-deconstructive analysis of the forms. The aim is to structure an abstract approach not based only on the inferential interpretation of the contaminations of the forms but based on the real progressive contaminations of the logics of transformation. This prefigures the essence of a generative algorithm.

Following the AI learning approach, Generative Art pursues the construction of an intelligent and creative system that represents our ideas, our creative possible actions in recognizable way.

Making an artwork that never stops to amaze you, gradually bringing into focus unprecedented aspects of your idea, is undoubtedly the ultimate in creativity. And Generative Art has this undeniable quality.

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**Key words:** generative design, Verona, Renaissance, Palladio, Baroc

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## PREMISE

After 35 years of Generative experiments, and after 21 years of exchanging ideas and discussions at Generative Art conferences, We have to accept that it's difficult to make a unique and final definition of Generative Art. ***As often happens in every approach to scientific discoveries, the generative approach to Art and Science is strongly linked to each subjective mind.*** We can only identify and trace own peculiar way to design, develop and run our subjective generative processes.

But this is not completely true. Following the reason why we are together at the XXI Generative Art conference, there are some questions that it's possible to identify as common:

- Generative **Art** is the human ability to design *generative systems*.
- Generative **Systems** are tools, software, hardware, robots and machines that manage the designed artificial DNA and produce *events*, all different but belonging to an identifiable artificial species.
- The Generated **Events**, all different and unique as natural individuals, represent the human vision that was at the basis of each *generative project*.



## INTRODUCTION

***Generative Art works by creating a process.*** The generative artwork is the executable process performed as software.

The aim of the process is the executive representation of a peculiar idea. This ***subjective creative vision is defined, at an abstract level, with the help of symbolic algorithms.***

The results of this processes show the idea through generated multiple scenarios. ***These variations, all together, tell the idea in its possible and multiple facets.***

This type of result is of great personal satisfaction because of the designed creative engine is a

mirror of own human creative approach. It produces an endless sequence of events belonging to the infinite possibilities of performing the same idea/vision.

More, the generative process, once created as software, can be activated on demand in the future and will automatically produce further variations, unprecedented and sometimes surprising events. Each scenario, in its uniqueness and unpredictability, increases the possible representation of the idea itself.

The generative AI engine, like the one that I designed, is really very communicative because it is able to focus the idea in its potential future also. In this way, ***it is possible to represent the idea as an abstract concept that is independent of the various used shapes.***

Precisely for this reason, the generative process is able to fully communicate the identity and peculiarity of an artist, architect, designer, and musician. ***The possibility to create and, later, recognize the imprinting of the artist*** is, therefore, one of the most important aspects of the Generative Art and of its results, ***very closed to AI singularity.***

Generating an artwork that never stops to amaze you, gradually bringing into focus unprecedented aspects of our idea, is undoubtedly the ultimate in creativity.

Generative Art has this undeniable quality.



## ***FROM THE PAST TO THE FUTURE***

As for all creative processes, the ***starting point*** is the pre-existing, the past, the artworks that we choose as a reference, the artworks of our masters, the natural and artificial world that surrounds us and which we are fascinated. In fact, the generative process presupposes the existence of a pre-existing in which it is possible to identify a character, a purpose to be achieved by a vision too.

***The generative process uses algorithms. They define how to transform the Past into the Future.*** It is implemented to make transformations pursuing a peculiar vision, an abstract idea that identifies the character of the results regardless of the possible formalizations. ***Generative Art doesn't repeat the existent but creates the process by interpreting the existent.*** This interpretation tries to find a possible algorithm able to manage some characters that we identified and appreciated in the reference without replicating its forms.

My passion for the Baroc of Borromini was the starting point of one of the generative experiments of mine that I loved most. Precisely because ***the interest in Borromini was not for the shapes he used but for the interpretations of the classical canons that he was able to define*** and structure as load-bearing elements to build his architectures.

Going ahead in this interpretive work of architecture was extremely fruitful. It has been said (The Guardian, Luke Dormehl, Sun 7 Aug 2016, article "Seven ways that AI could be A-OK") that ***the Italian Celestino Soddu have used evolutionary algorithms for taking a stab at what a baroque***

*cathedral would look like if it was a living thing allowed to evolve over many generations*", identifying this process as AI process.

I tried to act the same interpretative logic of Borromini referring to my contemporary age.

***In the generative process, the idea is not to foreshadow a result but its characters in progress.*** The vision is to imagine a progressive process where the starting point, the past, ***the pre-existing events will progressively disappear*** making room for possible new scenarios. This must happen also because one of the characteristics of the generative process is the non-linearity.

The generated scenarios contain in themselves the characters identified in the pre-existing but do not contain explicit citations, as identifiable shapes. The generated scenarios do not identify the starting point, which evaporates during the process ***as a catalyst*** in chemical processes, but very subjective interpretations of the past.



## ***NON LINEARITY and GENERATIVE ALGORITHMS***

The non-linearity of the generative process is essentially due to ***two factors***: the ***interpretation***, often tendentious and different from moments to moments, favoring specific contingent points of view, and the ***parallel coexistence of multiple generative processes*** whose transforming actions are progressively reciprocally contaminated during the processing time, like in a chaotic system.

The ***algorithms*** that must be developed to manage this process are in the field of Artificial Intelligent systems. They are based on an inferential data approach. In fact, the data are not analyzed, compared, systematized as happens in other processes but are managed with an act of abduction.

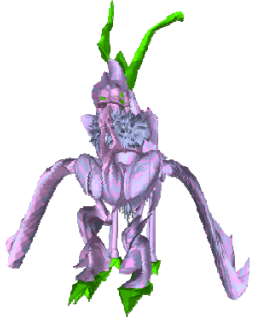
***Abduction***, quoting *Marco Somalvico*, "*is not so much an inference to the "best" explanation, but rather the generation of explanatory narratives that are driven and constrained by poetic and other conventions, even against the grain of reasoning about the real world*". Following this approach, the main reference is the concept of poetic outlined by *Enrica Colabella* for the generative processes.

The references are interpreted in the light of a particular key, in view of a specific character and quality that is appreciated in an abstract way in the pre-existent. Creating a generative process we like to propose again these qualities amplified according to a subjective contingent point of view. We rediscover these characters as recognizable in the future generated scenarios.

Forms cannot be considered meaningful data but only, following an algorithmic approach, the ***progressive geometric transformations born from subjective interpretation***.

***The great advantage of the generative approach using artificial intelligence is in abandoning the constructive-deconstructive analysis of the forms, so appreciated in the last century but that destroyed the relationship between Art and Artist.*** The aim is to structure an abstract approach not based only on the inferential interpretation of the contaminations of the forms but based on the real progressive ***contaminations of the logics of transformation***. This means to find again the important

role of the author. Rediscovering the human subjectivity of the artist prefigures the essence of a generative algorithm.



## **SINGULARITY**

The advanced idea of AI is identifiable in the progression of uniqueness, in the "singularity" that the system progressively acquires through learning. The AI system becomes more and more unique and unrepeatable because it memorizes the experiences acquired in a variable context. The system makes them its own knowledge through focused interpretive processes that are activated in the light of prefigured objectives.

There are two points that we fully find in Generative Art too: the ***progressive active memory of our learning from experience that increases the identity of a generative work*** and the ***identification of objectives*** to be achieved.

Following the contemporary AI learning approach, ***Generative Art pursues the construction of an intelligent and creative system that represents our ideas, our creative possible actions in a recognizable way.***

Unlike most AI learning systems, which prefers functional and "objective" evaluations of acquired experience, in the generative process feedback and processing of past experience does not happen automatically but occurs through the subjective and progressive interpretation of generated scenarios focused on specific characters that could be not necessarily "functional".

Subjective approach is not in contrast with the advanced AI structure but rather ***increases its progressive uniqueness.*** Operating through own critical ability to interpret the generated scenarios and to report these criticisms as an upgrade of the generative algorithms makes the generative structure more unique. Obviously, the generated events will be more recognizable as belonging to the singularity of each generative process. The author identity will be enhanced.

The increasing singularity happens if the algorithm upgrade does not only changes with another one but, adding the new one to a series of "***variation***" ***algorithms***, this upgrade better describes the many facets of the subjective vision of the author.

We are never the same when we work creatively. Yesterday we were different from today and tomorrow. This non-linearity could be represented in a generative process with multiple possible ways to reach a result.

The adopted logic in different and parallel algorithms are similar but not the same. The differences between these logics tell the progression and variation of our creative identity, together with the variations of our feeling.

Identifying each of these parallel experiences as a logic of a generative process and storing them as a possible alternative of usable algorithms is a small brick in ***the construction of an intelligent and creative system that represents us in a univocal way.***



It is **the first step towards a myth of the AI, that of the replica of ourselves.** It is the replication of our creative identity, of our way of working and pursuing a goal, of our ability (Art) to respond, even in an unpredictable way, to questions on how to transform the environment around us. In other words, it is possible to build not another complete self but at least our being architects, artists, musicians. In this way, it's possible to identify the strong relationship between the advanced AI systems and the Generative systems.



## **FORMS AND TRANSFORMATIONS**

The advanced AI Generative systems are possible starting from the consideration coming from a profound difference between working on forms (shapes) and working on transformations (algorithms).

Both forms and transformations can be mathematically represented. But while a form can be constructed through a geometric formula, the transformations are identified through algorithms. This means that the input is any form and the output are the transformed forms. The output acquires a further value, a peculiar character that represents one of the facets of the meaning of the generative idea.

This difference has an undeniable advantage for the generative processes. **The forms cannot be stratified but the transformations are.** In fact, the forms cannot be added together, they cannot be used in parallel even if they have parametric characters. Once a shape has been chosen, we can also vary it, also randomly, but it remains always a form, even if it is unusual and fascinating. It cannot be a moment of a generative process but only a final static outcome. We can only accept it or replace it. To move forward we need to move to transform acts.

Everything is different for the transformations, and for the algorithms that represent them. We can use one first transformation with a specific objective, insert in the process a second transformation that increases the second character, and so on. **Identities can be multiple** and stratified. More, the contamination of parallel generative processes has, in the generated scenarios, **the simultaneous presence of the characters identified and organized in the algorithms that run in the process**



**linear.**

## **COMPLEXITY, CHAOTIC SYSTEMS, AND RANDOM**

The result of this stratification of different transformation processes has an essential value: complexity. (referring to *Ilya Prigogine*).

The verification is immediate: it is impossible, if it is a real generative process, to manage the reverse process, from the results to the pre-existing event, or even to the structure of the process. The reason is that **the process is structurally non-**

More, this complexity, storing together different and, maybe, contradictory characters, fits the needs of possible different users (infinite meaning of Friedrich Nietzsche). Each people could find one of the multiple results as “own” result, finding the answer to his subjective need.

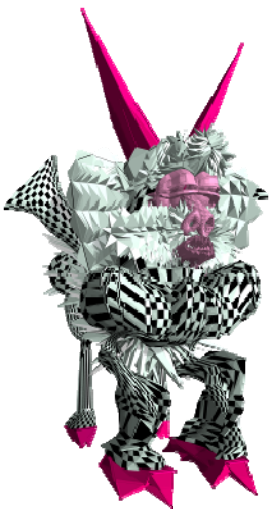
The complexity that is produced through a generative ***process is not reversible*** either because the process was neither analytical nor technological, but based on subjective interpretations, often different from moment to moment.

Moreover, this is also due to the multiplicity of progressive contaminations between parallel processes that, very often, are unpredictable because they are due to the contingency and the uniqueness of the implemented temporal path. ***The system could be called chaotic*** and, following the concept of *René Thom*, some ***singular points of the process could be called catastrophes***. The sudden change of point of view changes the meaning too: the consolidate references and shapes disappear for ***giving space to unexpected events***.

Each generative process is unique because it is susceptible to the contingency of the moment in which it is implemented, as well as any interpretation performed at different times is different even if conceived by the same subject.

The use of contingent parameters related to the time of triggering the process, as I am used to doing in my experiments, is strongly different from the ***use of random*** in the generation of forms. First of all because on one side there are the forms and on the other the transformations. ***Randomness is applied not only to the geometric construction of forms but to simulate the unpredictable temporal contingency of the starting time or of crossing transformation processes. The progressive dynamic of transformations have nothing casual, it's only chaotic.***

This unpredictable contingency translates, in my generative processes, into the possibility of opting for parallel generative paths already identified and organized. This does not detract from the peculiarity of the idea and the characters sought. On the other side, ***the randomness of the forms leads to the homologation, making poorer the creative process because the author identity will disappear.***



## **ORGANIC HARMONY**

Generative experiments and their results show an organic structure. My opinion is that the generated architectures, but also the artworks, design events, and the generated music are organic in the sense that can be attributed to the word organic in reference to Nature. The intrinsic attribute of this organic character is the harmony.

***The progressive harmony of the generated structures is, in fact, the backbone of the generative process.*** The same harmony that we appreciate in the Renaissance, where the mathematical control was fully used for proportions and relationships between parts.

It does not matter what is the event to be generated: a chair, an architecture, a portrait, a ship, a city and so on. The forms belonging to the reference event are not important. What is really important is ***to gain the harmony that pervades our references and to interpret it mathematically*** in

our generative algorithms.

An optimized solution doesn't exist in the structure of generative algorithms. Optimization is out of generative thinking, it's static. What we need to evaluate is how we can generate events that have, in their plurality and diversity, the harmony that we are looking for.

The fundamental aspect of the generative software is to represent a particular idea of organic harmony whatever the occasion: a cathedral, a chair, a portrait of a woman, a palace, a U.F.O., a lamp, a tower, a jewel and so on. My generative software generates a plurality of different events with the same processes of progressive transformation where the idea is a vision of an **organic system** and the contingent input is identified and managed by a topological paradigm.

### **INCIPIT and TOPOLOGY**

What is the incipit of the process that leads to these results, different also in the theme and in the generated forms but identifiable in a creative vision?

Surely the basic event to fit the different occasions is **a topological idea of the relationships between the parts** that can identify an architecture or any other object. All my generative works have a topological structure, which I call **paradigm**, referring to *Thomas Kuhn*. This paradigm works by organizing the progressive structure of transformations.

Every object, a lamp, a chair, a woman 3d portrait, and so on, have peculiar topological paradigms but the generative process uses the same generative algorithms.

Giving a particular attention to architectural events, it would seem natural that a cathedral, a tower, a garden, a palace have different topological paradigms. And this is partly true. But the topological structure of an architectural space is based on the external-internal path that we could also identify as a progressive public-private path and on the relationship between central and service spaces. **The possible paradigms that identify these relationships are quite similar. The difference consists of the characters that we associate with these basic relationships.**

In my architectural work, following the critical approach by *Wittkower*, all architectural paradigms derive from a **father-paradigm that arises from my interpretation of Palladio**, or rather from his Villa Rotonda.

After that, there is a **second level paradigm** fitting the architectural structure. It has as its reference the number 27 pointed by *Francesco Borromini* in his book "Opus Architectonicum" as the number at the base of architecture.

The first paradigm organizes the relationship between public and private, between large spaces and accessory spaces, between central space and service spaces, as it was clearly used in all Palladian villas and in many "organic" architectures.

The second paradigm defines how the generated event will be an architecture and it will follow all





the architectural structure, technical and peculiar functions. This secondary topological paradigm, in its variations of the 27 and 21, comes from ***an unexplained statement by Francesco Borromini that I interpreted as the relationship between the 27 elements that make up an architectural unit:*** the interior space, the floor, the roof, four beams, four capitals, four pillars, four walls, four pillar bases, four floor edge beams. In total 27. Following the architecture of S. Ivo alla Sapienza, if we act within a triangular grid, I supposed that this paradigm could be transformed into 21. The transformation between the two paradigms takes place, when necessary, even within the generative process through a special algorithm that I designed for fitting this possibility.

***They are abstract paradigms that define nothing more than a structure of relations between events that are not yet formalized.*** They do not even define the overall geometric structure because the ***same topological relationships can be transformed into different geometrical events.*** Instead, they define the structure of the generative progressions and the fields of possible interactions and interfaces.

The topological Palladian-paradigm together with the architectural Borrominian-paradigm obviously work in progressive stratifications and have been used in almost all my architectural generations. The peculiarity of every single generation, and the possibility to reach different architectural events, even in their possible use, is given by ***the progressive transformations of this basic structure into geometry events during the generative process.***

For other generated objects the topological paradigm is, obviously, different. Since topological and non-formal paradigms can be easily used to manage the relations between the parties but do not give problems in progressive formalizations because they do not contain forms but topological and harmonic relationships only.



## **LATEST GENERATIVE EXPERIMENTS**

This year the references were to the Peruvian architectural and design tradition, with the occasion of my exhibition in Lima last summer, to the classical and Palladian architecture of Verona, coming here for the 21st GA, to the medieval representations of fantastic animals, designing a species of artificial animals to fit the atmosphere of the Museum of Natural History of Verona that hosts us and, in the meantime, I used the same references not only for architecture but also for the generation of a “new” species of chairs, jewels, rings, necklaces, brooches, bags that I generated and directly made with the 3D printer.

Different occasions but one purpose, my idea of harmonious organic events.

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