

ARGENIA, ARTIFICIAL DNA AND VISIONARY VARIATIONS

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Abstract

Argenia is a Generative System activating a process that is analogous to a genetic code and that forms the basis of artificial worlds. It is a design activity, whose aim is not only to obtain a single result. It is an executable code that is capable of producing infinite variations during its evolutionary process. This is an inspiring experience. We can reread the meta-design approach of the sixties as a concrete realization of three-dimensional models, belonging to a species.

Key words: Generative, DNA, Architecture, Transformation, Variations.

1. Argenia, aims and structure

The aim of Argenia is going over the design of single results. Its challenge is designing cities, architectures, and industrial objects as artificial species with a strong identity belonging cultural identity and designer imprinting. The structure of Argenia essentially consists of a system with two different components: a system of codes of transformation that define the artificial DNA of the species and an organizational paradigm for the evolutionary dynamics that fit the constraints and needs of a specific project. Both elements are absolutely essential for realizing an idea as a generative motor.

2. The codes of transformation

The code system can be compared to the natural structure of DNA. The whole structure of rules is a matrix device that defines how to evolve a system towards complexity tracing and identifying a specific design behavior. With Argenia I have deepened and developed my interpretation of the Renaissance masters mirroring, with these rules, my concept of the beauty of Nature. They perform a poetic structure representing my subjective fascination for some particular natural structures, whose harmony is translated into rule systems.

Following the synergy between the artistic and scientific approach, I experimented the evolutionary logics of complex systems, looking for fragments of our code of harmony fathoming the Possible, seeking for our idea of beauty. The system's non-linearity, and its realization of unpredicted exceptions, represents an unexpected synergy among non-connected parts of our aesthetical research.

In searching for codes of harmony, I have experimented with geometric, perspective and mathematical codes. In particular, I have made transformations by using imaginary numbers, what has enabled me to identify the role of events within a complex system. In comparison to parallel events, this system could be

transformed and evolved along one "preferential path", which, through possible variations of the subsystems and of the details that represent it, implies a logic of paradigmatic control over the whole and its identity. I have also used multidimensional cellular automata for writing rules that define the topological structure of generated architectural scenarios.

In order to build individual events, this artificial DNA needed an evolutionary system, an artificial life, which allowed it to develop and achieve the levels of complexity proper of our time. The goal was the figuration of complex events, such as cities, buildings, industrial objects. It was not enough to produce beautiful and fascinating forms that allude to the natural complexity of possible environments, as for instance fractal or numerical wholes, represented by Bezier curves. My challenge was to produce artificial individuals that were "recognizable" within the complexity of the existing events: historical cities such as the Italian medieval cities, New York whose identity is also recognizable in the most marginal areas, Chicago with its ability to represent the history of the architecture of the twentieth century, Hong Kong with its unrepeatable mixture of west/east styles, and so on. I have begun my experimentation in 1986 designing the codes of Italian medieval towns.

3. The evolutionary paradigm

In order to reach the figuration of complex events and create their organizational paradigms, I needed to systematize the structure of the architectural space, as Renaissance architects have done. Therefore, I built a system in which relationships among architectural events are nested inside each other. This system formed a basis for the evolutionary structure and its exceptions. (Exceptions are important because they could overturn deeply the same structure during the evolutionary path.)

The system is made up of event-spaces with, all around, 26 synapses, which manage the interface with possible topologically

near events. The whole system is therefore based on the number 27. Every direct relationship between two spaces can maximally activate 9 complex interfaces. Every spatial event therefore has one to nine parallel possibilities for structuring a relationship with the topologically near event.

Every interface, to operate its own evolution-transformation, is characterized by a series of parallel systems which are usable together and which can be reciprocally contaminated. Each of these systems responds to specific characters that the event will have to explain and show. Each one has a different geometrical-topological structure representing its peculiarity. For instance, one of the evolutionary contaminations that has been used in some architectural generative projects works with three parallel geometric systems. The first one is based on the number nine (9x9x9 references linked with specific relationships, such as the golden section), the second on the progressive division of axis and diagonals, and the third one replaces the Cartesian coordinates by the polar ones building an order of preferential relationships with centre. The contaminations and the interferences between these three parallel systems simultaneously generate complexity and harmony.

The system, in addition, provides some foldings that can alter the structure of topology making to coincide in a single event the interface produced by synapses, which are, before folding the system, distant one from the other. In this entire transforming path, time enters as a conclusive factor of the possible bifurcations of the evolutionary structure as it is the only unpredictable element. Every possible start-up of generative paths is conditioned from the temporal moment of its beginning, that is obviously always different. And the folding of the system, with the respective acceleration or induced decelerations, manages the unpredictability of the results.

This approach makes it impossible to repeat the same generation. This uniqueness is due to the temporality of the generative process that was started up, and it can only be overcome by producing clones through manipulating and resetting the clock, which is, of course, antithetical to the aim of the generative approach.

Once the architectural spatial net is systematized, I have built, referring to every single design occurrence, the logical plot to check the evolutionary dynamics of the system in order to fit the client's needs. In other words, if the generative project has to realize a multifunctional skyscraper in Los Angeles or, for instance, a chair, it is necessary for the codes of harmony to work in such a way, as to reach this goal.

This part of the generative project is obviously built ad hoc for every single project. Therefore, schematically, we do not have a homologating technology.

4. Philosophy and technology

The generative projects are not tools for producing any possible result. They can't be used by all creative people. The generative projects need a subjective approach that can answer the specific needs of the client, in line with the humanistic tradition. It is

possible, instead, to define a *modus operandi* and to make it executable through rules, as I have experimented in didactics. But this needs a further examination.

The question is: can generative design be considered as a technology? Is it possible to think of a generative system as something that can be used, by every architect, such as CAD? According to my own experimentations, the answer must obviously be 'no'. A low level of generative systems can produce an endless set of random forms (emergent forms) leaving to the architect the opportunity to choose among them. First consideration: choosing is the job of clients; architects have to transform the existing world into the possible, pushing the existing environment toward his idea of the future, of the beautiful, of the useful, of the harmonic.

Second: it is necessary to consider the complexity of contemporary artificial objects. Producing a Bezier's curve that varies in a random way is, without a doubt, an interesting experience. But designing is transforming, building codes that realize complex forms, transcribing one's own visionary idea into rules. The random is not enough.

Then what is generative design? It is an idea that becomes a final product, an idea that is able to produce endless results among which the client can choose. Final results must not only be formal results but they must be direct figurations of realizable events. Argentinia is therefore built as an artificial DNA, as a code of harmony, and as an organizational paradigm that dynamically checks the specificity of the design occasion. The whole system is determined by the performance of rules of transformation as *modus operandi*, and by rules that control the relationships, interferences, contaminations and resonances that unexpectedly appear in the activated evolutionary dynamics. There is no trace of a database. When we study Leonardo's codes we learn to approach design using ideas as a lot of parallel experimental hypothesis. Each one of these hypotheses defines a *modus operandi* and not only an assemblage of components. As always happens in scientific approach when aim is innovation.

This is similar to nature. Unpredictability is not tied up to random forms but to the artificial life that the system will come across. The more this artificial life is complex and unpredictable, following different temporal evolutions, the more it is able to stimulate strong answers from the harmonic code matrices. These strong answers will increase the identity, clarity and recognizability of the idea as endless waves of the sea.

5. Generative design approach, conclusion

The creative act has changed. Not only because of the use of new digital tools, but because their availability introduces a new philosophy. Design changes from forming to transforming. And this is a step towards the representation of the idea at a more open and involving level. As musical variations departing from a common theme, every form interprets, in the manifold of possible parallel results, a *modus transformandi*, an idea.

Today, in fact, we have technological tools to pass from the old-industrial production of cloned objects, to the production of

unique objects. This is a new revolution. With equal costs the digital era can produce unique and unrepeatable objects that emulate Nature and the hand of the craftsman. The unique object becomes a new answer to contemporary cultural needs that have been underrated for a long time. It leads to a world in which each environment, architecture or artificial object mirrors the aura of uniqueness and unrepeatability of every person. In this epoch, in which the identity of natural beings is repeatedly attacked through cloning, the generative design approach to artificial worlds realizes an opposite trend. With this approach man can experience again, through the use of artificial intelligence, artificial life systems, and advanced technologies, the aesthetical and ethical pleasure in nature.

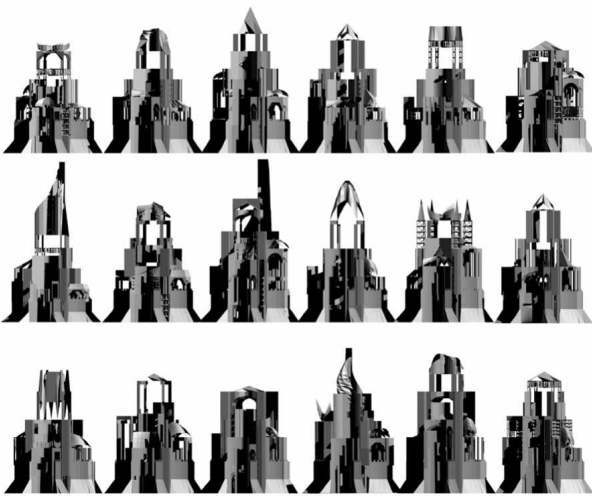


Figure 1: Sequence of generated contemporary/medieval castles. An architectural concept designed as artificial DNA.



Figure 2. New York DNA. Four city blocks entirely generated by Argenia using an Identity Code designed for fitting the idea of New York.



Figure 3. Two variations of the same Generative project: a skyscraper on the Nagoya downtown. The two variations are like twin brothers. Each one is unique but both are belonging to the same species.



Figure 4. Milan, the Museum of Futurism. Three unique and unrepeatable variations with the same constrains and functional structure, as happens in nature.

References

1. Soddu, C. Citta' Aleatorie, (random cities), Masson Publisher, Milan 1989
2. Soddu, C. Colabella, E., Il progetto ambientale di morfogenesi", (the environmental design of morphogenesis), Progetto Leonardo Publisher, Bologna 1992
3. Soddu, C. Recognizability of the idea: the evolutionary process of Argenia, in P. Bentley & D. Corne (edited by), Creative Evolutionary Systems, Morgan Kaufmann Publisher, San Francisco US, 2001
4. Soddu, C. New Naturality: a Generative approach to Art and Design, Leonardo Magazine 35, MIT press, July 2002
5. Soddu, C., Generative Design Visionary Variations, Communication&Cognition number 3-4, volume 36 p.157-186, Belgium 2003
6. Soddu, C. GA Conference Proceedings, GenLab, Milano 1998, 1999, 2000, 2001, 2002, 2003. <http://www.generative-art.com>
7. <http://www.generativedesign.com>
8. <http://www.celestinosoddu.com>