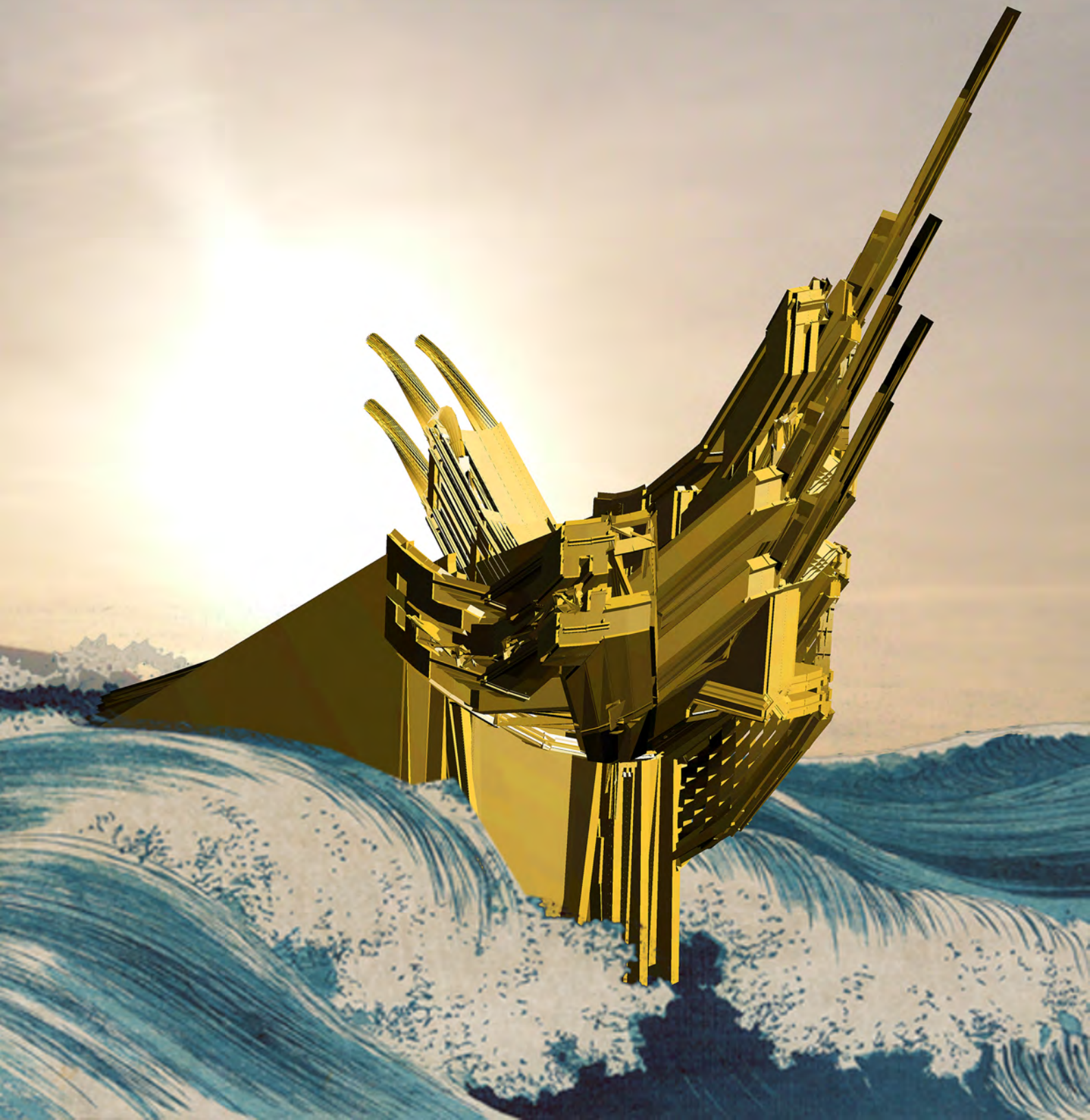


Celestino Soddu GENERATIVE ART



Generative Art

Celestino Soddu

Papers 1998-2015

Papers presented by Celestino Soddu
in the first 18 years of Generative Art international conference
1998-2015

www.generativedesign.com
www.generativeart.com

Domus Argenia publisher
ISBN 978-88-96610-29-9

INDEX

PREFACE

The Disappeared Digital Era

1. Argenia, a Natural Generative Design

GA1998

Introduction

The design of artificial species

Next step was the generative tool "Basilica"

Argenia, and the generative industrial design

Argenia, the generative art

Note 1 "Citta' Aleatorie"

Note 2 To manage the complexity

Note 3 The logical structure of "BASILICA"

Note 4 Case Study: Rome, Borghetto Flaminio, 1994

Note 5 Prado Museum, the evolution of the micro-urban system, 1995

Note 6 Argenia and industrial production

Note 7 Chairs generative design

2. Recognizability of designer imprinting in Generative artwork

Introduction

GA1999

The Generative Design

The project

- The construction, by the architect, of his own world of interpreted references
- The identification of attainable objectives.
- The transformation of the objectives
- The representation of the design idea as an evolutionary
- The management of the construction in progress of the project through an evolutionary
- The feedback between the client and the project.
- The feedback between end-user and designer
- Argenia. The Generative projects
- The first experimentations and realizations of Argenia
- The structure of Argenia
- The recognizability of the idea and the identity of the designer
- The idea as the product exists only if the idea is a recognizable code.
- Recognizability comes from subjectivity
- Subjectivity means not simplification (objective) but complexity.
- Argenia is a direct approach to complexity

3. From Forming to Transforming

GA2000

The ancient codes of harmony
The project. Identification of the codes of harmony.(Patheon)
Construction and use of a Generative Project (Borromini)
To operate with Generative Codes.

4. Generative Natural Flux

GA2001
Preface
Generative Creativeness
Designer/User, the random factor
The Generative Design, objective, subjective and adaptive aspects
Generative design experiences

5. “La Citta’ Ideale” Generative Codes Design Identity

GA2002
Abstract
Ideal Cities
How to look at future
Identity
Clarity and Safety, the Livability
Naturality
Complexity (Piranesi)
Case Study, Italian medieval Town Identity, Rome, Borghetto Flaminio and Hong Kong
Codes of Harmony
Structure and use of Generative City Projects

6. Visionary Aesthetics and Architecture Variations

Abstract
GA2003
History and Nature
Uniqueness. Generation versus Cloning
Complexity, Artificial Life, and Cellular Automata
Figuration and Idea
Generative Codes and Visionary Variations
Visionary Variations
The Visionary approach
Conclusion. Generative Art: technology or philosophy?

7. Meta-Code, Identity’s Borders. Visionary Variations of Milano. Generative Projects Designing the Identity of Milano

GA2004
Abstract
Generative Design, the concept
Generative Visionary Variations for Milan Identity. Designing the Code
The Visionary Variations of Milano Identity. Generating Architectures

The Generative Projects in Milano

8. Gencities and Visionary Worlds

GA2005

Abstract

Forms, identity, recognizability, and morphogenesis

The passage from a dimension to another.

- Perspective - 1*1. Perspective with only one point of view and only one direction of the look
- Perspective - 1*N. Cylindrical and spherical total perspective
- Perspective - N*1. Reverse perspective by Florenskji.

Construction of generative morphogenetical processes: subjectivity and variations.

Generation versus Cloning.

The generative city and the visionary worlds

9. Generative Design. A swimmer in a natural sea frame

GA2006

Abstract

Morphogenetic Meta-Project versus Project

Process versus Output

Idea versus Solution

Synthesis versus Simplification - Interpretation versus Analysis

Subjectivity versus Objectivity - Imitation versus Copy

Variations versus Optimization

Identification versus Homologation

Recognizable versus Anonymous

Generation versus Cloning

Unpredictability versus Repetition

Random of requests versus Random of outputs

Teaching How versus Teaching What

Teaching structure. A subjectively oriented design approaches for teaching design. -

Transforming versus Forming

Layering versus Permutation

Philosophy versus technology

Rules versus Forms – Organizing versus Choosing

Impervious versus Flat - Occasion versus Obstacle

Organic versus Minimalist

The design approach is focused on transforming and not on forming

Master Thesis

10. Endless interpretations, infinite in the mirror

GA2007

Abstract

Premise

The starting point

Transformations

Identification of aims and objectives

The impact with peculiar town environment and its local cultural Identity

11. Alive Codeness

GA2008

Abstract

Designing own vision with generative approach

How a Vision can be transferred into a design rule

New, Beautiful, and poetics

Argenia, from Forms to Transforming Rules

Generative Art is a Philosophy

Complexity and Quality

Generative approach and Cities Identity

Vision generates Variations

Questions regarding the structure of Argenia, my generative software:

Methodology

Topology and Character

Identity

Complexity

12. 20 years ARGENTIA evolution

GA2009

Abstract

Premise

My first experimentations: generative engines from moving through different dimensions

First Basilica, toward the complexity

Progressive paradigmatic development

Variations, Design and Generative Art

Artificial DNA. Recognizable City Identity

How to gain multi-subjectivity from singular subjectivity?

13. Curved spacetime perspective as the generative engine. Intersubjectivity & Contrapunctus

GA2010

Premise

Abstract

Software as optimized tool versus intersubjective software

Harmony and Intersubjective Vision

Paradigm, Harmony and Transforming rules

Argenia

References

14. Generative Baroque Algorithms

GA2011

Premise. Why Francesco Borromini and Baroc

Abstract

Basic Structure of architectural events. The paradigm “27” and the paradigm “21”

Progressive logics of transformation

Progressive logics of transformation of the local events

References

15. Logics of Imagination

Generative Art performs a Style as Executable Process

GA2012

Premise. Logics of imagination, some considerations

Some consideration about “new”

First part. Generative Art and logics of imagination

Second part. Identity Codes

Third part. Some considerations about subjectivity, casualness, variations, and complexity

Variations and Complexity

References

16. MUSICABLU

Generative Music Design software for increasing human creativity and generating unique and not repeatable musical scores

GA2013

Premise

The structure of MusicaBlu

The Melody

The Melody generative device #1 - Numerical sequences

The Melody generative device #2 - Dynamic structured passages

The Melody generative device #3 - Imaginary structured references

The Melody generative device #4 - Riff generation and progressive transformations

The harmony

The Rhythm

The evolution of Complexity, The counterpoint, and the interactivity among parallel generations

References

17. Generative Art Geometry.

Logical interpretations for Generative Algorithms.

GA2014

Abstract

The generative geometry

Generative Geometric figures

Generative Perspective Geometry

References

18. Futuring Past and Generative Design

GA2015

Introduction

Generation and Genetic Evolution

Beauty and Harmony in Futuring Past

Equilibrium and disequilibrium

Identification and construction of Generative Codes

Futuring Past projects

References

Preface

The disappeared digital era: when creating art was using one's own personal software

To me,
Happiness is traveling,
Not really "me" traveling,
But my Heartsongs traveling.
Mattie J.T. Stepanek, 2003

Introduction

In 1998 I founded Generative Art together with Enrica Colabella, and we organize, each year, the Generative Art conference, featuring exhibitions and live performances. This was a wonderful occasion to meet a lot of people working with a digital approach to creativity in Art, Architecture, Design, Music, and other fields, and establishing the main online archive of Generative Art.

But very few artists presented artworks made using original computer programs that they designed entirely themselves to focus their own subjectivity. Most of these artists belong to the same generation, that's also mine, that was able to use computers in the late Sixties and Seventies when commercial software was not available. Like me, these creative people started to use computers creatively, and in my opinion, we had, and we have, a common ability to wonder like children.

The Sixties and Seventies, common experiences

The artists of the first digital era and I too developed our research and creative activity in the same period, living through the same international cultural moments and the rapid generation of new technologies with a creative approach. As Plutarch said in his "Parallel Lives", the main interest in considering our lives as parallel is to easily focus what is peculiar and different about each of our identities. My purpose is not only to discover what we have in common but, especially, to find our differences, starting from our different fields of interest: music and visual art for the most of the visionaries of the first computer creative use and 3D space for me. But there were different approaches to technologies, differences in using random, and finally different characters of the final results: abstract toward abstract and abstract toward figurative.

In the seventies, incoming personal-computer technologies opened the possibility to create one's own procedural logics able to be performed by machines. These new tools could unite the approaches to Art and to Science, using technology together with hand-made artworks, to discover the aesthetic pleasure of creatively investigating new possibilities.

These artists were visionaries in different ways. My opinion is that all these precursors had a common love of working without a specific result in mind, and instead with an open attitude to discovering unpredictable possibilities. We shared a common background in our experience with free jazz music and an interest in science and new technologies. We asked the impossible of these new technologies and did not simply want to follow them. The possibility to write a code, to make it executable, and to perform it with a machine opened a door toward infinity, by discovering ourselves, our potential, and our visions.

Many people preferred to develop two-dimensional representations. With their programs, able to produce and manage images and their pixels, they tried to represent the iteration and the variation of human thought. My passion was three-dimensional complex space and its transformations.

Differences in our fields and approaches

These approach to art had a wide range. Firstly, someone experimented the relationship between emergent technologies and aesthetic representation. Following that, some artists experimented the structure of combinations. This last one could be considered a construction of what I have always called Generative Art, but it is generative only for some marginal aspects, mainly for the infinite variations of the possible results.

After many common experiences made at the beginning of the seventies, by playing with lights and videotapes and experimenting new devices, like pen plotters, we all arrived to construct own software for generating artworks, particularly in my experience for generating 3D scenarios drawn with pen plotters.

We all began creatively writing algorithms for computers in the seventies and using pen plotters as support for creative drawings. Each of us was a precursor in his own peculiar field because each of us advanced into unexplored fields before. Our uniqueness and differences lie in our individual subjective approaches and to the primary element that we used to develop own creative work.

Different primary elements define our fields

For many people, the primary element has been the pixel, the representation through a bit-map. Or the oscillation of sound, as a primary element of the music. My primary element has been the three-dimensional minimal element, the triangle, considered the base structure on which one can dynamically work on spatial transformations. Other artists worked mainly on other primary elements such as words to discover new potentialities in visual poetry.

In the seventies and eighties, these fields had considerable potential to expand into unusual forms in the newly digital civilization: visual art (painting, graphic design, movies), spatial art (sculpture, architecture, design) and music. All of us usually expanded our work to other fields to express our need to discover and discuss.

In our parallel experiences, we followed two different passions: the passion for complexity, and the passion for technology. I, therefore, explored deeply in the field of 3D space, designing algorithms that stratified logical thoughts over precedents and generatively interacting with them. I was not necessarily looking for the ultimate technology, but only to improve processing time in my work that, in the beginning, ran too long owing to the complexity of algorithms. And like me other artists in their peculiar field. Many other, in contrast, had a passion for emerging technological possibilities, by discovering previously unknown and unusual possibilities for direct relationships with technology, and looking for the aesthetic results. This was the purpose of their installations, as they often changed and upgraded the technologies they used and their methods of discovery.

An aim of some people, like me, was to keep own identity alive while developing some peculiar characters in own research. Some others tried to build unpredictable aesthetic results as a representation of the incoming complexity of technological tools.

But there are profound differences between our experiments and our approaches. Some visual artists focused on how to represent their idea with abstract simple images and bitmaps; I tried to represent a vision of cultural space by tracing possible ideal cities, architectures, 3D objects, and 3D artworks. Many artists were fascinated by unpredictable emergence from randomness. Because drawing with algorithms can easily produce endless recognizable variations, I focused on their possibilities to represent ideas.

We all held our spirit of discovery in our creative and scientific thought as we explored how algorithms could generate representations. Our differences have been, since the beginning,

in the structure of our creative visions and the scientific and technological approach to our tools. As Focillon said, each visionary first builds his own tools as a meta-project of his own possible results.

The use of random factor

We all that used algorithms and computers in the seventies made a great discovery: they understood, since the first moment, that the repetition of a logic is what computers can do easily and best.

But how to program the variations? The answer lies in the use of random factor. Random factor is not a simple tool. Casual components can construct variations but questions remain as to whether these different results can keep the character and ideas of the artist alive. Can we recognize the artist's imprint after the use of randomness? Is this imprint even important, or does unexpected novelty matter most?

One approach understands randomness as useful when, in the dynamic complex systems created by algorithms, it plays the role of the unpredictable environment, on a different occasion, of a possible theme and, perhaps, in the unpredictability of a client's request. Each variation should arise from these aspects, which we can easily lose when we move from a normal drawing into an algorithmic drawing and its variations. The random constitution of an unpredictable environment keeps the subjective logics and the identity of its own process alive. What randomly changes is only the virtual "occasion" of making art. On the contrary, the random factor is completely different when it is directly present in the process by constructing casual shapes, spaces, sounds, or words without any clearly focused control by the artist, for whom appreciation lies in the emergence of unexpected results.

Two consolidated and identifiable trends were born from these two different visions. Sometimes, they contrast one another, above all in terms of how one recognizes the artist's identity in a piece. We could also understand these two fields as belonging to two approaches, understanding art in terms of subjectivity and science, or objectivity and technology.

Preference for the objective vision considers subjectivity as an unreliable approach, instead preferring analytic technological methods to manage complex systems. Subjective creativity is here set aside and randomness takes that role. The artist could say, at the end, that the machine is creating by itself, losing the possibility that the artwork could be recognizable as belonging to each artist. Instead, the artist simply catches what casually emerges and what appears more "new", like a shopping session or like a spectator at the machine's performance.

A preference for the subjective vision considers the random only as a tool to amplify the possible expressions of a specific vision. This can happen because random is considered an unexpected constraint or difficulty in the developing path of an artwork. In this way, it increases the peculiar character of an artist's work, as difficulties normally add complexity to one's identity.

This "objective" approach could exist also because we can appreciate the random for its ability to catch us off guard. And this is natural because we are fascinated by the unpredictable events that could push us to think. But I believe that this approach if it is too radical, results in the artist losing the passion of self-discovery and of communicating a vision, a unique creative, and scientific identity. As well, sometimes artists like to go unrecognized: they don't like to communicate their thoughts, so leave the creative imprinting to the machine.

When the machines achieve or appear to have achieved the position of the artists, the

parallelism between Art and Science, where there can be no progress in science without a subjective interpretation of what surrounds us, seems to fail. Only the technology remains. My opinion is that the subjective approach is more European, and the objective more American, with a lot of exceptions, such as free jazz. More the subjective approach, involving Art and Science together, come directly from Italian Renaissance that I consider as the starting point of Generative Art. In any case, science and technology are two faces of the same logical creative approach. Sometimes one is predominant over the other.

We, precursors of creative use of computers, had different approaches to randomness. A first group had a passion for emergent results while, sometimes, they forgot to support their identity by forgetting to control the space of randomness with advanced constraints. The approach of another group and my approach is instead to support own identity and subjective vision strongly by bordering the random to represent the unpredictable environment.

Free Jazz

Many precursors of algorithmic art and me too have an explicit common influence: free jazz. Even if someone of us later followed different creative paths, we share the jam session as a fundamental formative experience where every soloist improvises. The improvisation uses a subjective interpretation of the musical piece that builds the character of the theme lets the jazz player build his own identity.

Jazz improvisation, interpretation, and variations are not random but follow the unpredictable "randomness" of the environment. Here, in my opinion, is the essence of the digital art made with algorithms. The rules are complex and contradictory, like the coexistence of inverse and retrograde canons in the counterpoint, but having rules is the essential environment for creativity. This happens because each constraint increases the complexity and identity of the artwork, by improves the quality of the process. As well, the construction and the succession of algorithms, when they progressively operate on the provisional results of what has come before, create a dynamic complex system where rules and constraints interact with each other to transforming themselves through their contaminations and resonances. The results are unpredictable but recognizable. I tried such an experiment with my generative software and I believe that many of the precursors of the creative use of algorithms can agree with me.

An image or a musical piece without rules is boring, just as an architecture cannot exist without rules and constraints: it crashes.

Non-linearity, art, science, and technology

Nothing simplified, linear, and obvious, can contribute to art. The non-linearity of the algorithmic process in artistic construction is a point of no return. Non-linearity is strongly present in research during the seventies on dynamic and chaotic complex systems that served as the scientific background of the first digital works. Non-linearity has nothing to do with appreciating randomness for its own sake. Chaos also has its rules and I believe that these rules have been a common point of reference in the artistic and scientific parallel lives of the visionary people in the seventies.

It is clear that we did not confuse randomness with the chaotic non-linearity of a complex system. It is also clear that we should distinguish an analytical approach following objectivity and optimization from a subjective process of discovery born from our own point of view and interpretation of human feelings. The subjective approach has brought us to consider art and science as fields with the same progressive process: a progression in which art and science

identify sometimes unexpected aspects of the world that surround us.

We could identify these different approaches as "objective-analytical-casual-optimized" versus "subjective-unpredictable-recognizable-visionary".

Personal software as style

A style arises from the possibility of recognizing an artwork as belonging to the peculiar vision of an artist. Above all, it arises from the ability of the artist to build his own tools calibrated to his own specific character and perspective.

Many artists constructed their subjective computer programs to verify and improve the aesthetic possibilities of new technologies. They created their software as their own tools dedicated to peculiar topics and emergent technologies by focusing on their aesthetic aspects and potentialities.

I took, together with other people, a different path: I tried to follow a progressive construction of my subjective computer programs to improve, step by step, the complexity of my creative works, if possible by continuing to use the same technologies. For instance, for particular generative architectures, I still use my first generative software "Basilica"; I upgrade it regularly to follow new stimuli and new interpretations by stratifying new algorithms. This is a program written for Apple II and the pen plotter that I moved to DOS, the pre-Windows operating system; in the mid-eighties, I had to rewrite all the algorithms. Now Basilica is too complex and large, having around 300 pages of statements, and I do not need to rewrite it again. Also, it still works very well and quite fast in a DOS shell, and it generates complex files for the last generation of 3D printers.

After thirty years of the digital era, an approach to creating art using one's own personal software has unfortunately almost disappeared. Now we are forced to use "objective" programs, commercial apps that are considered proper for everybody. They support us, like a common tool, in doing everything, artworks too. This is not a step toward the participation and the discovery of one's own vision, but often only toward homogenization, if we use them for creative purposes. Commercial software is wonderful for other activities but it denies, essentially, the possibility to be a visionary. Moreover, no commercial software, with only a few exceptions, can run for more than a short while because of continuing upgrades and changes to the operating systems. And it is impossible, even if they are open source, to transform them into a subjective tool able to be a long-term subjective support for increasing, step by step, the complexity of one's own creative activity.

The new technologies are important, but the forced transformations of planned obsolescence and prioritizing business applications above all else are destroying the memory of creative processes because it is impossible to keep the artworks made using them alive. It's quite impossible, for instance, to see our creative videotapes made in the seventies and eighties or run our programs created in the last 35 years if we had not stored all the hardware that we used.

The time when some visionaries can forge their own digital tools might end, but the passion for running subjective discovery processes can remain alive. It is the passion of Art and Science together. It's the same passion that moved Piero della Francesca and Leonardo da Vinci in the Italian Renaissance, and, later, Francesco Borromini and Gaudi too, that I consider as my masters.

The first digital era disappeared, but the experiences of these visionaries can show everyone a possible way to discover one's own thoughts and potentialities, by going beyond the boundaries of simplification.

Argentina, a Natural Generative Design

GA 1998

Introduction

Leon Battista Alberti defines the Beauty of Architecture "a concert of all the parts together, performed with proportion and logic in something in which it is possible to find again each event, in a modality that will not allow the inserting, extracting out or changing anything without decreasing its Beauty".

With generative art, we can approach, directly, this complex paradigm of proportions and logic, and we can directly design the Beauty, or better our idea of beauty, before the realization of each single possible artificial event. This is the heart of generative approach. The Generative Artwork for the beauty, in the sense of the humanistic approach of Renaissance, because the generative code, which is the project of generative design, is the real structure of the idea. It defines how to concert all the parts and the dynamic relationship among these parts in the evolution of complexity. The generative project defines which is the law of proportion and which logic the dynamic evolution will follow. All the events that this code can generate will be, in a humanistic sense, beautiful, or, if we prefer, will belong and represent our Idea of the world.

And more. The generative art produces events that are unique and complex. The uniqueness and complexity are strongly related one each other. As in Nature, each event is generated through an artificial life, which, as in the natural life, produces uniqueness, identity and complexity during an identifiable time.

This complexity is a natural-like complexity. We can recognise, in the artificial ware we produce through this generative approach, the harmony and the beauty of the natural-like complexity that refers to the Humanistic approach of Renaissance: Man, Geometry, and Nature as references for "the harmony which is not thought as an individual caprice but as conscious reasoning." (L.B. Alberti, *De re aedificatoria*).

1. First experimentation with generative design, the challenge

When, in 1987, I realized my first generative approach to town environment (note 1), my challenge was to operate with experimental tools inside the field of the temporal evolution of artificial sphere, using the progressive systematic falsification of the scientific developing procedures. First step. I have to identify the two different fields of designing action: the designing idea and the design evolution.

The *designing idea* is the natural/artificial dynamic system that everyone try to forge upon the reality, by drawing a model of a possible desirable event, shaping own thoughts and wishes. And it is a peculiar act of human beings.

The *designing evolution* is the sequence of logical procedures to increase performances and complexity, and to open this subjective system to inter-subjectivity and social requests. This evolution may be emulated by machines.

I have investigated about the logic approach and evolution procedures more than about the quality of single events to define the theoretic and experimental approach and try to emulate the evolutionary processes in architectural and urban design. The approach was to operate in order to prefer meta-design to design.

The concept idea was that complexity, both natural and artificial, is controllable only by using an approach that follows, and emulates, the increasing complexity procedures existing in nature, but also in the artificial worlds, as town environment. Overall I have identified the complexity as the formalization of an experience, of a reached identity. And, I want to think, also a possible aesthetic quality, the quality that we can find in all matured and history/stratified town, for example.

To define the field of my research I have considered these two points as faces of the same logic of evolution:

1st, the design increasing ideas, that are unpredictable but, at the same time, increase the identity of the designing idea and of the same designer

2nd, the evolution of each environmental system, that is also unpredictable but identifiable by the power of self-organizing structure that fights to increase its peculiarity.

This approach is based on the concept in which the identity is double (or, better, nidificated as a fractal shape) 1st, the identity of the species, the DNA in nature, and the Idea in the artificial ware, and, 2nd, the identity of each event, which is strongly connected with its experience, the design history and the market experiences for artificial objects, the life experience of natural objects, or the historical/cultural experiences for the town environment. When we emulate this sequence of different experiences, we build an artificial life, a sequence of evolution procedures that give to each object its own identity. But we can also identify the complex frame of stratified orders, the recognisable density of sense (we can also call its sense of beauty) that appears in all the events generated by the same dynamic evolution, by the same dynamic system, because the system (a dynamic chaotic system) evolves each time in a different way, but with the same "attractor".

The "attractor", in the field of design, may be the idea, or the identity of the designer, and it may be realized as a generative project, an operative meta project.

The first operative step was the experimental realization of original software, that I called Design of Morphogenesis. The challenge was to emulate the logical procedures of some specific and subjective approach to the increasing complexity.

How can we call this program? A genetic set of algorithms or an AI software? The genetic algorithms are used to perform the selection. But the selection, in design approach, is not only the selection between choices with different functional or quantified qualities. This selection is the easiest one, analytical and not concerning "beauty". When the alternatives are between different possibilities with the same functional level of quality, the selection is only the exploding of the designer identity. The AI software can emulate the logic sequence of the evolution, but it cannot emulate the birth of an idea. We can identify the generative software as the emulation of the same logic sequence of "artificial life" (defined a priori as a generative project, the Idea) starting from different points (different project sites and requests) and reach always different events but all belonging and representing the Idea.

Each time we use this tool, it generates a sequence of different virtual scenarios that we can identify as belonging to the same species of objects, of architecture, of the environment.

Each different scenario follows the same Idea. Each scenario is one of the possible representations of the same design Idea. And more: our idea is in evolution.

2. The design of artificial species

First operative software: Citta' Aleatorie (Random Towns), 1988

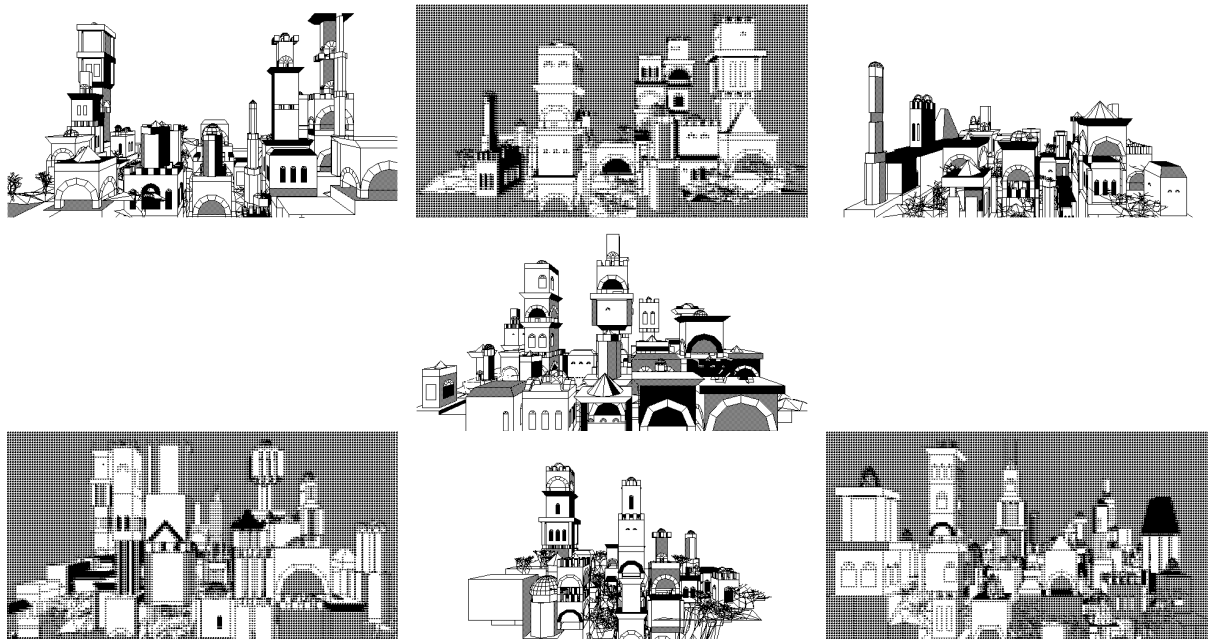
My first generative project was in the field of town design. A tool that performs the possibility to control complexity and increasing identity of each environment, working on the codes of its development and being able to preview a sequence of possible incoming scenarios. (Note 2)

The hypothesis was that the identity and recognizability of each town, of each environment, was strongly connected with its evolutionary laws (its DNA). The random events that occur in its life cannot do anything but increase identity. The clouds are strongly modified by the wind, and they enlarge and change their image. The dunes walk at all times modifying the desert shape. And this endless regeneration performs impressive and unpredictable beauties. But the clouds are always recognizable as clouds, the dunes hold, always more, the shape of the

dune. The natural DNA is recognizable notwithstanding each event is unique and unrepeatable

The generative project is the DNA of artificial object, of architecture, of towns

So I had performed my generative software to use the random events to increase the identity and the complexity of town systems (identity and complexity come together).



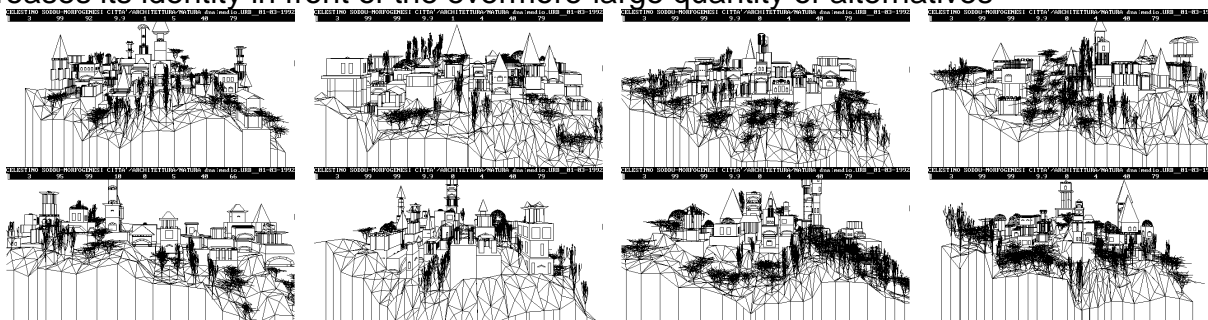
“Citta’ Aleatorie”, a sequence of generated 3Dmodels by the first generative project of Medieval Towns in Italy, (1988)

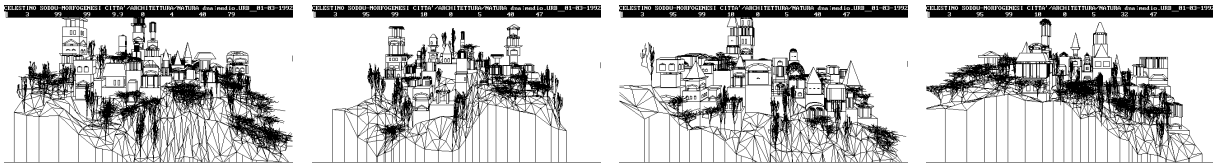
The first study case was the typical medieval town in Italy, identified referring to the paintings of Simone Martine and Giotto. It was possible to rewrite the laws of this particular environment as an operative paradigm where the logical structure that controls the formalisation of events, was stratified and nidified from macro to micro events.

The random face of this system was realized with a different and unpredictable "speed" of a set of different generative devices belonging to the multiple possible faces of the same formalization: geometry, material, technology, etc.

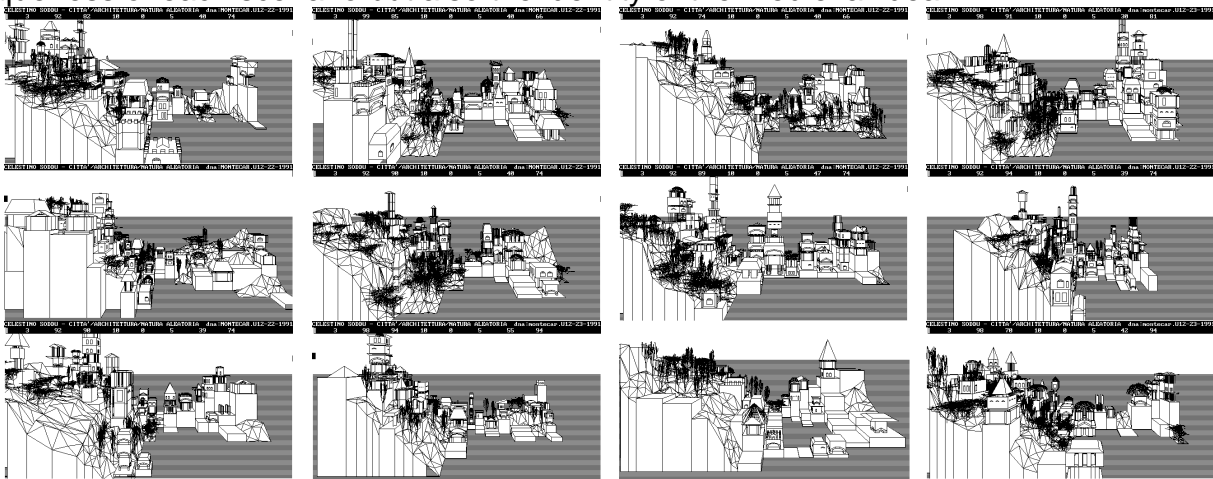
This approach has allowed me to not use a database of pre-designed shapes, but only a set of generative machines that worked together.

A generative design, from my point of view, cannot use an array of data, but a set of different generative devices, like a set of different dynamic chaotic systems, that works together and uses the unpredictable contamination each other to access to different "point of view", to different formalisation of the same request. The recognizability of the project grows, increases its identity in front of the evermore-large quantity of alternatives





A sequence of medieval towns 3Dmodels generated by the second version of the generative project “Citta’ Aleatorie”. The finality of this project was to design the evolutionary relationship between natural and artificial environment in Medieval Town in Italy. (1989/1992) The result was very impressive. And I began a sequence of experimentation changing the DNA, the code of recognizability of the town environment looking forward to increasing the uniqueness of each scenario but also the identity of the medieval idea.



A sequence of 3Dmodels of towns generated by the project “Montecarlo”, an evolution of the first generative project. (1991)

The approach I have identified was that it is not interesting to change something in the code, but to increase its complexity. Because the increasing of possibilities brings to the recognizability of the choice.

With a surprise: it was very easy to succeed in generating something that looked like a town, with the principal functional problems solved. It was more difficult to perform the sequence of steps to bring these incoming virtual towns to represent a particular idea, the genius loci of a town, through its multiples and different scenarios.

The idea. Using the town environment as a study example, the problem was: am I searching my idea of the medieval town or the idea of medieval town “tout court”?

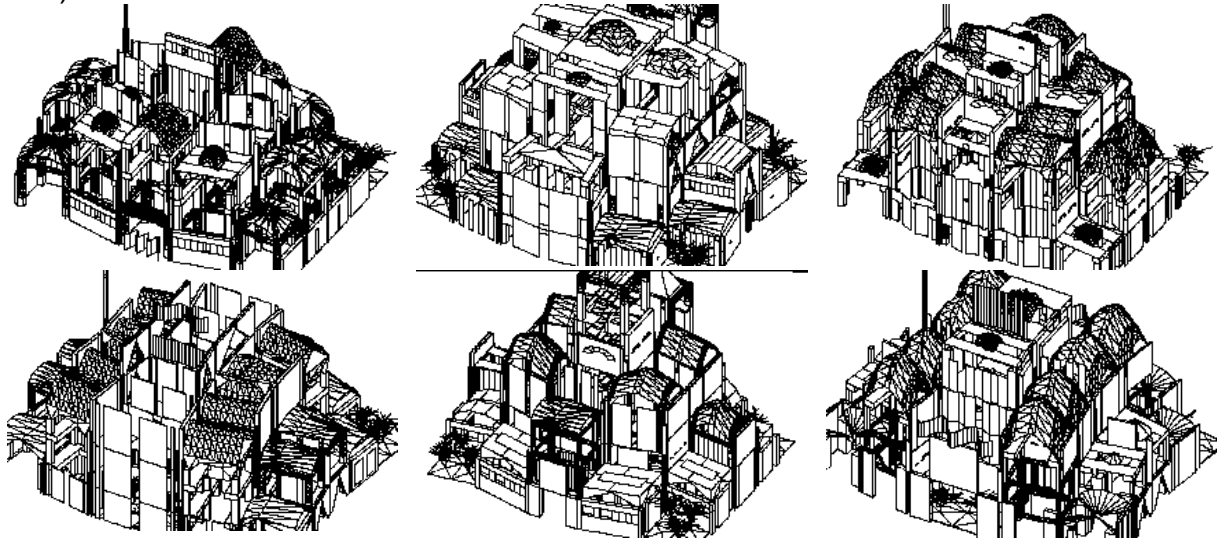
I am an architect, and I work using my subjectivity to reach the possibility to give to each unpredictable user the pertinent answer to his subjective requests. The interface between my subjectivity and the unpredictable subjectivity of a user is the complexity, as an adaptive structure in which everyone can find his particular answer. The structure of this complexity and the set of basic functions resolved identifies the hand of every designer and the identity and uniqueness of each architect.

With a doubt. Will it be possible for any architect to use a generative tool to design his own architecture? And not only the architecture of the designer of the tool? Once I have performed a generative tool, can an architect design his own architecture using this tool? I don’t think so. The generative approach is inside the design approach; it is the structure of the idea.

But there is another possibility. An architecture, realized with a generative tool with a complex and adaptive interface, can explain two identities: the identity of species, belonging to the architect that has designed the generative tool, and the identity of each event, belonging to the architect that has used the tool. The problem is that a generative tool is not an instrument as a pencil or a Cad. It represents an idea in a strong way.

3. Next step was the generative tool "Basilica"

In 1992, I designed the first version of a generative tool able to generate architectural 3D models, and to control dimensions, materials, technology, and structure of the function. (Note 3)



Six scenarios belonging to the same evolutionary paradigm. These scenarios were generated by my software "Basilica"

Basilica is a software that emulates the design procedures, starting a moment after the idea till to the endless sequence of possible scenarios

Basilica operates into the field of design processes, it is realized with a set of logical procedures that is, in practice, the logical procedures of discovery. These procedures are not analytical. They are like the epistemological structure of scientific discovery. These procedures represent the structure of a subjective, performed as a generative code.

This software can generate, using a controllable logical sequence of morphogenesis, a set of different formalised scenarios in response to the progressive multiplicity of questions. These scenarios are, in practice, 3Dmodels of architecture, usable in all CAD and Rendering tools.

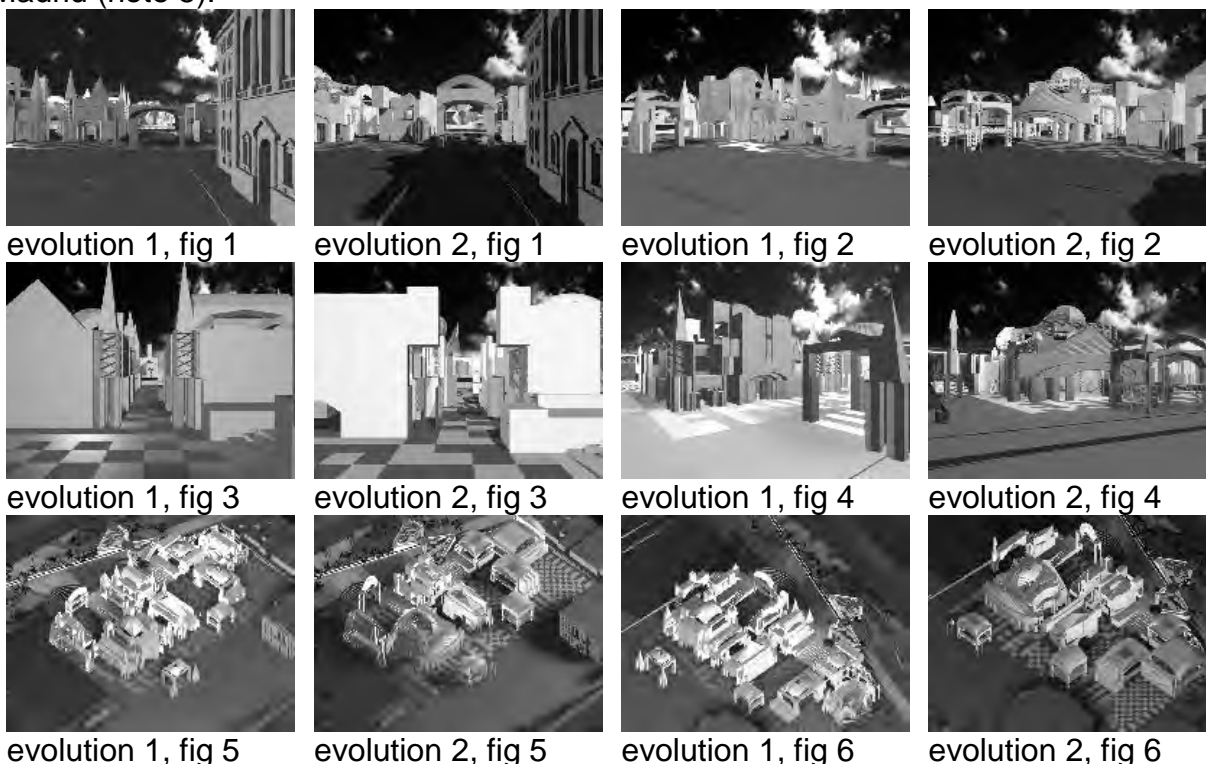
Every generated scenario is (or better needs to be) a different and clearly characterized one. The reason is that each design procedure is a developing path. In order to emulate it, we need to use a non-linear, unpredictable, and increasingly complex sequence. The challenge is to reply not only to the pre-coded questions but to the incoming and unpredictable questions generated by the same evolution.

Basilica is a generative meta-project of my idea of architecture that I can use, and I have used, in my researches but also in professional activities. It is, I think, my extra large office, where a thousand of brilliant architects, all with their mind on my mind, work to produce an endless sequence of 3D models of possible architectures, all belonging from my idea, and each of them performing an unpredictable representation of my being architect.

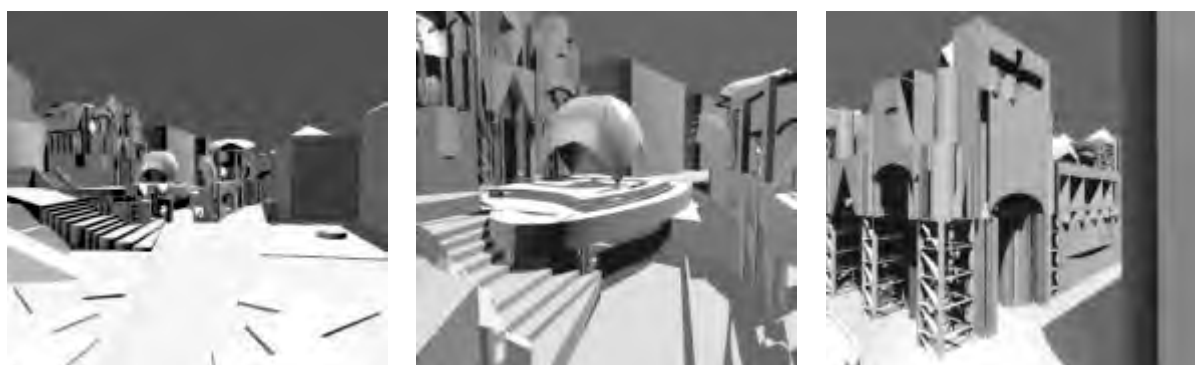
Basilica has an operative interface to choose, in real time, the starting paradigm of the architecture, identified in the dynamic meta structure of spaces and interfaces and in their relationship belonging to a multiplicity of fields. In other terms, it is possible to insert in the

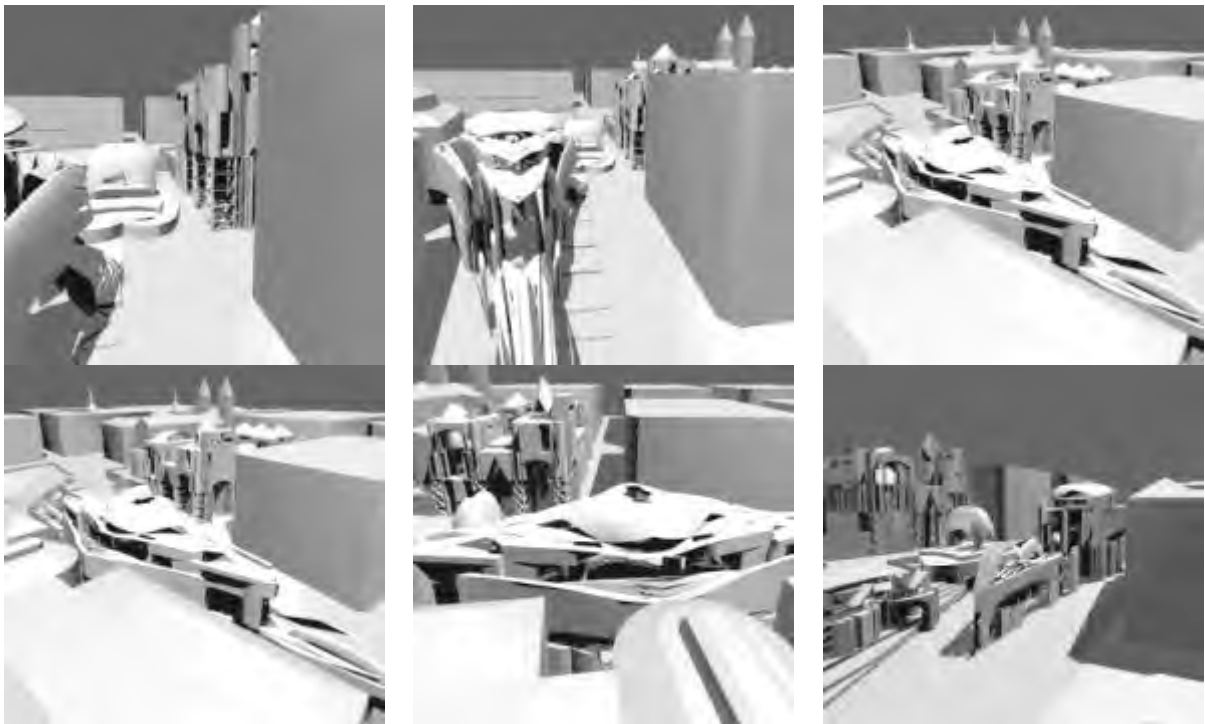
program the basic requests of the incoming project and emulate the evolutionary sequences of each possible formalization and increasing complexity.

With this tool, I have realized, for example, the project of "Borghetto Flaminio" (Note 4), one of the least void urban spaces in the center of Rome, and the extenuation of Prado Museum at Madrid (note 5).

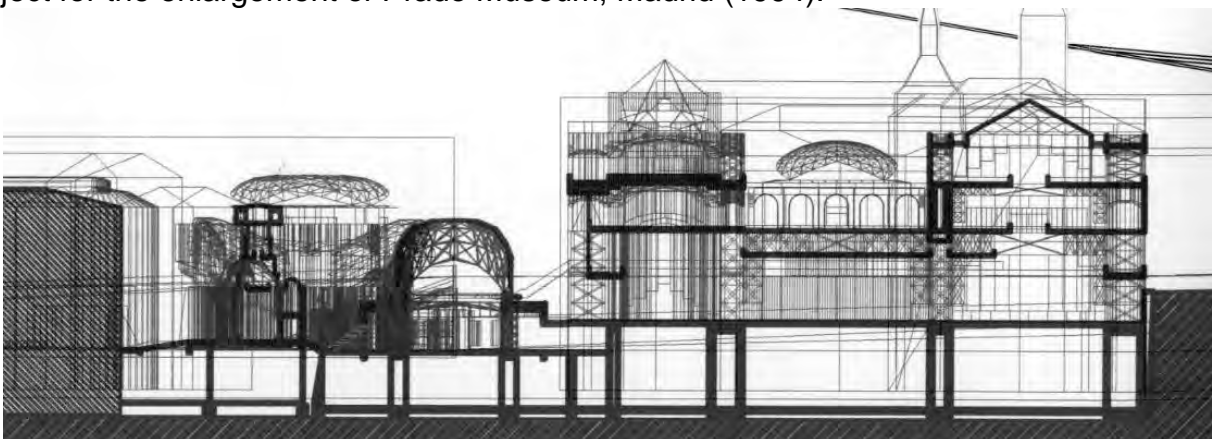


A project of "Borghetto Flaminio", 1994. The images refer to two of the scenarios generated, in sequence, using the generative tool "Basilica". The scenarios are represented using the same sequence of points of view and show three parallel histories of the same virtual time of development. The second scenario is the last one, and we have used it to present the project.

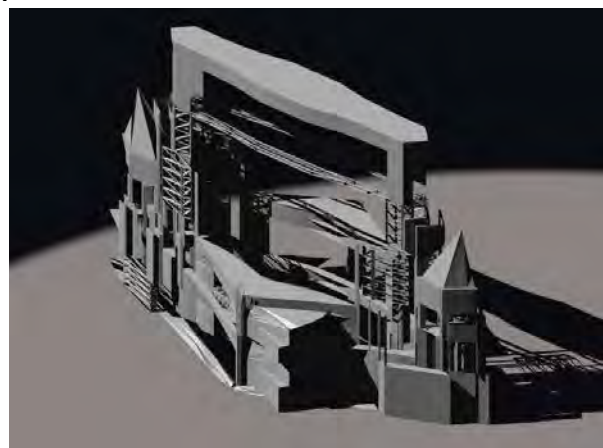
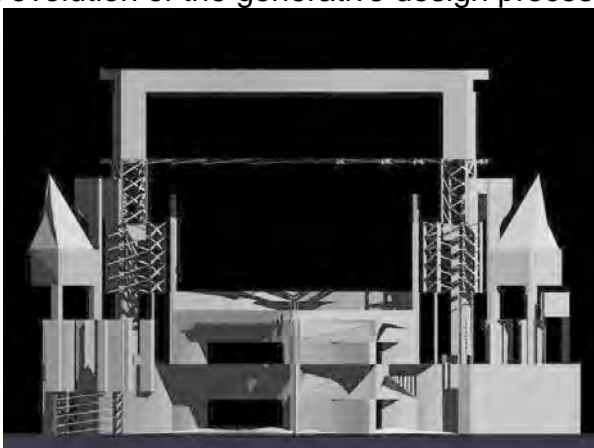




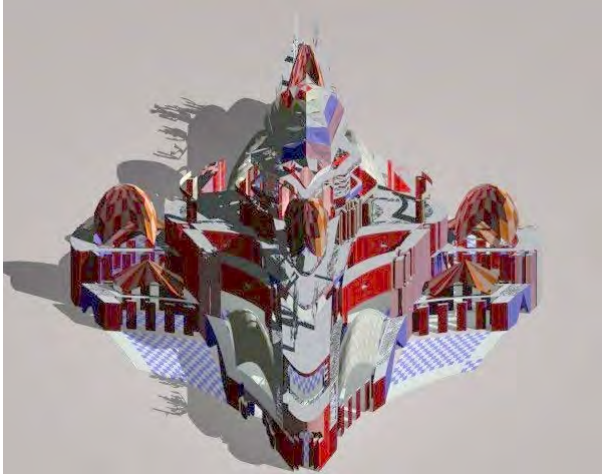
Project for the enlargement of Prado Museum, Madrid (1994).



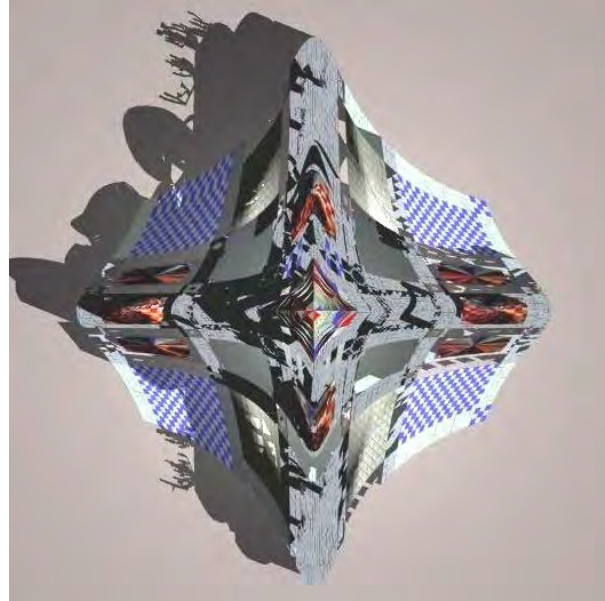
The project of the Prado Museum is entirely realized using an original generative software by Celestino Soddu (a particular release of Basilica). The project answers to all the functional requests of the customer. We have used, as a final project, the 3D model generated by the last evolution of the generative design process.



A multimedia urban stand in Milan, designed by Celestino Soddu using “Basilica”



The Multimedia Square in Milan. New urban spaces designed by Celestino Soddu with his generative software “Basilica”



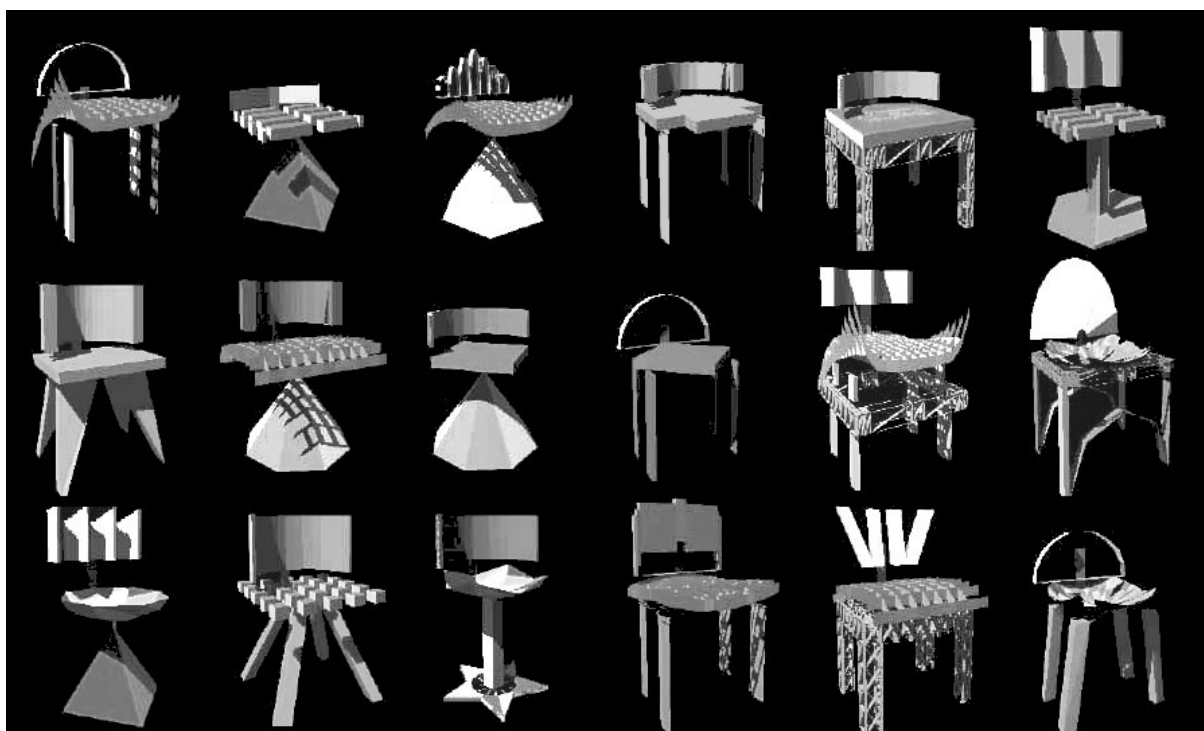
4. Argenia, and the generative industrial design

Once I have identified that the challenge was not to construct the evolutionary emulation of an existing system, as a town or industrial product, but to design my own evolutionary way to develop environmental and architectural projects, an unexpected perspective was lightened.

The possibility to design the idea, and perform the idea as operative meta project which is able to generate an endless sequence of possible scenarios (3D models of a generation of artificial objects, all different but all with the same functional and aesthetic qualities), opens a new era for incoming industrial production: the natural production of industrial objects.

In the two centuries of the Industrial Era, by now finished, the objects have been produced as multiple unidentified. The chain of assemblage produces objects all equal. And this equality has been celebrated overestimating the processes of optimization and building aesthetics of the repetition. If we use a generative approach, and we exclude the relative preconceptions about the cost, about the optimization of the functions and about the recognizability of the designing idea (note 6), the Generative Design is set as conceptual and operative innovation in order to the realization of the products of the Third Millennium. Unique and unrepeatable products, like the human objects have always been but realized in the factories. These objects are made in the measure of man because they fit a strong subjective approach. These products are good for the environment, not only because they may be recyclable, but also because they have a slow obsolescence.

I have called this design activity with the neologism Argenic Design.



My first generative industrial design, a generative Argenic design of chairs (1991).

I have realized this design as a first experimental project of industrial design in order to carry out a series of objects always different from manufacturing in a factory with digital control machines. The difference between each scenario/project of the chair is such to stratify the identity into more levels. A strong identity of the meta project, of the idea, and a strong identity of each chair in its uniqueness (note 7).

5. Argenia, the generative art

I realized the first sequence of paintings using one of my software, "Tracce" (1996) that allows generating from 2D images a sequence of 3D models that can perform the multiplicity of possible subjective interpretations of the increasing complexity concerning the transformation from 2D to 3D. This is not a full generative project, but these performances will be used as one of the generative devices in subsequent projects. The first experimentation was realized from Kandinsky.



An interpretation from Kandinsky. One of the possible 3D models realized using "Tracce" (1986/1991).

The generative project "woman portrait from Picasso"

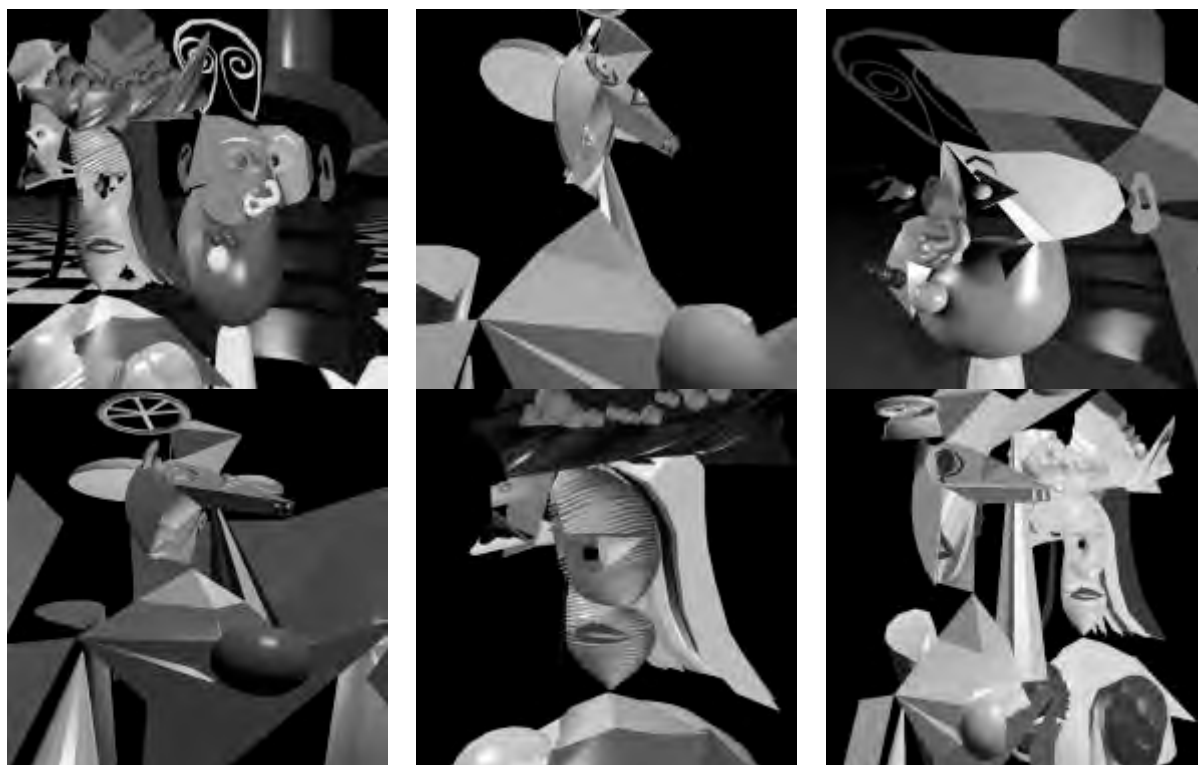
This experimental generative design born from the consideration that each generative project is an Idea, or a subjective abduction, one of the possible point of views, interpretation of the reality.

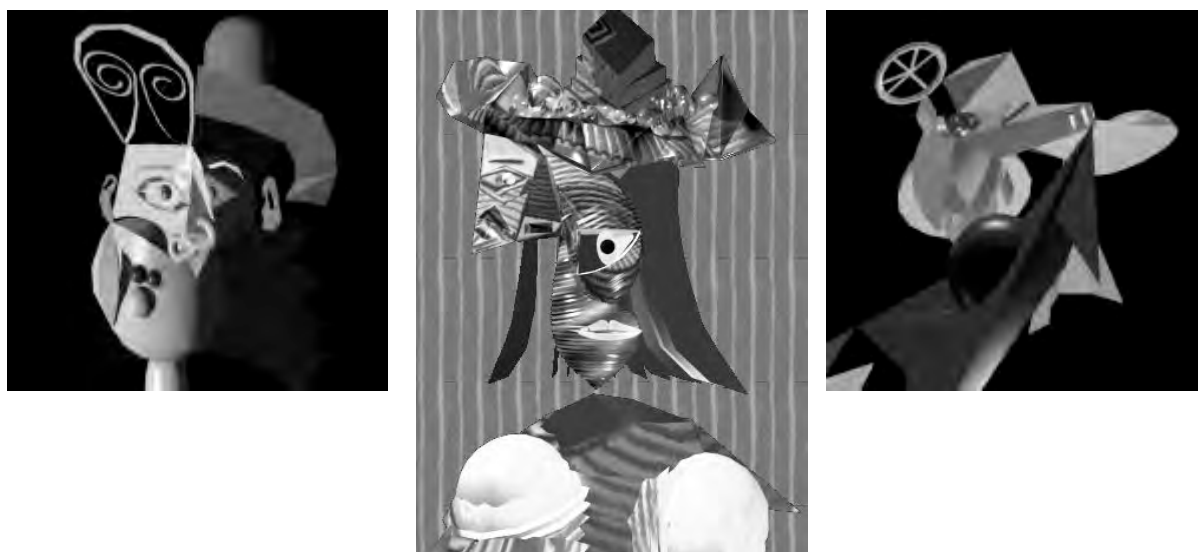
So I tried to design the generative code of my interpretation of the woman represented in the paintings of Picasso. I have chosen the paintings of Picasso because the complexity, the recognizability (and the impressive and erotic charm!) of these women are strongly connected with the evolutionary sequence from African representation to our references and culture.

I was conscious that my challenge was to perform a generative code able to generate 3D models of women that must communicate not only the recognizability of Picasso's hand but also the recognizability of my subjective interpretation and idea.

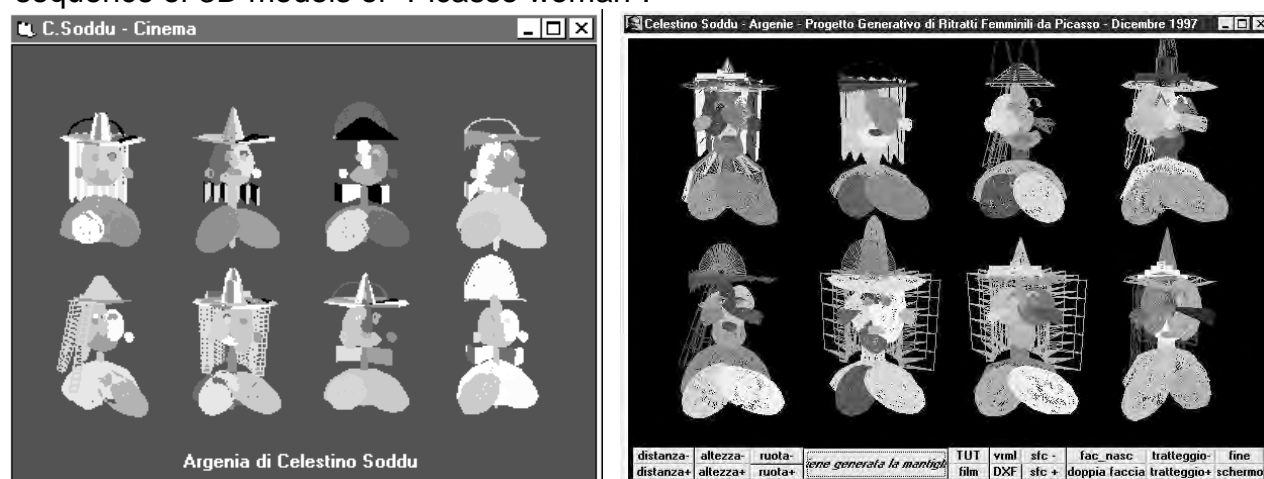
I was sure that this challenge was realizable because the identity of an event is a stratification of multiple identities, and the women of Picasso are an example of this evolutionary stratification. My generative project of "Women from Picasso" had to be only a further stratification of sense as everything inside the art/cultural approach must be. By the way, Picasso himself had also painted some possible evolutions of "Las Meninas" of Velasquez.

The first sequence of paintings was realized using the last release of one of my software, "Tracce". When I tried to approach the Women of Picasso, I found that the field of possible interpretation between 2D and 3D was very interesting. It was possible to realize an impressive sequence of digital paintings.





Argenic “paintings” from Picasso. I presented this project in an exhibition in Milan in 1997. The second experiment was directly a generative tool to emulate the evolutionary sequence starting from African images to Picasso and more... This software can generate an endless sequence of 3D models of “Picasso woman”.



Screen Dumps from the generative tool “Woman Portrait from Picasso”, 1997

Note 1

"Citta' Aleatorie" (Random Towns) is the book I have published in 1989 with Masson Editor. It explains my first operative research in the field of town and architectural generative design. In the book before, "L'immagine non euclidea" (Not Euclidean Image), 1987 Gangemi Editor, concerning my experimental software in the field of representation, I presented my first experimental realization in the generative art for a natural environment emulation.

Note 2

To manage the complexity, I referred to the concept that the complexity is not generated ex novo but only by using a process to stratify sense into a flowing simulation of a temporally irreversible path. We can activate and control this stratification if we design a system with a self-organizing paradigm that can keep sense, (practice) during the simulated time flowing. To build this paradigm I referred to the chaotic dynamic systems that are suitable to be controlled by algorithms, but that can produce ever-different events. I have used a fractal but non-deterministic logical frame. In other terms, every decision cycle has inside, nidified, a lot of other cycles, and so on. The structure of these cycles is, as in fractal objects, ever the

same. The difference and the unpredictability springs from the resonance with the other cycles, from the time of activation and from the ever-different flow of information. Each cycle represents a whole structure in simulating the decision choices. It operates the transformation of the answers into possible shapes. This device is designed by:

1. The use of a paradigm to control the auto-organization procedures. This tool represents and controls the gained complexity but, in the meantime, represent the adaptivity to the incoming developments. It is the device that allows us to reply to an answer putting one of the possible formal matrixes into the paradigm.
2. The identification and sharing of the random margins between answers and shaping reply. The system uses and represents these margins as "operable fields" for the designing choices to improve the project evolution.
3. The set of possible formal matrixes that are abstract shapes but usable in giving body to a set of possible performances. These formal matrixes are not a database. They are extemporary generated by the bound-up cycles, by a set of simultaneous devices operating into a series of different fields, like geometry, dimension, materials, technology, complexity, and so on.

Every formal matrix is, therefore, the extemporary production of the contamination and resonance into a set of different subsystems performed as a following paradigm/random margin/formal matrix, in a subsequent homothetic complexity that looks like a fractal shape.

At the end of every cycle (and of the related and multiple progressive nidifications) the result is:

1st. An increasing complexity, and the related passage into a more evolved representation of answers, and together the proliferation of the same answer.

2nd. The production of needs, for the reason that every event we design was born also using subjective and random postures. It was not necessary before but it began necessary after the choice: it is a part of the project history. This happens also if we, later, remove it because we consider this event as an obsolete one. The event is into the project history, and we can appreciate its contribution as time patina. A time patina that measures the gained complexity, the growth of the specific identity of the project, shaped by the past research occasions used as training events.

Note 3

The logical structure of "BASILICA"

The algorithms of this software are not organized with a shaped database and do not refer to a deductive request/reply structure. This is because, in the design processes, every formalized reply exceeds the field of the pertinence of the request. We use the random margins between requests and formalized replies to answer to our conceptual needs, to perform our idea of the architecture. The role of these algorithms is to simulate the human procedure of design evolution, of discovering the possible fields and, in the same moment, replying in advance to the unknown and unpredictable answers with a set of possible virtual scenarios.

In other words, this tool simulates logical design procedures shaped as a formalizing engine that changes every answer into possible choices using a formal matrix. During every cycle, the developing project system gets to an increasingly complex level. As it normally happens during any design process, the software changes what before was random into what after is necessary, because it has just happened.

The logical and operative structure of this emulation system is based on the use of the main cycle, with auto-organization capability, and a set of ever growing secondary cycles. All are bound together.

Each cycle represents a whole structure in emulating the decision choices. It operates the transformation of the answers into possible shapes. This device is designed by:

1. The use of a paradigm to control the auto-organization procedures. This tool represents and controls in progress the gained complexity and, in the meantime, is adaptive to incoming developments. This device allows the system to reply to each question using one of the possible formal matrixes to increase the complexity of an event.

2. The identification and sharing of the random margins between questions and shaping reply. The system uses and represents these margins as "operable fields" for the design choices. This improves the project evolution.

3. The set of possible formal matrixes, which are abstract shapes but usable in giving body to a set of possible increasing complexity performances. These formal matrixes are not a database. They are generated by the interconnected cycles, by a set of simultaneous devices operating in a series of different fields, like geometry, dimension, materials, technology, complexity, and so on.

Therefore, every formal matrix is the extemporary transformation of the contamination and resonance into a set of different subsystems performed as a subsequent paradigm/random margin/formal matrix. All are in a subsequent homothetic complexity that looks like a fractal shape.

At the end of every cycle (and of the related and multiple progressive nidifications) the result is:

1. An increasing complexity, and the related passage into a more evolved representation of answers, together with the proliferation of further answer.

2. The production of needs, for the reason that every event was formalized also in front of our subjective (and random) approach. It was not necessary before but it became necessary after the choice: it is a part of the project history.

When we design a new architecture using the interface of Basilica, we can build a new paradigm, perform the structure of the relationship between possible events, change the geometry and stratify multiple possible geometries within the paradigm, define the quantity of possible exceptional events and the relationship between these events and the normal structure of the architecture. And, finally, we can choose the time, speed and structure of evolution that we wish to emulate.

With Basilica, it is possible to design an artificial DNA able to generate a set of always different, unpredictable and individually characterized artificial events. Every scenario, that is a 3D computerized virtual model of architecture, is recognizable as an individual of the same species. So we can identify one product realized with Basilica as an Idea of architecture. With a little amount of memory, we have the universe of possible solutions that this Idea can generate when faced with the same design problem.

Note 4

Case Study: Rome, Borghetto Flaminio, 1994.

The identity and uniqueness of Rome are due to its specific way of living history, time, and contingent events. An operational hypothesis to design a subsequent growth of this city must be based on the identification of a developmental code that reflects the developmental tendencies, the *modus operandi* of this city, the DNA of Rome.

The project is a generative code that represents Rome and his developmental way. In operational terms, this project is a meta project/software realized to be a tool to hypothesize and generate a set of possible incoming scenarios. These scenarios must have, in their difference and unpredictability, the character and the identity of the Roman urban environment.

This design approach doesn't operate in the city as a static system, but directly on the urban dynamic system that, in the meantime, is evolving, describing the manifoldness of its possible evolutions in real time.

The designing idea identifies a possible developmental code able to emulate the modes that characterize the evolution of Rome. This code is based on considerations extracted from an imaginary of Rome, from Stendhal to Piranesi, from Michelangelo to Borromini, but also and, above all, from the subjective fascination that the vital structure of this city operates on us.

This developmental code that we have represented and transformed into an operational tool, a software/meta project, woos the challenge of representing the idea and the identity of Rome not reprocessing the same events that look like the existent ones, but enhancing the uniqueness and identity of this city like it has always revealed: giving birth to unique and unrepeatable sites that widen in time and that stratify the texture of the Roman paths of discovery. The unsuspected presence of unpredictable architectural events explicates the immanence of the possible. And this presence, in their differences, sometimes casual, enhances and fix the identity and uniqueness of this city.

This uniqueness and unrepeatability emerges at every level, and appears, like a fractal sequence, in the spaces, in the varied plazas of which Rome is composed. The same plazas are, in the proposed developmental code, the bearing structure of the simulated evolution of the city. The objective of this virtual evolution is to save and increase an environmental identity that, until the last architectural event, till the unpredictable detail, each time that we pass, would be able to unexpectedly discover or rediscover following one of our contingent moods, one of our subjective new codes of reading.

By designing a code, a DNA that represents the immanence of the possible of this city, we can operate on the structure of the exemplary complexity of Rome, and give birth to urban environments that allow finding again the unpredictable infinity of possible subjective paths of discovery.

It is not possible in fact to think that we can describe the urban complexity with a unique gesture, with a design that bears from the idea of building a situation of equilibrium. We cannot propose, especially in Rome, a static situation, an architectural event based only on the contingency of a functional application related to a specific temporal moment. This approach means the annihilation of the idea of Rome, of its complexity, of its adaptivity to the possible and of its ability to be, however, a germane and essential response to the manifoldness of the possible subjective applications.

Our challenge is building the complexity, like the design of a Roman site requires, by triggering the developmental "modus" of Rome, operating with the simulation of subsequent stratification of complexity, also if we adopt a virtual time simulated with an operational paradigm able to stratify different moments, and which find again in the "felicitous randomness", as Simmel wrote about Rome, the occasion to increase the identity of the place, its uniqueness.

The design of an evolutionary code, of a generative code, it is an architectural and urban complete and recognizable design. It is a design that is different from a traditional design, which doesn't seek a unique and final solution. It generates a universe of possible scenarios representing and identifying, in their plurality and difference, the same "genius loci", the same structure of environmental complexity.

Each scenario is unique in its difference, in its being an individual belonging to a species. It has gone through a contingent and bumpy temporal path, increasing its complexity and uniqueness.

Even if, to realize our project, we opt for one of these scenarios, having checked its quality directly in the genetic code that has given birth to it guarantees us of adaptivity to the possible, of its strong belonging to Rome identity and uniqueness. And we can presuppose that these characteristics will grow with time, and they won't be only an ephemeral season of flowering.

Procedures used in the construction of the developmental code of Rome.

We have considered that the character and the acknowledgment keys of an urban environment belong more to the developmental procedures consolidated in local cultural tradition than to the individual architectural events. We have identified some characteristics, some developmental procedures that, according to our subjective criteria, characterize this urban environment.

1. The "piazze". The evolution of the urban system is based on the empty sites, the squares. The building system evolves all around these sites that flag the identity of each place. This developmental paradigm, that we have transferred in our proposal, is characterized by the ability to increase the recognizability of each individual "piazza", increasing its peculiarity and, at the same time, its recognizability as Rome, just as it is legible in the historical evolution of Rome.

2. The uniqueness of architectural events and urban recognizability. The developmental structure of Rome is so recognizable that it allows, without fear of contamination, the structure of differences and the presence of exceptional events. Better, Rome owes its recognizability to the presence of a stratification of complexity and not, as in other cases, to the presence of particular formal and/or technological matrixes exemplary of a specific cultural and historical moment. Rome is the city that, more than any other, has enhanced its own identity and recognizability by passing through extremely different historical moments, living and transforming extremely aloof and contradictory cultural contributions, preserving, and at the same time evolving, a Roman way to go on and to look at the future. Each site, each ward, each plaza has increased, over time, its own recognizability and uniqueness. At the same time, it has contributed to increasing the uniqueness and recognizability of Rome, in its global image. If this evolution stops, if we think only for a moment that we can stop time by building equilibrium, we deny this identity, we would remove the recognizability and uniqueness of Rome. The organisational paradigm that we have built into our design, and that allows us to check the developmental modes toward complexity, bears from the idea of using the contingent and the casual for "training" each urban event, increasing its complexity like a germane response to the need for uniqueness of each place, of each event, of each detail, but also as an unpredictable response to the need of be, however, Rome.

3. The basilica. The developmental structure of Rome is constituted not only by the urban void, by the plazas, but also by the basilicas, the big covered plazas, of the "thermae" considered like the fractal symmetry of the overall urban structure based on the plazas. Like a city's calidarium, Piazza Navona is the shelter from the north wind. The playful component is essential in this sequence and, also, in the recognizability of the form of the plazas and of the fountains. The organizational paradigm that we have built to operate the subsequent evolutions in the historic center of Rome reflects this type of performance, this way of describing the complexity of the spaces. The bearing elements are the empty spaces that, in the specifics of the contextual site of the project, enhance their own identity in the progression difference of their rapport with the green lawn, using the green as a playful response to the field of human needs concerning naturality.

4. The design of the natural sites. A consolidated tradition is, in Rome, the use of natural elements in the developing city system. The natural environment, as is common in Italy, but

in a more accented and unique way, it is a characteristic of the environment fitting the measure of a man, to measure his necessity but also his pleasure. The natural events reflect and answer to the human need of naturality. It has been carefully designed to answer to this human need. The natural event is, in other words, an artificial ware of the best quality. Often it is, like in the parks, realized with trees and meadows, but also, it is often a right response to our need of natural complexity. In the Roman fountains, particularly in the Trevi Fountain, we could read this aspect of the "genius loci" of Rome, this awake and intentional way to report to the form of nature. This approach to natural events belongs to the logics adopted in the construction of the urban complexity. An approach that tries to get a recognizable response to the demands, also the playful demands, of Roman people. But not only of the Roman people, also of whoever because the responses of Rome must be, in the first place, strongly adaptive to difference, because Rome does a boast of preserving differences and uniqueness.

5. The relation between artificial and natural environment. A way of growing that belongs to the identity of Rome is identifiable in the sequence of progression approach to each natural site. If we want to characterize a serviceable developmental code of the center of Rome, we can look to the sites where this rapport between the natural and artificial environment has already been expressed, always in different ways but respect to the comparable situation: the stairway of Trinita' dei Monti and at the Pincio. These natural/artificial sequences marked from the construction of architectural events have amplified and redefined, over time, the morphological structure of the seven hills that has been one of the "starting data" at the base of Rome's evolution.

The morphogenetical code we have designed, as we can see in the sequence of the possible incoming scenarios generated by our tool, is in tune with the Roman idea of the presence of multiple paths of discovery among the artificial and natural.

Note 5

Prado Museum, the evolution of the micro-urban system, 1995.

This design proposal is about the general organization of the micro-urban system that has the center in the Prado Museum. It is in harmony with the historical character of this particular urban environment. And this design proposal wishes to increase this particular identity. Because we can preserve the urban identity only preserving its evolution and not freezing the environment.

Our subjective approach to the environment all around the J. de Villanueva building is finalized to enlight the reciprocity between the historical and incoming architectures, using the texture of complex geometry that harmonizes the different architectures redefining their roles and hierarchies. We design integration where the historical differences, the typological and morphological differences mirror and amplify themselves. A sequence of different spaces belonging to the same environment to the same urban identity that the visitor can discover walking through the heart, the pulsing engine of this environment.

We want not to realize a museum as a neutral scene. The museum is a laboratory to develop the cultural research, and the architecture, the 3rd and 4th dimension is a field to use for increasing the identity and uniqueness of this particular environment. But space must be designed to be adaptive, and not neutral, to the incoming requests.

Architectural Concept. The relationship between the historical architectures and the new ones is realized if all these architectures belong to the same level of complexity. And the complexity of the architectural image is one of the characteristics of the Spanish Architecture and environment. The environment can gain this complexity living its history, stratifying

experiences and formalizing the answers, but also, during the design procedures, living an artificial life and stratifying complexity.

We have realized our design proposal designing the generative code that represents our idea of Spain, Madrid, and the Museo del Prado. Using this code, that is based on the software "Basilica" of C. Soddu, but is an original evolution realized for this project, we have generated a sequence of possible scenarios of the environment that has the J. de Villanueva building as a center. Using the Artificial Life, these scenarios have lived their "historical" evolution, increasing their complexity. Our final proposal is one of these scenarios, the one that has acquired the most interesting complexity and recognisability.

The generative paradigm designed to perform the generative project has, inside, all the functional organization requested by the customer. In front of these requests, we have designed the evolutionary paradigm organizing it in three functional blocks. The first, that we call the "Bridge" is the building in the back of the J. de Villanueva building, the second, that we call the "Bubble", is the main entrance with a cupola that organises the two main different levels of this town environment, the third, that we call the "Pinta", is the building near the Iglesia San Jeronimo el Real.

The "Bridge" is a building performed by three floors: the underground floor that includes and amplifies the existing engine room, structuring the technical support for the whole museum system. The ground floor (at the same level of the ground floor of Villanueva building) is 7.70 meters high and is organized with a central hall and two lateral spaces. The function of these spaces is the temporary exhibitions, and it is possible to use the fluorescent artificial light or the natural lights. The upper floor, with the same high of 7.70 meters, is dedicated to the sculpture collection. It is possible to use the natural light and the fluorescent one, and space is organized in one large central hall, covered with a cupola and in two other different spaces in which it is possible to organize a cafeteria and a restaurant.

The "Bubble" is the entrance structure to the museum system, with the ticket office and the information hall. This entrance is reserved for the visitors group (the single visitors can enter directly in the Villanueva building) and is organized in two different spaces: the entrance and the information hall. These spaces are in the same level of the ground floor of the Villanueva building, at the back after the bus parking. The information hall is under the square in front of the Iglesia, under the parvis of the church, and it is organized with computerized information tools regarding the Prado Museum and Madrid. The entrance is in front of the "Pinta", but at the level of the Bus Park. It is covered with a cupola that is the environment sign in the upper path in front of the Iglesia. From this entrance, it is possible to go to the new building and, through that, to the J. de Villanueva building. In the other side, it is possible to go to the "Pinta", the new building near the church and, with an underground passage, to the Cason del Buen Retiro and to the Army Museum.

The "Pinta" is the building near the Iglesia S. Jeronimo el Real. It is structured in three floors and one underground access from the "Bubble". The ground floor (at a level of four meters more than the ground floor of Villanueva building) is eleven meters high, and the other two are six meters high. It is possible, using this high, to organize the functional use in double levels, in front of the contingents needs. In the ground floor, there is the entrance of the offices and departments of the Prado system, and it is located the Library. In the upper floor, there are the Departments, the Offices, the Conference Hall and the offices of the parish, that are reachable directly from the church and are not interfering with the museum areas.

At the first floor, there is the cloister, that is the center of this building.

Our proposal born from an idea of Museum articulated, interlaced with the past, the present, and the future, with the challenge to get the time with a project based on a synchronized

complexity. The focus is to gain the museum quality with a European characterisation, amplifying the cultural heritage of the differences, of the uniqueness of every particular history.

To gain that is to gain a very high-quality level, a sophisticated level that, respecting the tradition, get the new events dynamic, use these events like a possible echo of a particular environmental beauty. These new events may be, with their fullness of significance, the unpredictable points of application to preserve the identity and uniqueness of this environment. This is a possible reply to the contemporary city problems, and to one of the most important one: the homologation of the urban image.

The identity, the preservation in progress of this identity is strictly interlaced with the urban quality.

Note 6

Some presuppositions today have lost their force of axiom, and could be disproved easily for the reason that they are not more respondent to the potentiality and expectations of the man:

1. The objects realized in series all equal cost minus of objects all different and unique.
2. The optimisation of the functions brings necessarily to the identification of a "unique" designing result.
3. The quality of a designer, the quality of a particular design idea is the final result, the crystallised scenario of the last action. This is the only possible result respect to the designing idea; it is the unique possible realization.

1. The first point is not yet real. The productive clockworks to digital control realize, with the same operational cost, unique things or repeated things.

We have the example all the days under the eyes. A printer costs the same if press ten all different pages or ten times the same page. The differential of cost belongs to the commands, to the reprogramming actions in the robot, in definitive to the design.

If the design is a generative meta-project, it will be able in emulating the process to generate the designing results. And to generate these results as they are in reality, as always different scenarios. An operative meta project can realize these scenarios formalizing them like reprogramming actions, in real time, of the digital control machines, of the robots. In this case, the additional cost, if it exists, it belongs only to the design operations.

2. The legend of the optimization of a product has finished. We cannot identify a design result like the only one "necessary", once that we have discovered, or re-discovered the role and the irreplaceable importance of the subject designer.

The design is not an inferential process. Identification among optimization of the functions and designing single result it is not thinkable. Margins of the variability of the formal matrixes, of the technological matrixes and of materials will always exist inside of a full satisfaction of the functions. The production of multiple unidentified it is, on the contrary, an impoverishment, without benefits, of one of the final qualities of the object. The possibility of linking the objects to the different human individuals and to their diversified requests comes less. In synthesis, a fundamental function that qualifies the object comes less: the capability to increase the identity and the uniqueness of each human individual.

3. The quality of a project is not deductible by the final single result. In order to show and value the quality of a project, it is not more acceptable the action to rebuild the project, a posteriori, in terms of the inductive/inferential sequence. It is not more acceptable to depart from the result in order to "demonstrate" that the same result is the only possible result if a determined quality was wanted if a definite idea was wooed. If we want to clarify the relation between design, ideation and creativeness we must identify, inside the designing processes, what it is possible to emulate using the computers and what it is, instead, the exclusive

dominion of the human thought, and it is not and it could not be emulable. The idea, as subjective construction of a hierarchy of possible relations and interferences inside an incoming object, is not emulable using a computer, for the reason that an idea is not the fruit of inductive or inferential processes, but of processes of abduction, that is of interpretative processes that strongly belongs to the subjective approach. Once conceived, the idea could be explicated and communicated in two ways: with a series of projects or with a subjective meta project. But a series of projects is not exhaustive of the idea, it carries out only some of its possible scenarios. And the process of building a scenario (today sometimes identified with the design, and this one also identified with the idea) it is a process which could be emulated by a computer for the reason that it uses processes of inferential synthesis, as the consolidate procedures of the Artificial Intelligence.

If instead of explicating the idea through some results, that however are only some of the possible scenarios, we carry out a subjective meta-project of an operative kind, we have carried out a total communication of the same idea.

A subjective operative meta-project is a computer program of Artificial Intelligence that explicates the idea, because it is able to emulate at the computer the processes of the building of scenarios, and manage these scenarios in the manufacturing sequence.

I called his design with the neologism “Argenic Design”.

Note 7

The achieved goals of the generative industrial design of Chairs are:

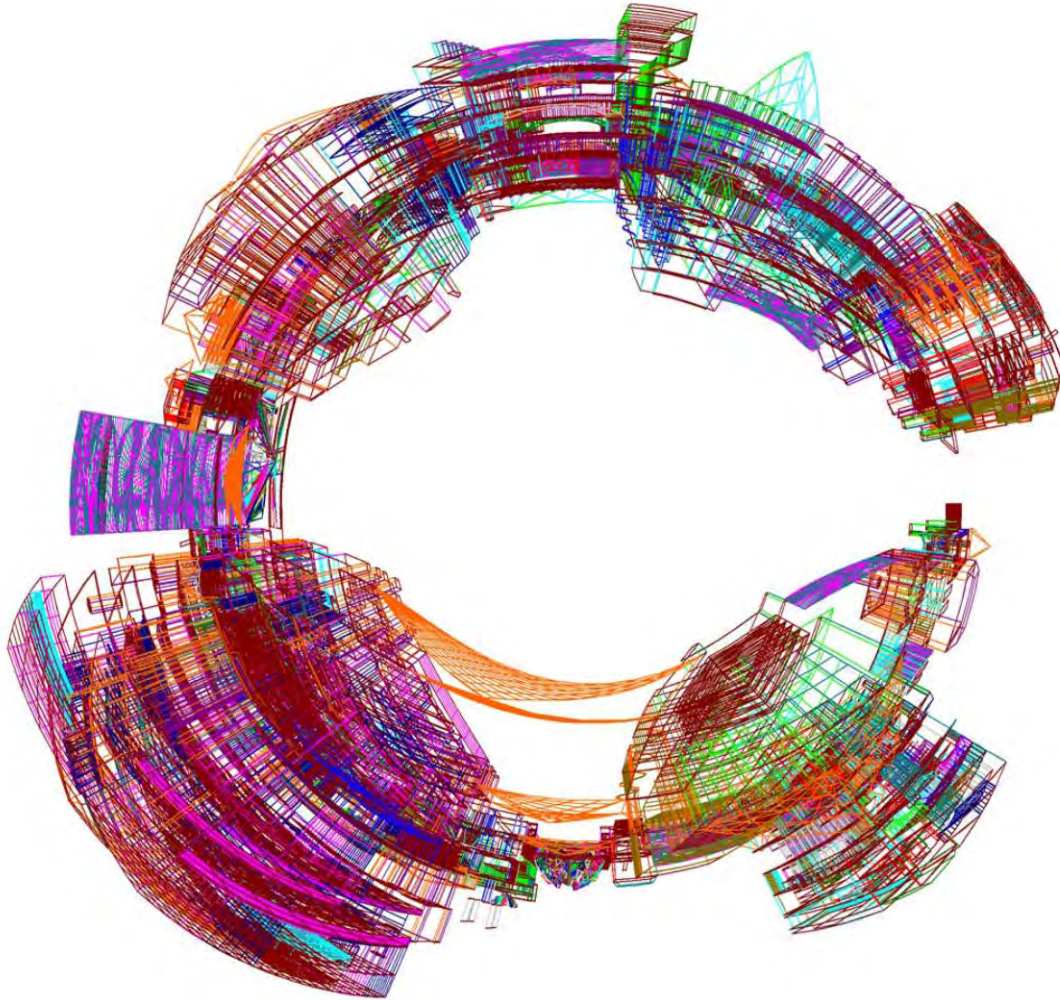
1. The idea is recognizable notwithstanding the difference about the individuals/chairs we have realized.
2. The Argenic design has not been realized through a random compilation of database: we have not used, in the code, a sequence of pre-defined shapes but a series of procedures of generation.
3. The logic approach that overview to the codes of generation and to those of control is an emulation of our designing subjective procedures that we, as designers, normally use. We have represented and used this logic procedure in a fractal way, from the global shape to the detail, in a way to produce chairs that are identifiable by the idea, by the designing logic approach that we have adopted, but with the impossibility to foresee the final shape.
4. The used system emulates our procedures of the design of chairs. These procedures come activate using the codes that emulate the evolution of a design like a dynamic chaotic system, therefore like a system strongly sensible to the starting data.
5. Each chair is unrepeatable, like all the scenarios produced by dynamic chaotic systems. If a model is repeated identical, the same system would enter a cycle of iterations, it would enter fibrillation, and it would come minus to the objective of an Argenic Design.

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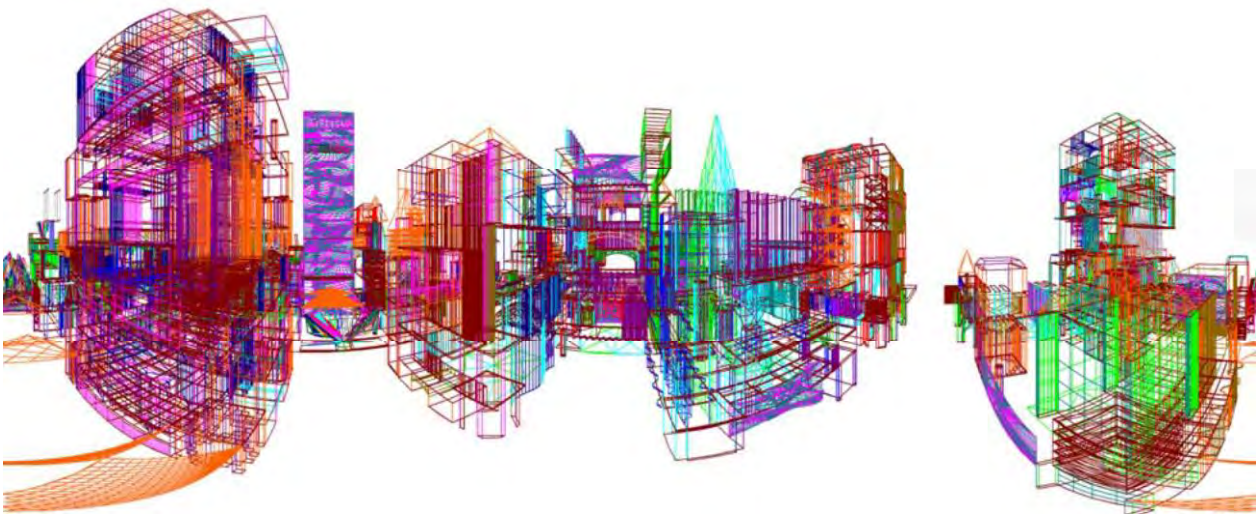
- Celestino Soddu, “L’artificiale progettato” (designing the artificial ware), Casa del Libro Editor, 1979.
- Celestino Soddu, “L’immagine non euclidea” (not-euclidean image), Gengemi Editor 1986.
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Other projects until 1998

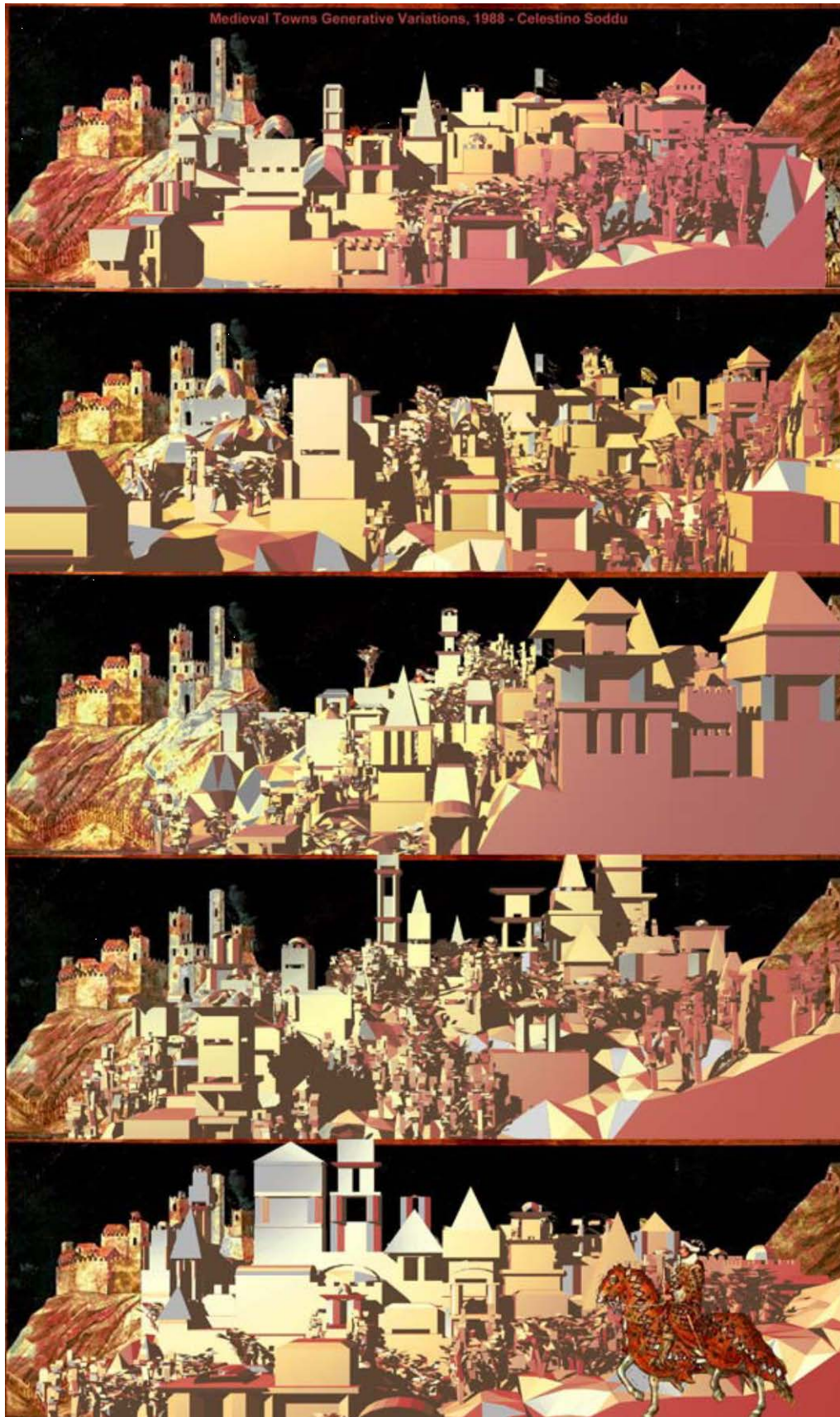
1986-2003 Total anamorphic representation of generated architecture:



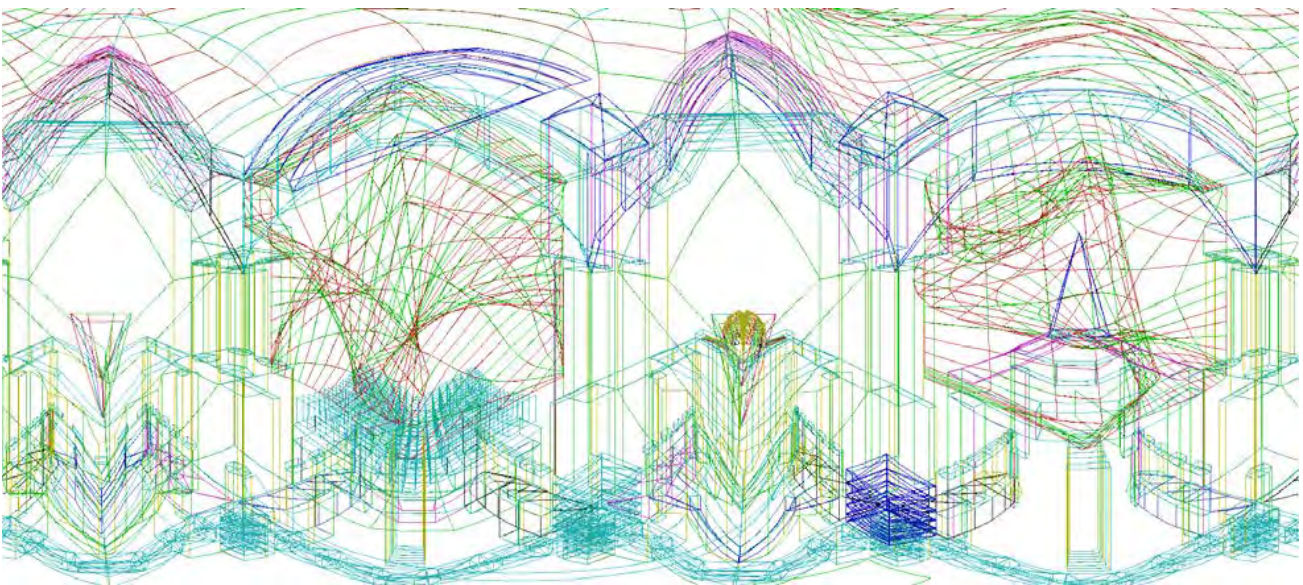
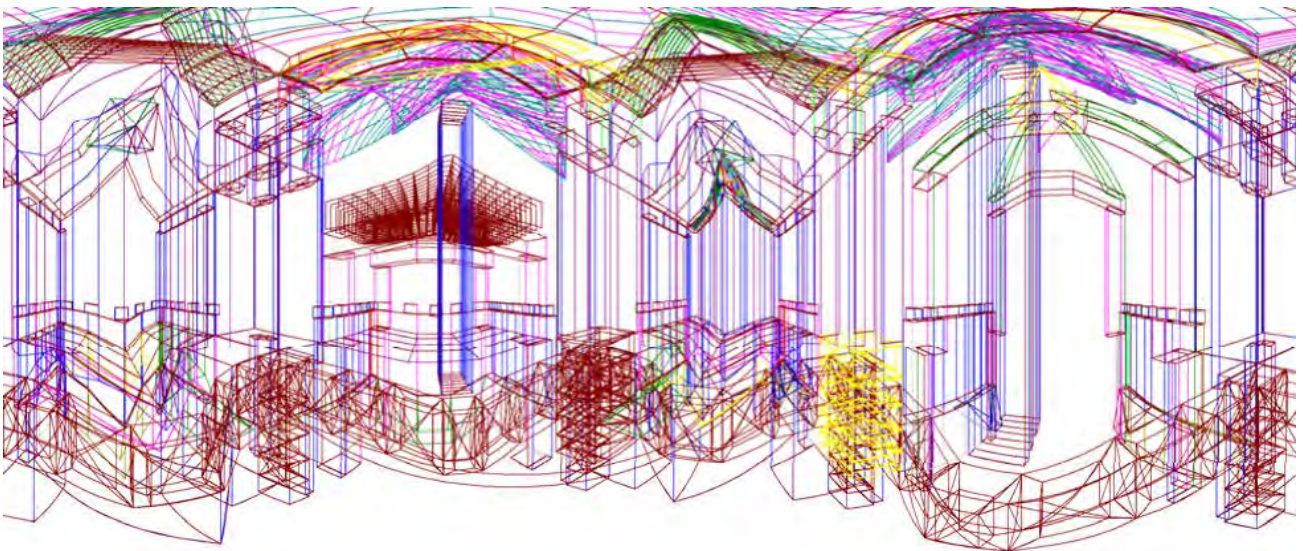
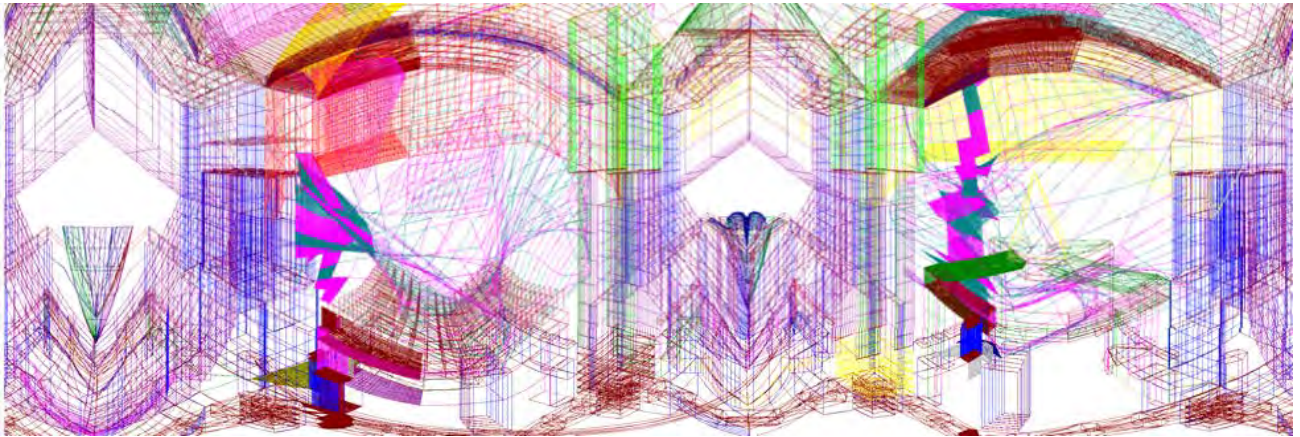
and of a generated urban environment



1988. Generation of Italian Medieval cities.



**Total anamorphic representation of generated architectures, showing the interiors
at 360 degrees. 1999**



1994. Generation of lamps

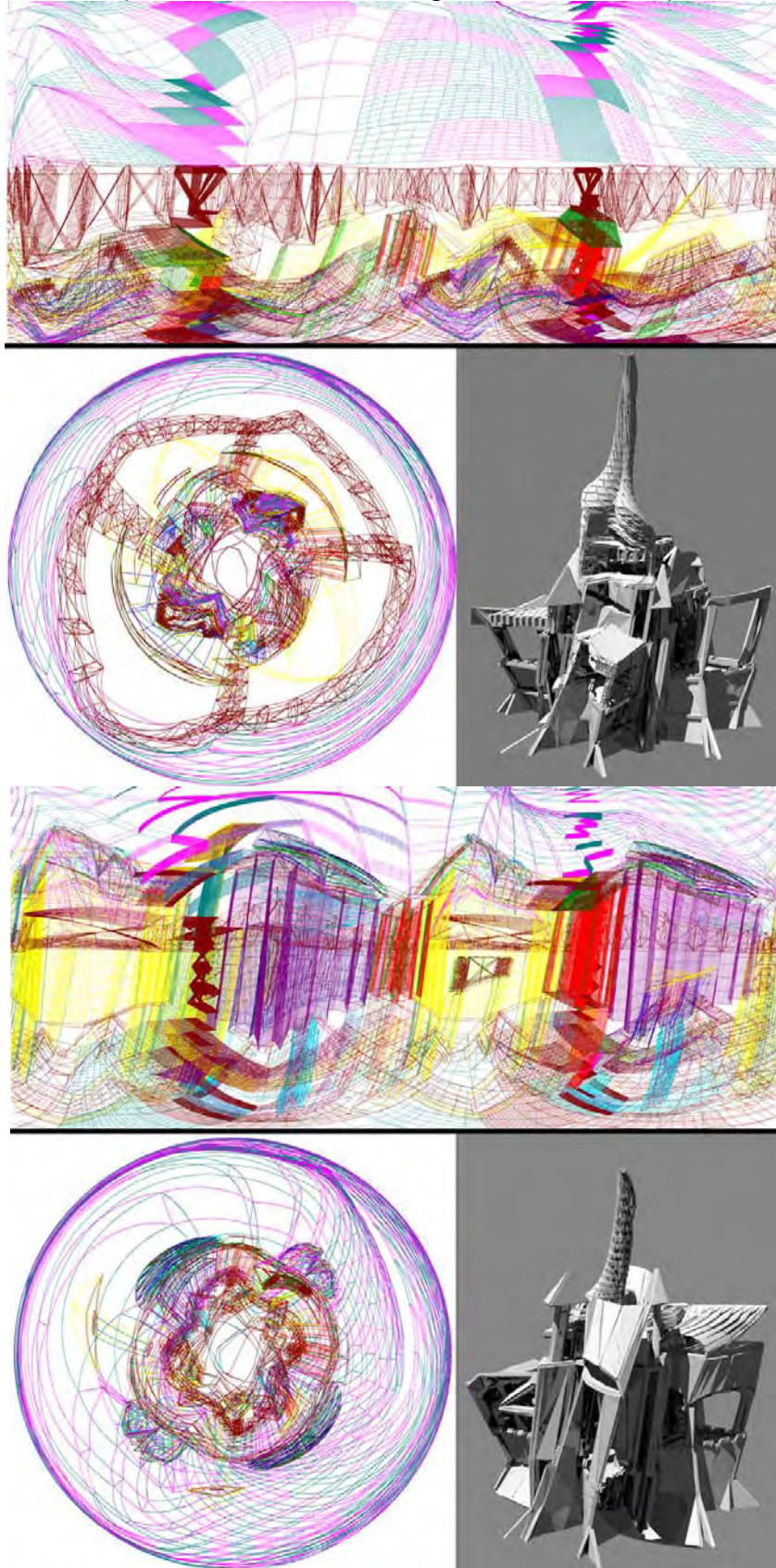


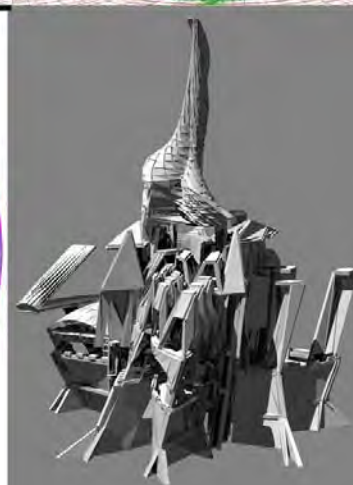
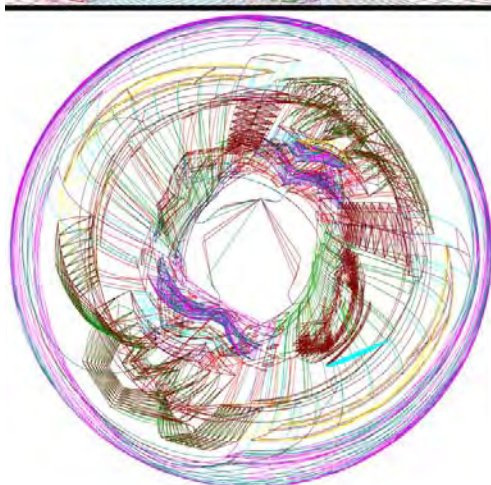
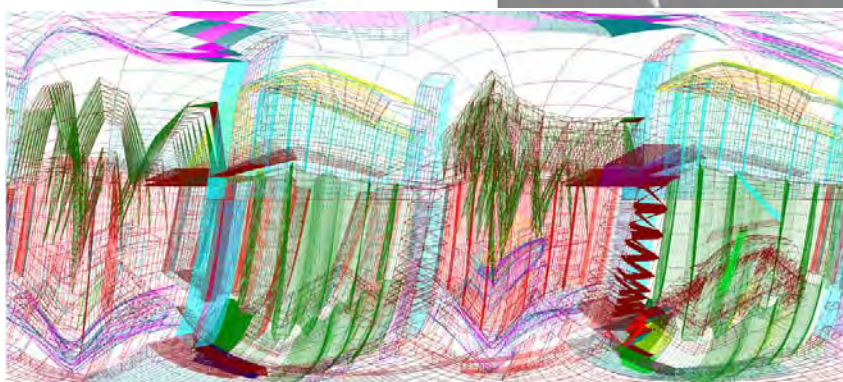
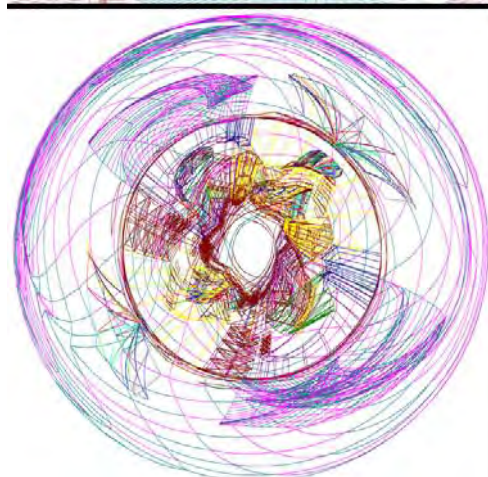
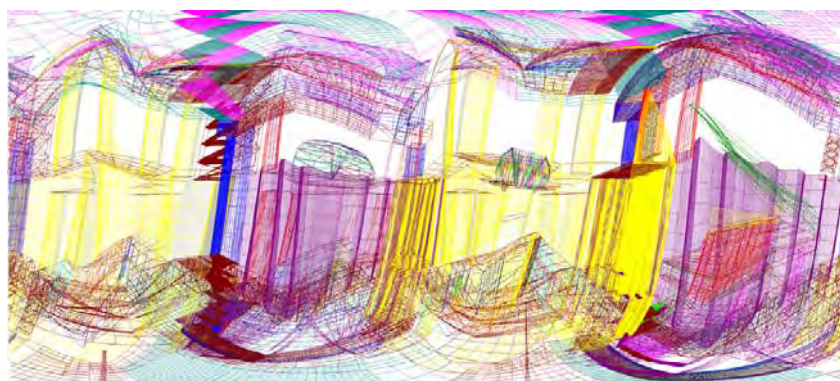
CELESTINO SODDU -LAMPS GENERATIVE DESIGN

Generation of chairs
1991

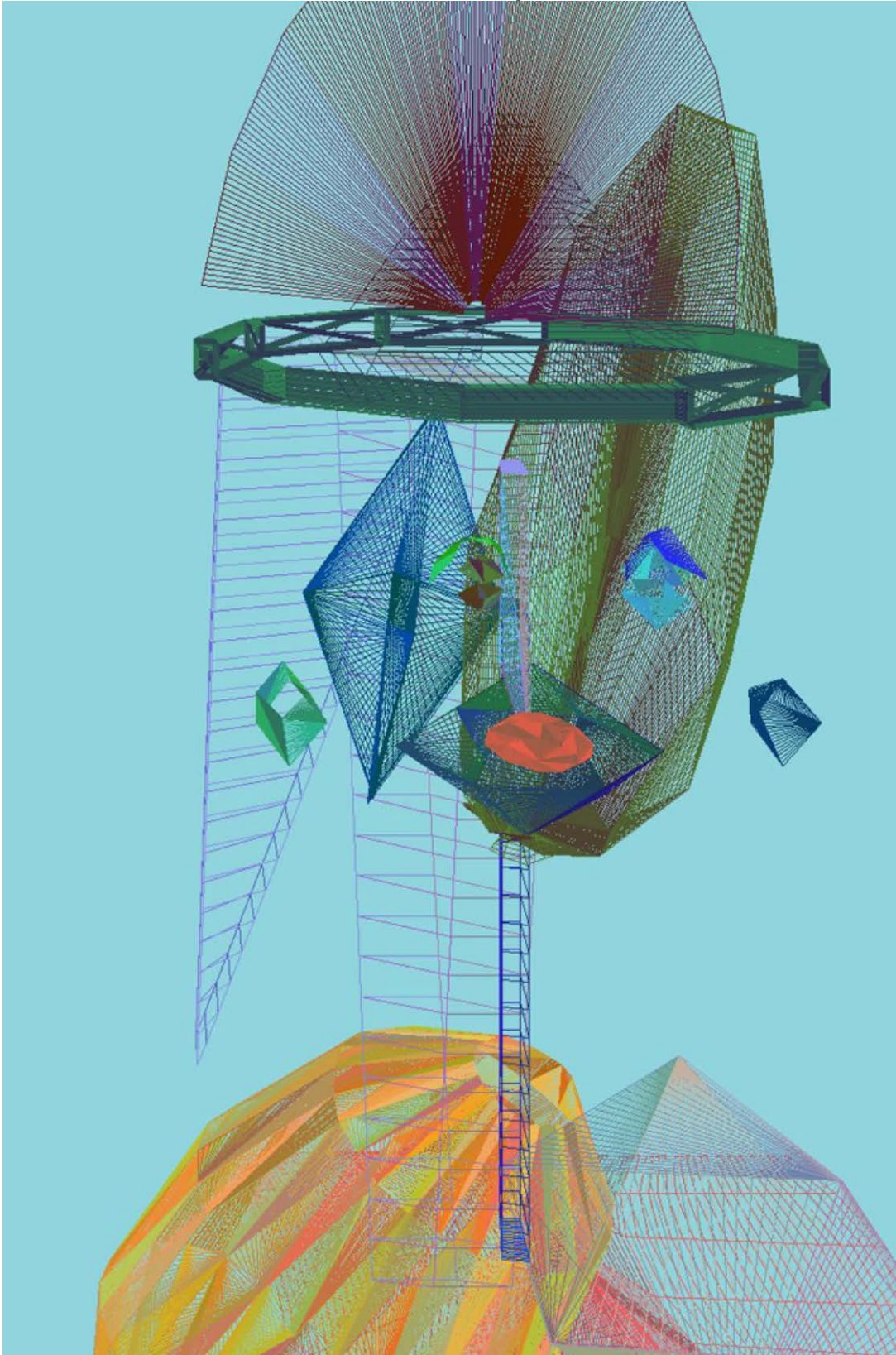


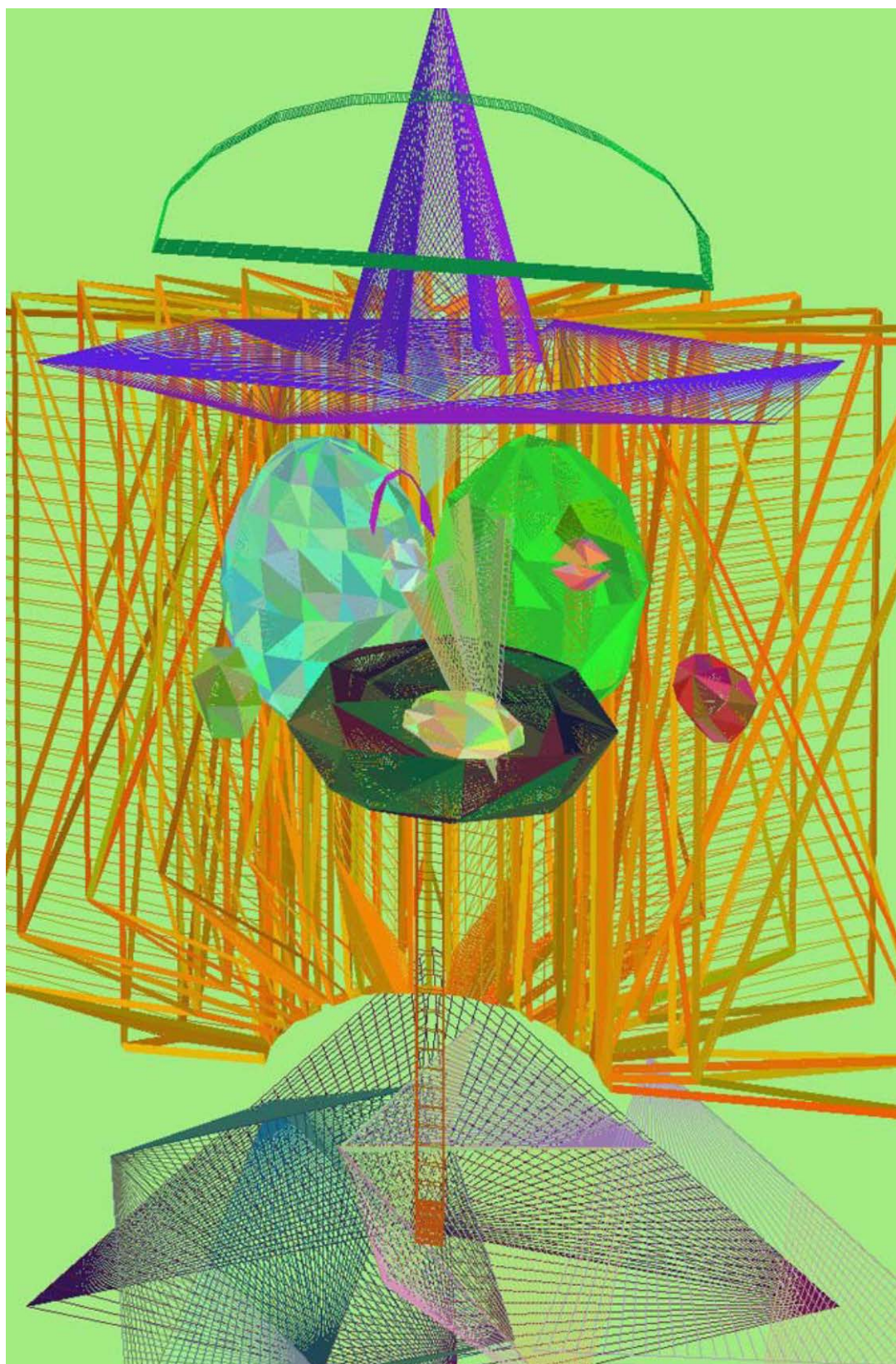
1986 (original software) for generating anamorphic perspectives.
(the architectures were generated in 2008)

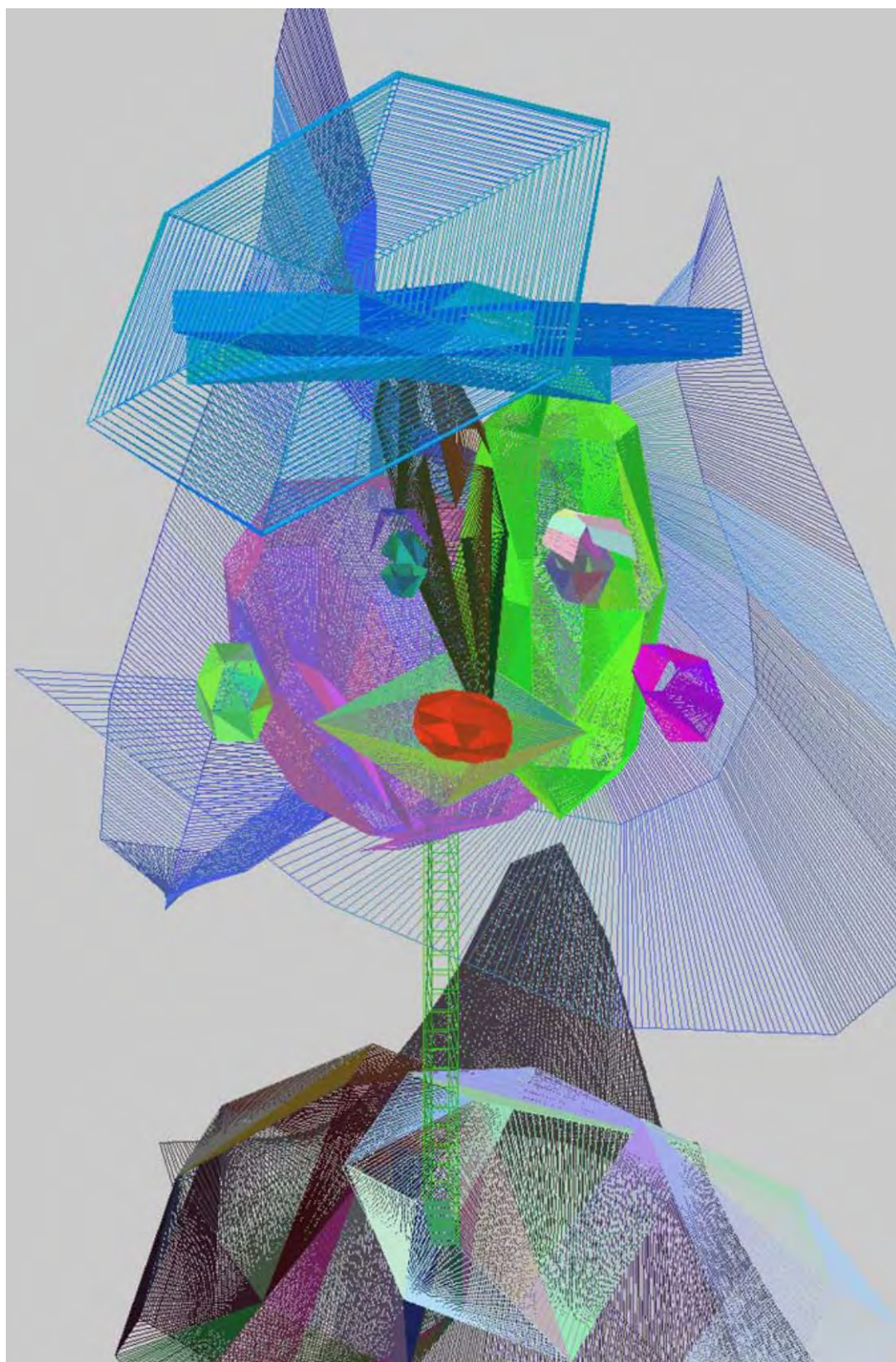


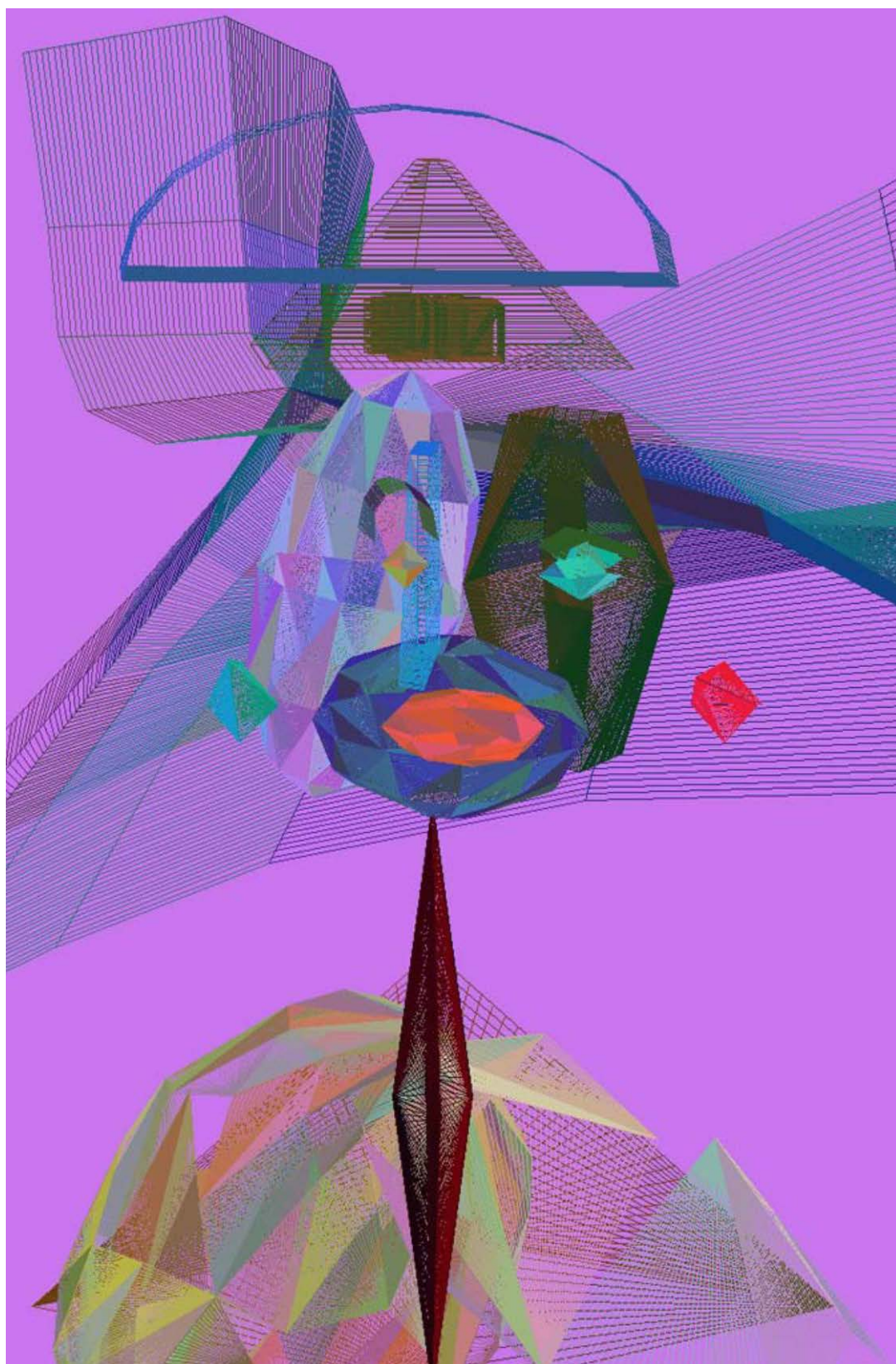


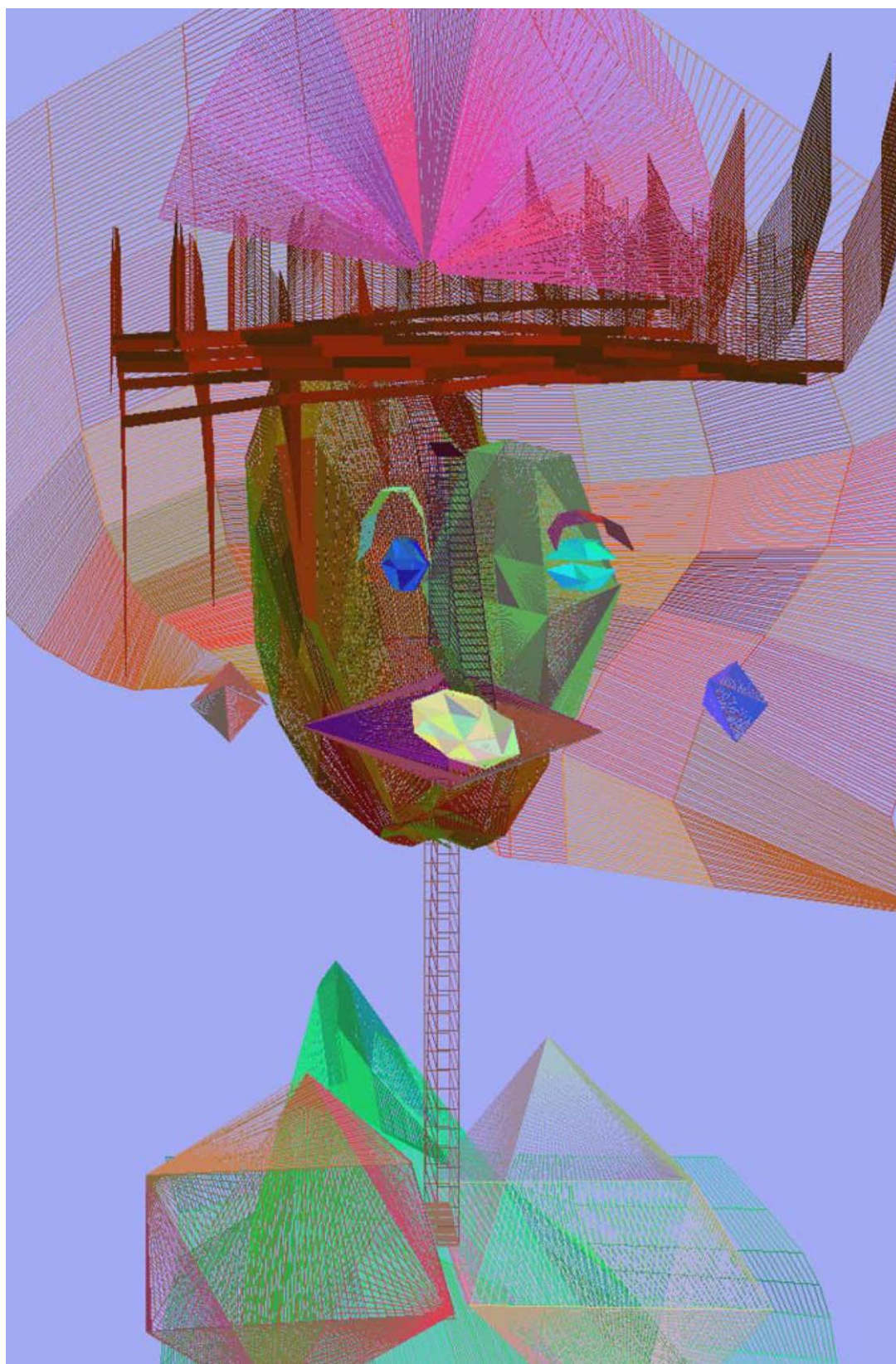
**D'apres Picasso, 1996
Generated woman portraits**

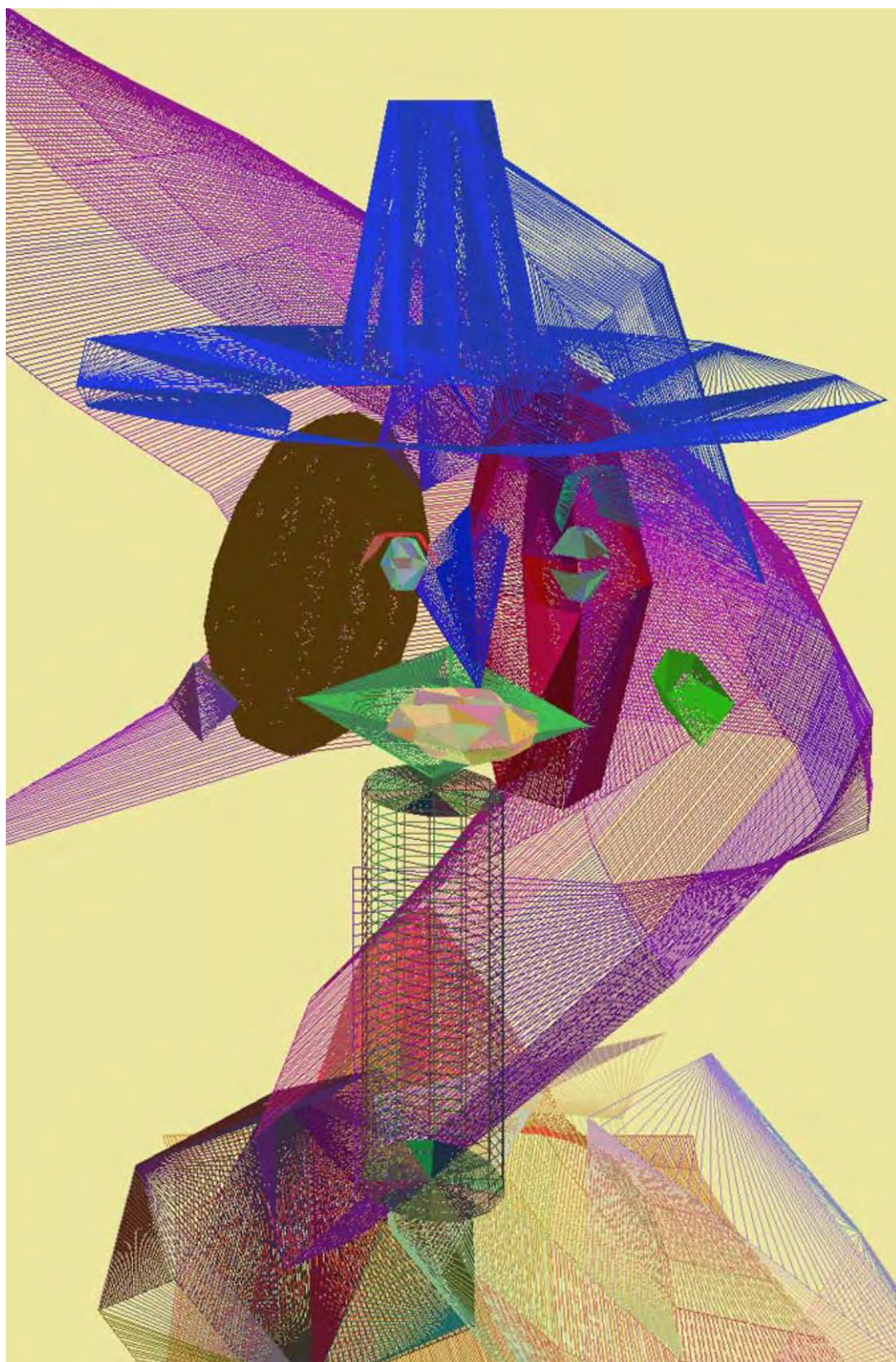














CELESTINO SODDU - GENERATIVE WOMAN 3D PORTRAITS

Recognizability of designer imprinting in Generative artwork

GA 1999

Introduction

Design lives within two fundamental stages, the creative and the evolutionary.

The first is that of producing the idea: this approach is built activating a logical jump between the existing and possible worlds that represent our wishes and thoughts. A design idea is the identification of a set of possibilities that goes beyond specific “solutions” but identifies the sense or the attainable quality. The field involved in this design stage is “how” the world may be transformed, not what the possible scenario may be.

The second is the evolutionary stage, that of the development of the idea. This approach runs into paths of refinement and increases in complexity of the projects. It involves the management of the project to reach the desired quality.

Generative design is founded on the possibility to clearly separate the creative and the evolutionary stages of the idea. And the first is reserved for man (because creative processes, being activated from subjective interpretations and being abductive paths and not deductive, inductive or analytical ones, can not be emulated by machines) and the second may be carried out using artificial devices able to emulate logical procedures. The emulation of evolutionary logics is useful for a very simple reason: for getting the best operative design control on complexity.

Designers know very well that the quality of a project depends, very importantly, on the time spent designing. If the time is limited, the project can not evolve enough to attain the desired quality. If the available time is increased, the project acquires a higher quality due to the possibility of crossing various parallel evolutionary paths, to develop these and to verify their relative potential running through the cycle idea/evolution more times and in progress. (scheme1)

This is not all. In a time-limited design activity, the architect is pressed into facing the formalization of performance requirements in terms of answering directly specific questions. He is pressed into analytically systematizing the requirements before him to quickly work on the evolution of the project. The design solution can be effective but absolutely not flexible. If the real need of the user is, even slightly, different to the hypothesized requirement, the quality of the project, as its ability to respond to needs, breaks down. Projects approached in this way, which we could call “analytical”, are quickly obsolete, being tied up to the flow of fashion.

A more “creative” approach, where we don't try to accelerate (thereby simplifying) the design development path “deducting” from the requirements the formalization choices but we develop our idea using the requirements and the constraints as opportunities of increasing the complexity of the idea, enriching the design development path to reach a higher quality, needs, without doubt, more time. As well as being, of course, a creative and non-analytical approach.

This design approach, which is “the” design path, is a voyage of discovery that is comparable to that of scientific research. The fundamental structure is the idea as a “not deducted” hypothesis concerning a quality and recognizability of attainable artwork, according to the architect's “subjective” point of view. The needs and the constraints, identified as fields of possible development of the project, are opportunities for the idea to develop and acquire a specific identity and complexity. Once possible scenarios of a project are formed, the same requirements and constraints will take part, as “verification of

congruity”, of the increase in quality. Then the cycle, once more, will be run again to reach more satisfactory results. It is, without a doubt, an approach that requires time.

The Generative Design

Generative design is an effective solution to the need to fit the contemporary times and rhythms of the management of a project to the need Celestino Soddu, which is felt more and more, and also no longer postponable, of a quality of the product adaptable to change and to the uniqueness of the user that doesn't want to adapt himself anymore to a product which reduces his expectations: the user wants to find a product in tune with his uniqueness and unrepeatability as a human being.

Therefore, we need a complex but the synthetically shaped product. A product that is adaptable to changes in requirements but also recognizable by its design idea.

These characteristics are the same as those present in natural objects. Rather than the characteristics, in the two centuries of the industrial era, that are characterized by identical objects, of an obsessively repeated architecture and of cities without identity, which has marked the difference between natural and artificial, or, at least, between natural and “optimized” and artificially-flattened goods.

We can form the hypothesis that present passion for the natural world is not a reaction to the artificial world 'tout court', but to the artificially simplified and flattened products of the industrial era. The carved natural world can't be anything other than the desire for a high quality “artificial” environment responding to the human need for naturality. We look for a possible answer not only to “essential” needs, the confirmed and simplified needs, but to the most complex needs of everyone, coming from one's identity and uniqueness.

The project

If we had to sketch some notes on the logical structure of design, we could identify some phases of design activity that are not necessarily in sequence but that often have a parallel development. Each of these phases is specific to Generative design.

Stages in Design:

1. *The construction, by the architect, of his own world of interpreted references.* This is the fruit of the passage from the exegesis to the hermeneutic, that is from the comprehension of our existing environment and of human experience in building artificial events to the interpretation of the same environment and of the cultural references belonging to man's design activity.

This is the notebook of the architect. Where we not (only) find annotated and observed, analyzed and systematized events, but the possible interpretation of them. Each sketch traces and discovers the subtended logic that the architect has found in the event and, I would say, some evolutionary logic used as a procedure for transformation and increasing the complexity of an idea.

In Generative Design, this notebook is realized through a series of sketches/algorithms. In other words, the sketch, relating to the interpretation of his own references in terms of transformation, of a code of evolution of complexity of an event, can be annotated with an algorithm which, evidently, defines how the transformation of input to output would happen. Every possible result, obviously, “remembers” the initial event but the process of transformation is able to characterize the final event using, as a base, identified objectives (objectives of sense, identified with the concept and abstract field using specific meta-project

configurations).

This memorization of procedures (algorithms) is the historical memory of the architect, but it is at the same time the motor of his design activity. It acts directly on the characteristics and on the recognizability of his projects.

The Generative project, as in all design activities, use this notebook. In Generative design, however, this notebook is on-line. And it is structured to be usable immediately for the reason that each note is a procedure and not an image that refers to an interpretation which, every time, must be “remembered”.

But, as in all architect's notebooks, it can be used in different ways. In the traditional notebook, we can interpret the same images in different ways, following one's mood. In the “Generative notebook” each procedure can generate unpredictable results depending on the “artificial environment” generated up to that point.

But neither the traditional notebook nor the Generative one is not a database of forms nor of spatial organizations such as “typologies”. It is not a database of pre-cooked design solutions referred to for analyzing relationships between needs and design solutions. If it were a database of forms it would be impossible to use it to build complexity, because different forms, by nature, cannot be used all together. Being a repertoire of procedures, the notes are usable in the desired quantity and in series, without fear that some procedure contrasts with another. It is as if we have to operate a series of arithmetic operations of the type: divide by two, multiply by three, make the square root, and so on. They can be done, one after the other, without limit.

If it were a typological database of organizational patterns, it would deny the possibility to build an adaptable and flexible project, as these type of references are typically of a reductive and “analytical” approach, and therefore of a project “halved” in its potential and destined to be rapidly obsolete.

This approach brings (in Generative design it operates through repertoires of procedures and not of a database of “solutions”) the possibility to attain, simultaneously, a whole series of objectives even when they are in contrast with each other or, for example, belong to different fields of reference: the world of the architect and his cultural reference points, the client's world, the world of the product engineering, the world of communications, of marketing, and so on. The final project has the ability to surprise each of the design partners. It will be a pertinent representation of the idea of each one; each partner will recognize the project as belonging to his own idea for the reason that he will identify, following his specific point of view, the project as carrying the characters that, in terms of “procedures of increase of complexity”, he had given.

In this sense, Generative design performs an approach to the project which is able to put together different people and different capabilities that may also be (seemingly) in conflict. For this reason, the Generative approach to design is developing in sectors such as mechatronics, where the complexity of products requires the simultaneous holding, in different and not integrable scientific and technological fields improved design activity. The agreement is to speak a common language: the language of procedures, of “how” to transform and not “what” is the solution.

2. The identification of attainable objectives. The objectives that are only partly (as they also belong to another point, the 3rd) the objectives defined by the customer.

These objectives are, instead, the objectives that show how the architect identifies the limit between the real and the possible world. These objectives identify the field of the possible world as the design field, interpreting a model of reality in terms of evolutionary dynamics.

Generative design requires the explicitness of the relationship between this objective

(represented as a conceptual model) and the set of procedures of which to the preceding point. In such a way it will be possible to organize the use of the procedures in a paradigm of control, pointing out when they are interchangeable if they have the same objective and when, on the other hand, they must stratify and/or contaminate one another to reach the proposed objectives simultaneously.

3. *The transformation of the objectives* required by the client (and of the relative connected constraints) *in areas of possible evolution*, in new areas of design possibilities, needs to approach these requirements not as constraints but as opportunities in design evolution, as opportunities in increasing the identity and the recognizability of the idea.

In Generative design, the architect must redefine the client's requirements into procedures of increasing complexity (and of increasing performances). It is clear that this “translation” is not only understanding the requirements but operating a design interpretation of the requirements. It is already a design choice. It is possible, however, and I mean it is necessary for good generative design, to realize these translation-interpretations in a pluralistic way. It is possible to build a set of transformation devices that would presumably operate toward performances in line with the requirements of the customer.

The following phases of the design will allow the architect to calibrate and to review parameters and connections of these dynamic “hypotheses” when the design evolution highlights contaminations and produced synergies.

4. *The representation of the design idea as an evolutionary paradigm* whose characteristics are a) adaptivity to possible evolutions, b) synthesis that goes beyond possible formalizations but identifies the sense of design choices, c) the hypothesized codes for the control of recognizability and identity of the designer.

In this representation of the idea, whose general aspects evolve from project to project, every single design opportunity, with its own specific quality, enters the process as stratification of complexity that hypothesizes and identifies the idea in an organic structure of the whole, of the parts and of the usable evolutionary fields.

In traditional design, this paradigmatic representation of the idea is effected through the schematic sketch that identifies the “laws” of the project. The “codes” of Leonardo are one of the most meaningful expressions of this design stage.

In Generative design, this job corresponds to the construction of a Generative code (I call it Argenia, and I think that it is already a product) that defines the idea as a recognizable architectural hypothesis and the management of the constraints/needs of a specific project as possible fields of development. Such paradigm will be built through events and relationships, with the indication of “how” these events are being progressively transformed activating specific relationships with others, and with the indication of the laws that operate on the recognizability of such relationships, on the degree and the plausibility of mutual contaminations, on the structure and the number of acceptable exceptions and on “how” are managed to fit to condition (or to capsize) the following evolutions.

Being a ponderous body of laws and rules, this generative code is composed of a connective structure that remains, even if in evolution, in the various successive design stages, and in particular laws for specific occasions. In my generative projects, this paradigm is assembled ad hoc for each project even if it always uses a whole series of control procedures of complexity and the same system of management of the channels of connection and contamination between the events in their evolutionary process. This code builds recognizability into the final project, despite always being different and unpredictable.

For instance, the choice to operate through fractal evolutionary logics, that are universally proposed in all different scales, from the project as a whole to the detail, characterizes my

projects. As all architecture produced by my Argenies is also recognizable because the code involves the choice to build the paradigm with two classes of events, the void and the solid so that for every void there is a corresponding series of 26 solids, to arrive at the number 27 as in Renaissance architecture, and that to every solid it has an associated virtual void with 26 interfaces, proposing still nidified 27, and so on. All this, together with the hundred evolutionary procedures that, operating in different fields, from geometry and proportion to technology and materials, have implemented in the last 12 years these Argenies, identifies my idea of architecture, making this idea recognizable in all design opportunities and results of my designing activity.

The charm of Generative design is that it is possible to use complex structures of proliferation and homothetic as fractals, not acting on forms, but acting on logic. After all, the experience with fractals has taught us that, in the recognizability of the final image, the form from which we departed from doesn't count, but the idea, the recognizability belongs to the procedures adopted and repeated.

5. *The management of the construction in progress of the project through an evolutionary structure* that checks and verifies the simultaneousness of the possible evolution and increases in complexity of the design hypothesis (paradigm). In the large professional practices, this stage concerns the project team, the identification of the operational hypotheses to develop, the verification of how the results are meeting the hypothesized quality and the idea.

In Generative design, this stage means the realization of a structure of *artificial life* able to let the project evolve, testing and increasing its complexity, and surveying the multiplicity of possible results as multiple representations of the same idea.

So we can consider the double face of Generative design: The existence of a code, of an identifiable and designed DNA in a way which represents the idea, and the existence of a designed artificial life, built as an unpredictable environment, that can also be sometimes “hostile”, but anyway not structured to be an easy route, but which allows the code of the idea to germinate, to self-organize, to grow and to increase its own “personality” really in journeying, making experiences and sometimes fighting adversities in this “artificial environment” that interacts with its evolution.

Artificial DNA and Artificial Life are the two systems that must be designed for activating a Generative design. They are two separate projects, sometimes contrasting, but they represent the two faces of the same idea of a project. With a deep difference. In the first one randomness doesn't exist, in the second randomness is one of the factors of control and amplification of the idea. In every case randomness must not be used “to produce random shapes” but to upset the code (that represents the idea) letting it react in a way as to increase (and to render explicit in the project) its identity and recognizability, exposing unexpressed potential of the idea (or holes to fill).

The code will therefore always be the same, at least in a single generation of events. The artificial life that will serve as an environment to its evolution has to be ever-changing, even if it has to be able to maintain a pre-defined degree of “difficulty” in a way that the evolution of the project is completed with a sufficient degree of complexity.

What is the result? Certainly an ability of the project, so used to a “hard” artificial life, to fulfill the requirements, also the unpredictability of the consumer. A degree of complexity that can be similar to some natural objects or, I like to think, to the complexity of a historical city that owes its beauty and charm, and, therefore, its ability to resolve the specific needs of everyone, to the long-lived and difficult history, to a stratification of cultures, periods of expansion and contraction, and from the acquired (in this artificially lived life) ability to

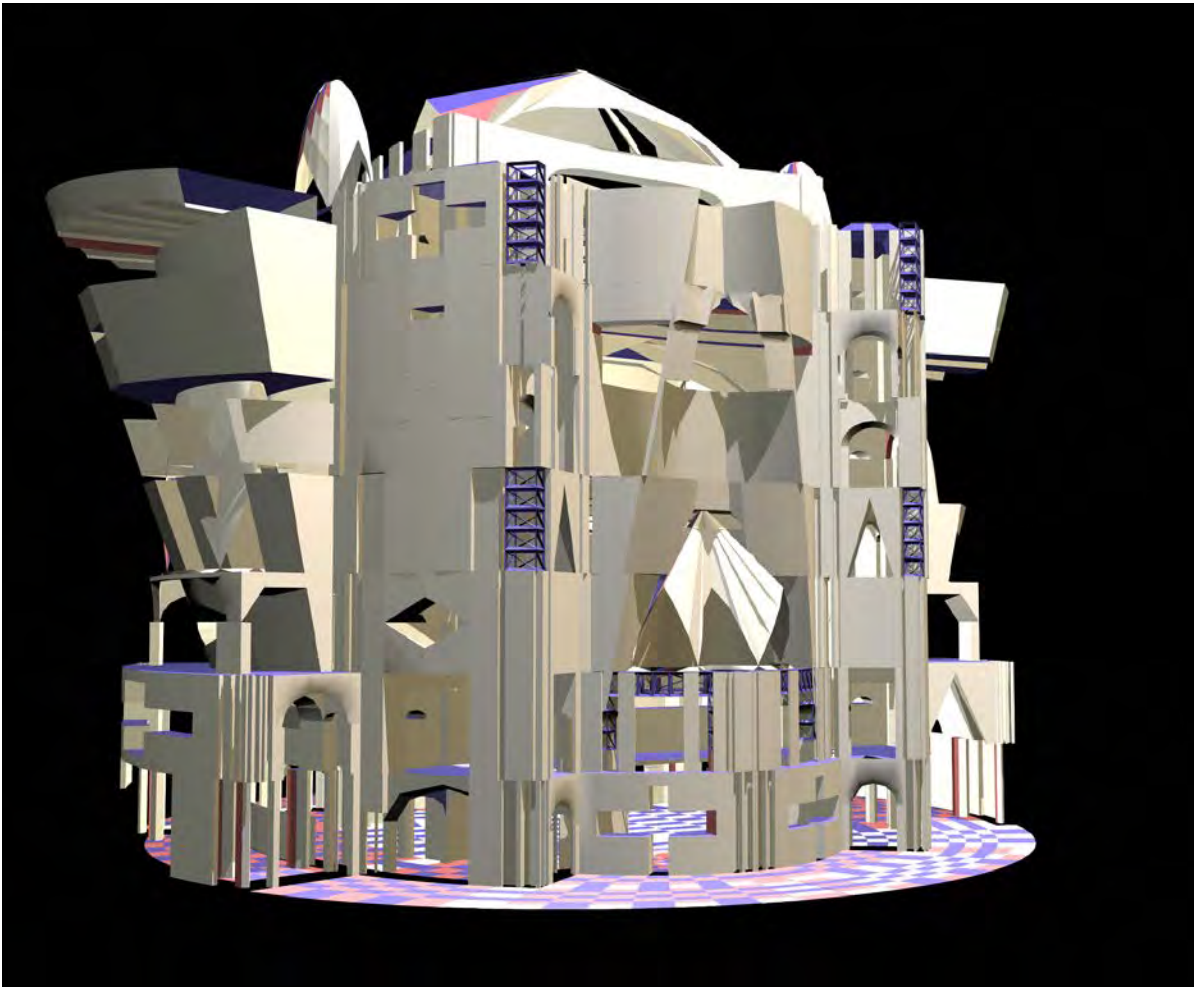
develop, or better increase, its own uniqueness and recognizability.

6. *The feedback between the client and the project.* The hypothesis to pursue is that every successive requirement by the client does not “change” the project, but increases its complexity. One of the traditional rules of design, that our teachers have taught us, has been to never use the rubber, to never cancel but to superimpose. If we change one “solution” with another, we lose what the first solution could give us, even only as a memory to bring up an idea that could be interesting in the following steps of the project. Synthesis, as control of the simultaneousness of different fields and of possible hypothesis, is the highest design act, the substitution of one “solution” with another is the lowest, the last resort that should be rarely used. If the buyer's requirements are “translatable” by the designer in terms of procedures of transformation and not of a change of form, the customer will find more and more in the project which mirrors his needs. But the architect will also have, from these successive increases, the opportunity, the chance to give the project a stronger characterization and recognizability of his design idea. The project will acquire a more evolved order and will be able to answer to progressive multiple requirements. This means that the project will be more adaptive and flexible, and will be able to give relevant answers to the further unpredictable needs of the client and, also, to the unpredictable needs of the final consumer. In Generative design the traditional relationship with the customer has substantially changed in form but not in substance: The sequence need > transformation procedure > generation of possible scenarios puts the relationship between architect and customer regarding mutual capabilities. The buyer is not asked to point out “how” to realize the project but only “what”, what performances he desires. The architect is asked to “interpret” the customer's needs using a procedure, a “how to transform” the project. And these interpretations of the designer are not communicated, as often happens, through a form-idea, but through evolutionary procedures that are represented, in the pluralism of possibly generated scenarios, the idea of the architect. Eliminating the misunderstanding of possible false associations between form and idea but proposing the idea in its potential to go beyond the norm.

The result is the full possibility to carry out feedback between customer and architect in times that are unthinkable with traditional design management and, moreover, respecting the role of both.

7. For projects that also evolve physically (following not only models of industrial products, cities, but also architecture, if we consider the evolution of a project in another one as an evolutionary path of an idea of architecture) the *feedback* is also *between end-user and designer*, and respecting both roles.

The result of this feedback cannot be other than the increase in complexity as a synthesis of sense, an increasing adaptivity to the multiplicity of possible meanings and interpretations (and uses) and, in parallel, the elimination of complication meant as the structured overlapping of limited answers to specific needs.



Freedom House. Milan 1999. Generative architectural project generated with the Argenia software by C.Soddu

In Generative design the project-consumer feedback is a fundamental part of the origin of the product, above all if the product is an industrial product. The consumer chooses “his” object identifying it in a succession of virtual objects that a generative project produces in real time.

The consumer not only chooses his object but “he gives birth to it” for the reason that his choice will activate the production of that unique and unrepeatable object.

Here a conflict rises between the two possibilities of Generative art. On one side a Generative project that works prevalently in a field of randomness, and that leaves the consumer the role of “hunter of emerging events”, a role that tries to emulate the designer's role. From the other a generative project that operates confining randomness to being a simple tool, to an unpredictable but necessary environmental contingency able to increase the recognizability of the idea of the designer. This alternative brings Generative objects nearer to being natural objects, where the recognizability of the species is strong, and where the choice of the consumer exists, but importantly, is not a design choice. When I choose one natural thing as oppose to another, a rose for example, or a cat, I choose a cat for an immediate feeling, and for me this cat immediately will be unique and irreplaceable. But I cannot think that I have designed it. The “project” is the “project of the species”, and not of the individual, and to choose among many possibilities, between many individuals of the same species, is not a designing activity.

Argenìa. The Generative projects

My objective, since my first generative projects, was to design a *species of objects*, of architecture, of the urban environment that could represent my idea of possible artificial worlds. The aim has been, therefore, the construction of the idea as a product, as artificial DNA. This generative code is a product because it is usable to produce artificial events, identifiable as Idea because each produced event is referable to the same idea, that transcends it. The objective has been building generative projects able to produce a multiplicity of different artificial events but not random events, unpredictable but ever recognizable events, amazing also for me but immediately identifiable as one of the possible communication of my idea.

I have given more importance to an approach that excluded casualness as form generator but used randomness as a starting point for the growth of complexity of forms whose identity must be directly checked and constructed by the design choices. In other words, the design of “identity codes”, of DNA of the artificial events is so strongly structured and identified that we let them evolve inside a “designed artificial life” whose random unpredictability is used for “training” the project and to let its complexity grow. Therefore, these projects were not genetic projects (with genetic algorithms) but generative projects: projects of artificial generative code (artificial DNA) interfaced with projects of artificial life.

I have called the idea product of these codes “Argenìa”, because the search has been on creativeness transcending the single event, on the idea as a project of possible artificial species.

The first experimentations and realizations of Argenìa

My first Argenic experiments were produced from three-dimensional representational software that I developed in the mid-80's and some experimentation on algorithms representing chaotic dynamic systems.

The first Argenic software in the field of three-dimensional representation was founded on the concept that a two-dimensional image could be considered, if opportunely observed, as a generative code of a universe of possible three-dimensional models. The passage from the two-dimensional image, interpreted as referring to a three-dimensional order is, in fact, immediately conceivable as a “perspective reconstruction” if the two-dimensional image is a perspective and the three-dimensional space, that we are looking for, is the 3D model of the space represented in perspective. However this approach becomes more interesting and complex when the initial image is not a real perspective, but we read it *as if it were a perspective*. And if we, as architects, use it as a catalyst to investigate our own idea of architecture and to create spaces and possible objects that represent our own concept of space.

The passage from the 2D to 3D image, in fact, is not an automatic evolution, but it presupposes a subjective interpretation that increases the specific quality and identity of the results. The initial image is not immediately readable as a 2D representation of a 3D object.

If the initial image is a sketch or, for instance, an abstract picture, the result will be, fundamentally, a 3D space creation based on the architect's interpretation. The created space will be a space representing the architect's idea because space is not “derived” from the original image which was only used as a catalyst of the creative path.

I have produced, on these presuppositions, the software “Traces” as a management tool of

the subjective interpretation of 2D images for the creation of 3D models. This software was built on the rules of anamorphosis, that is of the plurality of possible interpretative codes of an image.

Not only this. Since classical perspective drawing, the 'perspectiva artificialis' is, just an artificial representation, or rather an allusive note of the vision but not representative of how the vision happens and how the full immersion in an architectural space happens, I have replaced the "perspectiva artificialis" with a perspective that I have called "total perspective", performed through specific algorithms projected by me. The total perspective is an anamorphic perspective which uses 360 degrees. The difference between this perspective and every other 360-degree perspective is the anamorphic rectification of curved lines. In other words, the total perspective interface is a cylinder and we are inside the cylinder and we position ourselves in the center of it, the curves, that represent the straight lines in the real world, are perceived as straightened, that is right, because the bending of the cylinder and the bending of the curved lines, representing the straight lines in the perspective drawing when it is stretched out, are annulled by anamorphosis. And when we look around the space represented in the cylinder, the straight lines move, changing direction, but they always stay straight, since anamorphosis operates as a fourth dimension that, in real time, promotes the more opportune visual interpretation.

Therefore, I have activated, in the software "Traces", the possibility to interpret a 2D image as one of the possible representations of a space read from the inside of the same space. Therefore gaining the possibility to work directly on the possible integral transposition of a 2D image as a virtual environment, a full spatial immersion of the designing architect.

All that remains is a background of complexity, as codes of management of ambiguity, inside the successive realizations of Generative projects.

The structure of Argenia

In the following years, beginning from 1987, I produced the first Generative projects in which, once the idea as a code is set out, the evolutionary structure of artificial life, Argenia (the integrated system which joins the Generative code and artificial life) automatically produced a whole and endless series of different and unpredictable three-dimensional events, all different but all representations of the same idea.

The structure of these argenic projects is founded on the pre-suppositions first identified:

1. *the code of the idea* is built through a parallel series of interpretative codes that operate a transformation of each input to an output event with an increasing complexity that belongs to my idea of architecture. These procedures represent my architect's notebook.
2. *a primary paradigm*, or better a set of superimposed and autonomous paradigms, that represent and manage the use of the procedures of transformation and their homothetic symmetry from the whole project to its detail.
3. *a secondary paradigm*, also this is multiple because it refers to the various fields involved in the designing action, that manages the transformation in relationship to specific data of a particular design opportunity.
4. *an artificial life*, a management code of evolution of the complexity of the project, that allows the progressive increase in complexity of the idea. Inside this emulation of an open designing path, there is the random factor as a factor of stimulus and catalysis for bringing out the progressive recognizability of the idea. This artificial life shell, in fact, is the structure that produces not forms but ever new incoming fields of design opportunities.
5. *A structure of representation*, in progress, of the generated 3D model that allows the

immediate reading of the generated scenarios. This real-time representation allows the acceleration of feedback and, then, the construction in progress of the idea as a product.

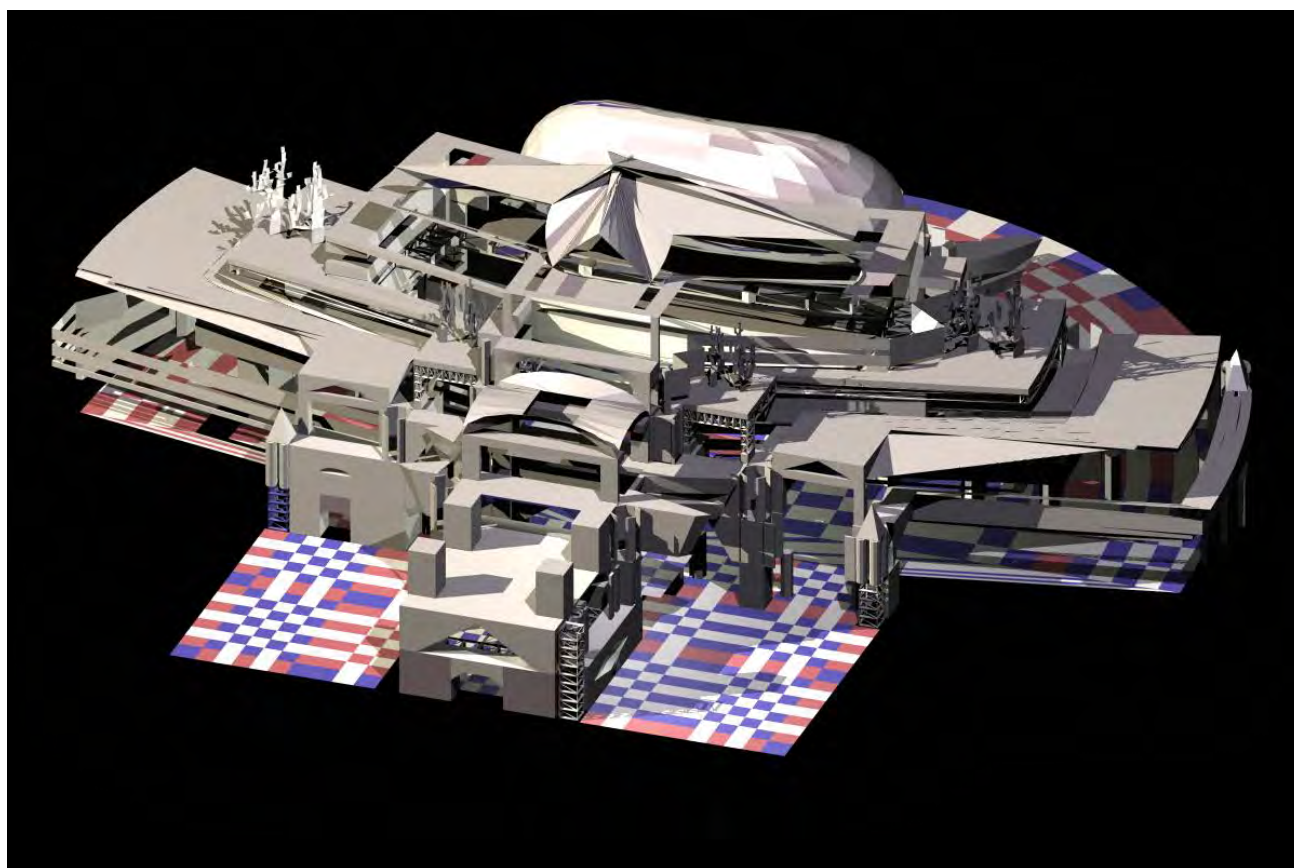
The recognizability of the idea and the identity of the designer

1. The idea as the product exists only if the idea is a recognizable code.

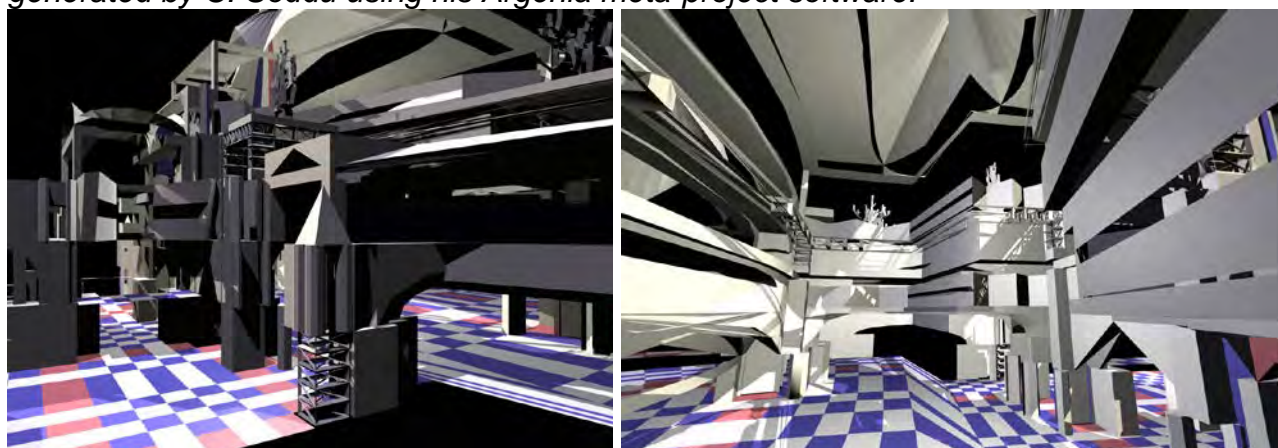
To pass from a product-object, therefore from an “always equal” and physically identifiable product, to a product-idea as a usable code to produce different physical objects always means to address the design job to the recognizability of this idea. And this recognizability, once it is not linked to a specific physical object, has to postpone the concept, to the meta project, to the “hand” of a specific designer.

Generative designing, therefore, requires a strong concept design and a design able to make the difference in terms of desirability of the product. Certainly, it is always possible to apply to every produced object a mark, a hand-writing that points out the “stylist”. So the architect, the designer would be recognizable. But this recognizability has no value as a quality. A picture of VanGogh is not recognized from the writing Vincent. Even if we have never seen one of his pictures before, we do not recognize it for the signature, or for the colors, or for the type of line, but for the identifiable idea of the world that comes out in all his work.

Our recognizing codes are built up from infancy. This process is peculiar to art. We learn, from early infancy, to recognize everything in the world, to recognize, for example, a chair from other similar objects. We are able to build our own peculiar structure of the idea of a chair. When we are in front of a chair that we have never seen before, despite having a shape which is new and different from any other known chair, we succeed in recognizing it as a chair. The recognizability is, therefore, our abstract synthesis of already lived for the valuation of the unpredictable incoming events. But recognizability is not an objective category. We cannot learn to recognize objects only through our own experience. This synthesis belongs to the field of subjectivity, it is a distinguishing mark of our uniqueness and identity as human beings. It is the subjective building of categories, of species for the identification of individual products. This synthesis is also the first step in approaching the design process. (C.Soddu, Edinburgh 1999)



Blues Terminal, Milan 1999. Axonometric internal views of the architecture completely generated by C. Soddu using his Argenia meta-project software.



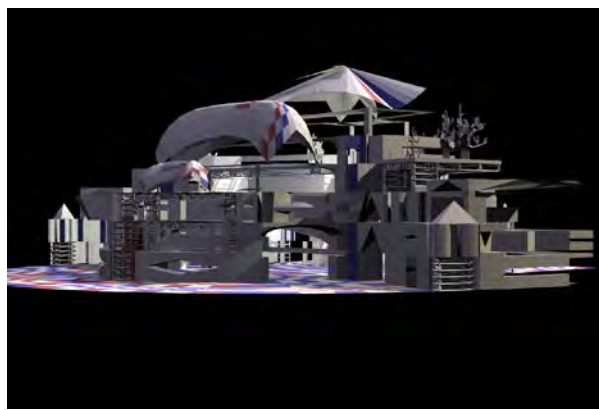
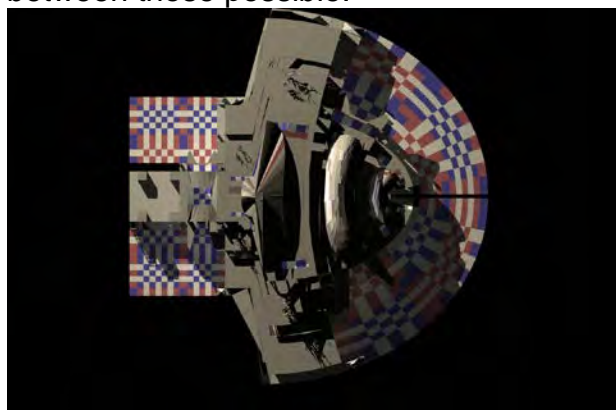
2. Recognizability comes from subjectivity.

The structure of recognizability and of its identification from the user is, therefore, fundamentally, a structure of connection between two subjectivities, between two syntheses of the world, between two ways of seeing a possible environment: one subjectivity belongs to the architect, the second to the user.

And here the only possible field of investigation emerges. To manage, in the act of designing, these possible connections between different subjectivities: complexity. We mean complexity as an answer in terms of flexibility, of adaptivity to inter-subjectivity; as a pertinent

answer to unpredictable subjective needs but, on the other hand, being able to recognize it as it really is, which is to exist as a subjective idea of a species.

We could say that the architect builds his own idea-product on the field of sense, building in complexity and multiplicity of this sense from own references, while the subjectivity of the user is rendered explicit in the identification of a meaning (but also identifying a possible use) between those possible.



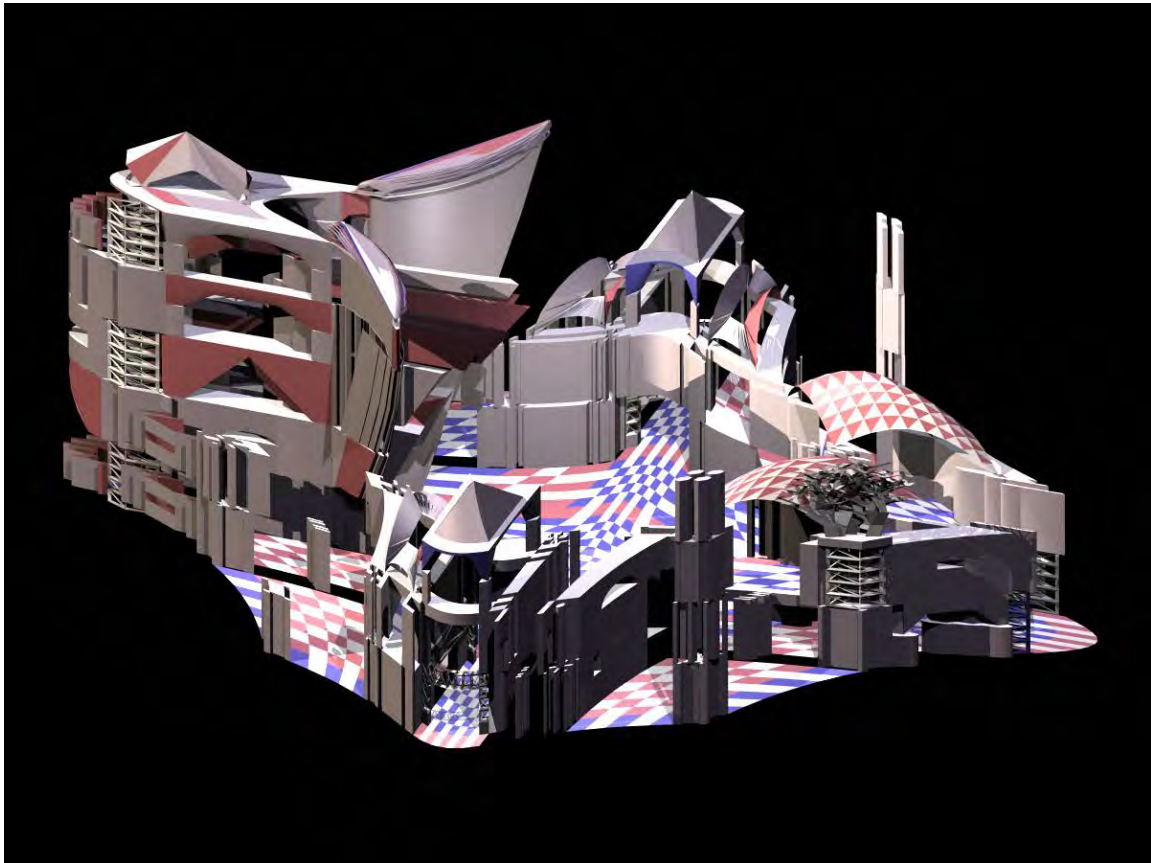
Plan and perspective view of Blues Terminal. Generative Architecture by Celestino Soddu

3. Subjectivity means not simplification (objective) but complexity.

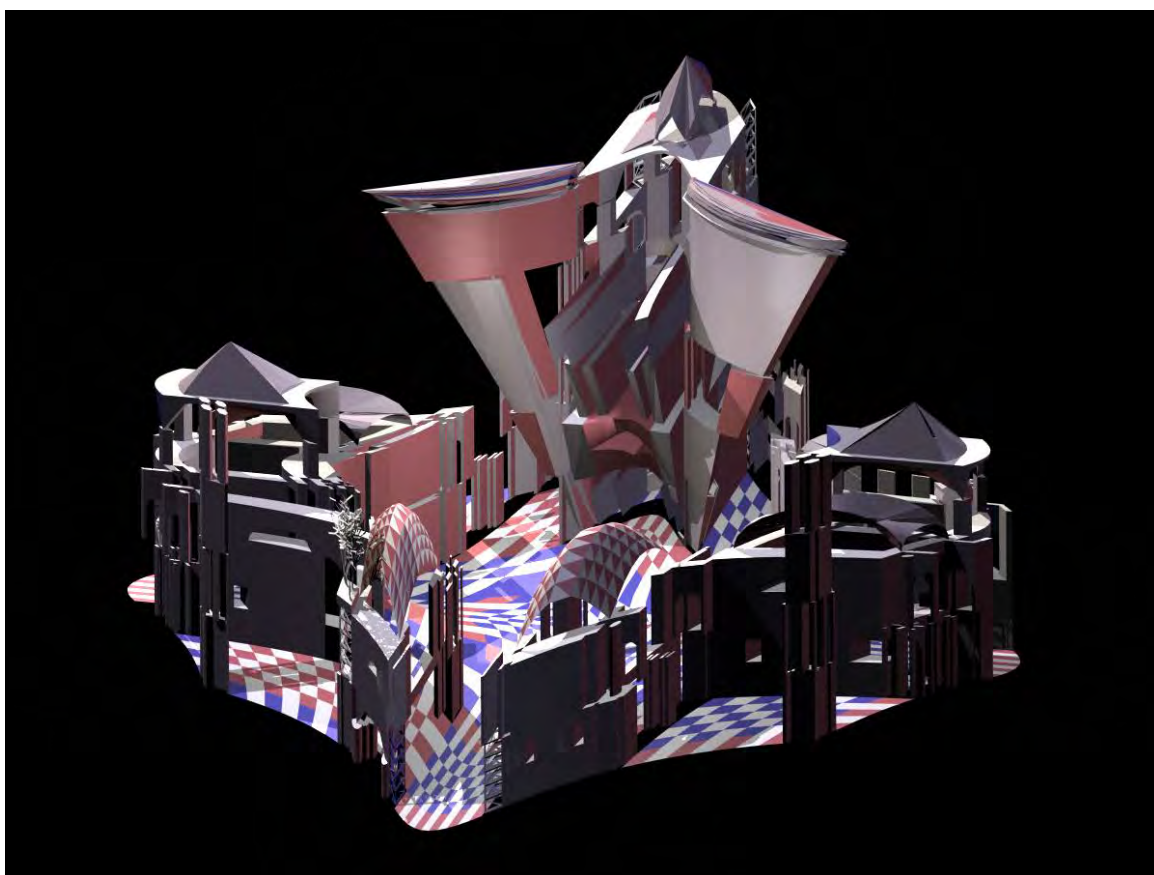
Wanting to use drawings as a metaphor for the relationship between subjectivity, objectivity and complexity, we could say that with a drawing such as the axonometric, which is objective, we would never succeed in representing the infinite, whereas with the perspective, which is fundamentally subjective, we can represent and “check” the infinite. The complexity of an idea-product can only be created from the subjectivity of the architect. But, the more the subjectivity of the designer is recognizable, the more the idea-product acquires quality and market.

4. Argenia is a direct approach to complexity, and in this, it finds its strength irreplaceable in contemporary times.

Generative design, and particularly Argenia, for the reason that it has a preference for the recognizability of the designing idea and not for the random generation of forms, turns out to be an easy designing approach to complexity. Complexity, in fact, is ever-present in an Argenic project, it is its necessary fuel. As I often say to my students, if an architect complicates his (designing) life, he accelerates the project evolution, because he identifies the fields of possible design choices more quickly, and, therefore, the necessary fields to activate increases in complexity in which he will be able to let his own ideas emerge. In the structures of Argenia, this means that the more the client requirements are complicated, the more these requirements are also contradictory, the more different kinds of constraints will be set on the project, the more the process of construction of the recognizability of the idea will evolve.



Caravanserraglio 99, two axonometric views of an architectural generated 3D model. Project by C.Soddu, using his Argenia.



This is not all. Given that the requirements must be “translated” by the designer into transformation procedures, these requirements are added up one over the other, sequentially, and the management of the complexity becomes easy. One of the greatest potentials that have emerged in the Generative design approach is that it is a suitable approach for projects of great complexity where the designers must control a whole series of unrelated disciplines.

In contemporary times, where buildings, objects and, naturally, cities are becoming more and more complex, where uniformity and blandness is no longer acceptable and where subjective and cultural identity is more and more required and precious, the Generative approach finds and will continue finding its own irreplaceable space in the activity of design and production.

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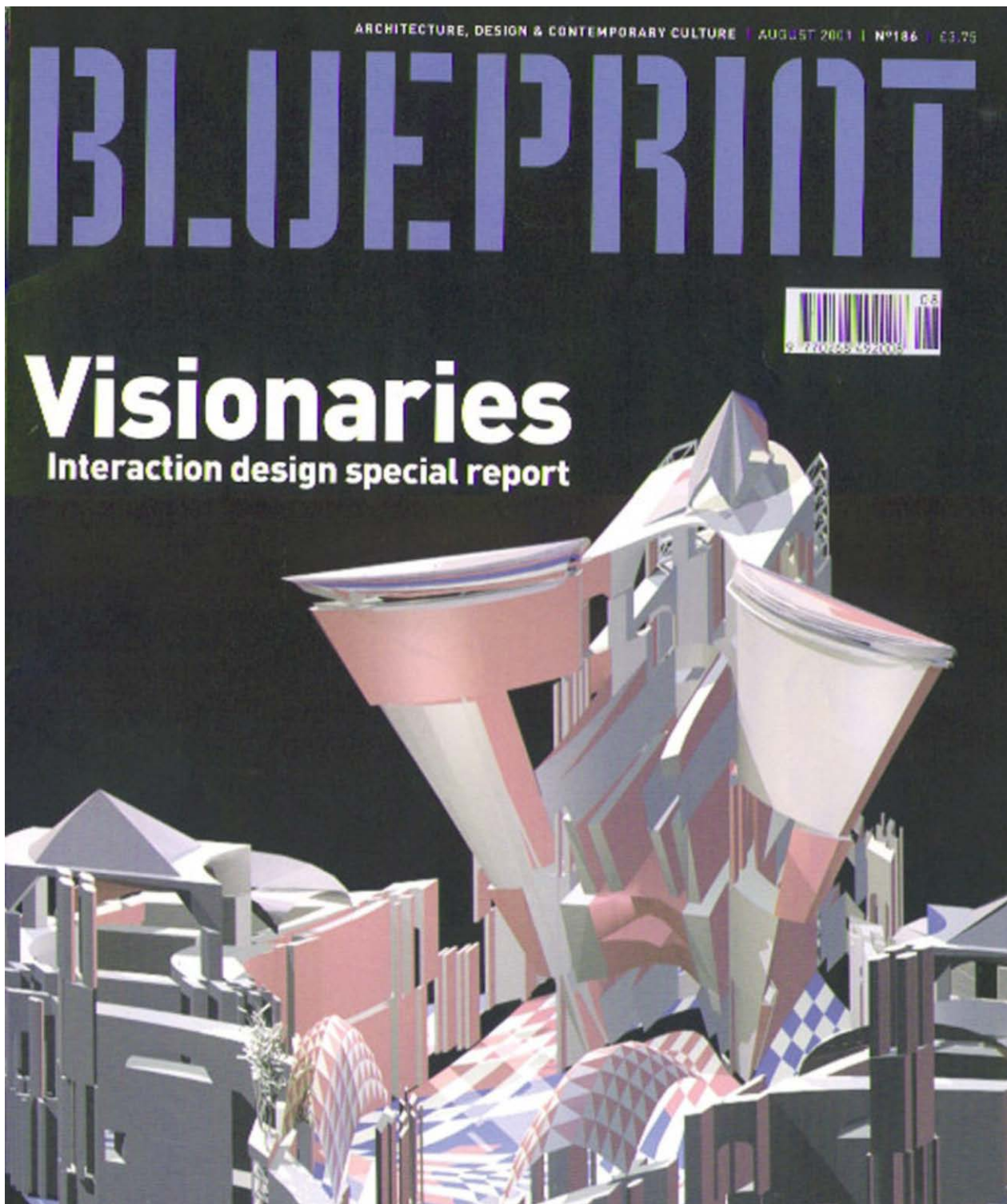
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The cover of BLUEPRINT with the generated architecture by Celestino Soddu



From Forming to Transforming GA 2000

The ancient codes of harmony

The ancient codes of harmony stem from the human vision of the complexity of nature. They allow us to think the possible, to design it and to perform its realization. The first gesture of every designer is to take, in a new application that is born from a need the opportunity to experiment with a possible harmonic code. And to operate in the evolution of the project so that this code buds and breeds beauty as a mirror of the complexity and wonder of nature.

In this design activity, project after project, every architect builds his own code. This is strongly present in diverse ways in every architect. The code of harmony born from the attention of every man to the complexity of nature manifests itself in interpretation, which is logical and therefore feasible, of the laws of formalization of relationships. Every interpretation is different and belongs to the oneness of every architect. Every interpretative code stems from, and reveals, our approach to the world, our cultural references, our history, our present and the memory of our past.

Each idea is born as a representation of the interpretative code that is a cryptic and subjective code, even if it refers as constant to the history of man. Generative art is the maximum expression of this human challenge: it traces a code as a reference to the complexity of nature, and it makes it feasible. So man is the craftsman of the possible, according to the laws of the natural harmony.

What does a code of the harmony contain? As for all codes, it contains some rules that trace certain behaviors. It is not, therefore, a sequence, a database of events, of forms, but it defines behaviors: the transformations. To choose forms and to put them together is an activity that can also resemble that of a designer, but essentially it is the activity of the client. The designer does not choose forms but operates transformations, because only by doing so can he put a code of harmony into effect.

Between transforming and choosing forms one can trace the borderline between architects and clients, between who designs and who chooses the projected objects. This difference must be reconsidered especially today because we are going toward a hybridization in which the client wants to feel himself a designer, even if he only chooses. And the designer, using sophisticated tools, works as choose between different solutions, in practice as a client.

To design, to create through transformations is, however, an activity that takes time. The generative design, building a usable and upgradable code, makes time virtual and, therefore, allows the architect, even in a speeded-up world as today is, to design and reach levels of complexity that mirror the complexity of nature and its beauty.

The project. Identification of the codes of harmony.

In every project, there is the first step. The designer knows that his first act has a precise purpose: he has to trace a system of relationships that must be adaptable to each possible development. If this act involves tracing a form, the designer has to know that he is faced with two possible ways: to consider this form as an allusion to the final result, discarding other possibilities, or to use this form as a catalyst of the design evolution process. This second hypothesis represents the real design approach. The first traced form is useful, in fact, only to focus a field of reflection on our history, on the present and on the memory. This first design act is the occasion to use the code as a means of possible transformations, and

the traced form is a frozen moment in this transformation process. We are not able, in fact, to transform a white sheet: we trace a form transcribing our memory a spark of the idea.

Doing this we know:

- 1, that we have operated by choosing one way among many possible ones, and therefore we have conditioned the result of our project;
- 2, that the project we are realizing won't be less attractive, in terms of satisfaction, quality and beauty then another possible project. It will be the result (or better one of the possible results) of one of our design code. The quality that we reach will be measurable by the quality and complexity of this code.
- 3, that an idea, concretized as a code, realizes in every architecture a cryptic writing that will also emerge when functional demands and fashion change. An idea is timeless, appreciable as the interpretation and re-reading of the built reality.

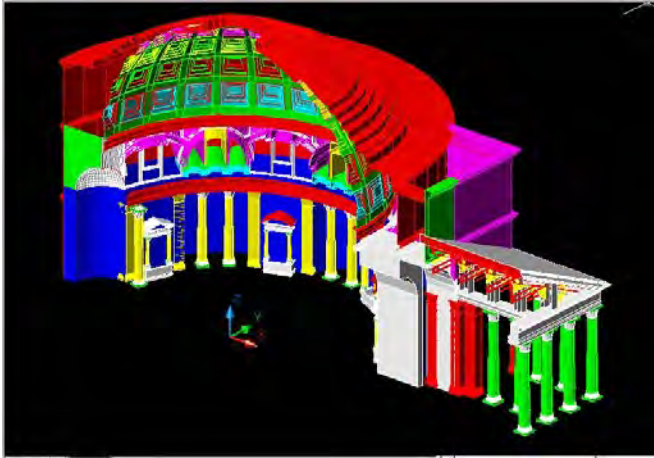


Fig.1, Pantheon digital reconstruction

The Pantheon is timeless. This idea is by Adriano. It doesn't matter if it has been realized by transforming an existing building or if it is a new building. And it is not important who initially realized it and who transformed it. This idea is strongly identifiable by reading the adopted code: the omnidirectional structure as a concept of the universality and the relationship with nature, the north orientation, the inside perspective structure that connects man to the built space and through this to the universe but, above all, the overlapping multiplicity of possible geometries that, hidden in the apparent simplicity of the construction, manage the progressive transformation of the space and its increase in complexity. These overlapping geometries stem from the idea of the omnidirectional structure of the space as a connection to the universe and nature: the concept of harmony as the awareness of manifold subtended relationships that build a pattern whose sense is discoverable by each man in a different but calibrated way of feeling himself a craftsman, inside the natural complexity of the possible. Redrawing the Pantheon with the computer I have made some discoveries of overlapping geometries.

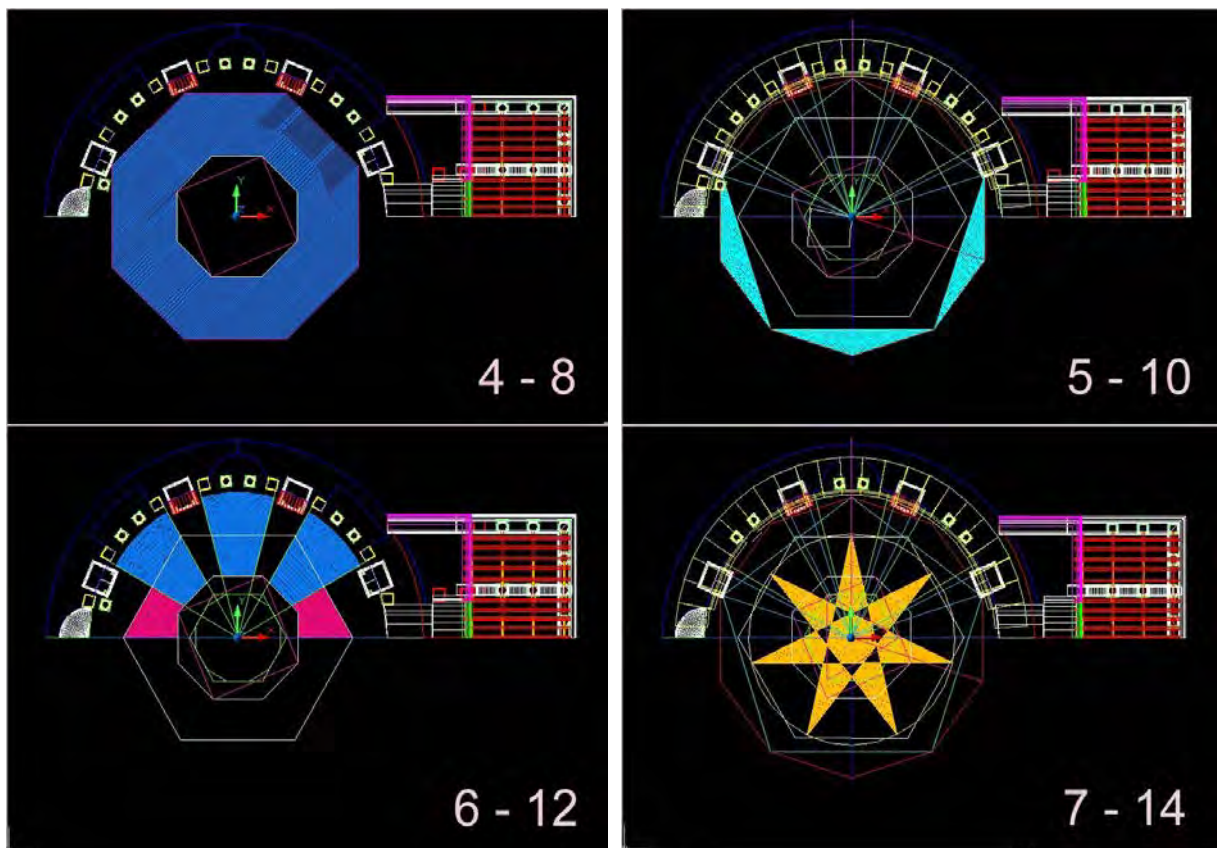


Fig. 2, Pantheon cryptic geometries.

To the apparent structure of a spherical geometry divided into two parts and of an octagonal division underlying an impending heptagonal division (the series of panels in the cupola are 28), there are other possible hidden geometries. In particular, I have found myself drawing a series of elements with progressive angles of 36 degrees, tracing a further pentagonal geometric structure of the curved space. While the octagonal structure traces the sequences of the spaces, the pentagonal / decagonal one defines the rhythm of the emergent pillars. Not only this, but there is other subtended structure referring to a hexagonal geometry, with the moving on the transversal axle of the twelve-sided polygon that alludes to a possible scanning in 24 parts, restoring the double axle of symmetry.

What is amazing is the actuality of this space, its ability to stimulate the search, in every person who crosses it, a personal point of view, to answer in this way to the unpredictable needs of each person, to be a boundless continuum of possible subjective “discoveries”. And one hardly realizes that the inside is double. An original layout of the attic internal facade exists together with a more recent layout that completely transforms the structure of the inside front. The idea is so strong and explicit that the two layouts, despite their strong difference, appear only as two possible and interchangeable scenarios of the same design idea.

Ever Bernini, building above the Pantheon the famous ears, then demolished, has not done anything else other than to produce a further possible scenario of the idea of Adriano of his code.



Fig. 3 Pantheon's interior setups.



Fig. 4 Pantheon's ears by Bernini

The code, in fact, represents the idea. Every possible scenario of a project, that is born from different initial acts or, as in the case of the Pantheon, from subsequent cultural contingencies, is nothing more than one of the possible representations of this idea. Obviously, it happens if whoever continues the work is able to recognize the code and to interpret it, to read the cryptic composition score. This is because every use of the code is an interpretation of the same.

The generative approach to the project, realizing the code realizes the idea as a product that is autonomous from possible further applications, from possible evolutions, from possible contingencies. The generative code, as an Idea-product, is the essence of the creativeness of each architect or artist. It is the idea, the concept, realized through an operative meta project whose performances are predictable in terms of quality, clarity, and recognizability, but are unpredictable as formal results. We can ask the question: these results, although unpredictable, are they also surprising?

To transcribe an event, a memory as a code.

If with a pencil, we scribble on a sheet of paper, we have represented what surrounds us with a bidimensional image. The scribble can allude to an event of our memory, to a thought, an aesthetic emotion, an object that fascinates us, a system of relationships. If this scribble is our initial design act, we have to make it in such a way that it is legible usable to build our code. It all starts when we look at this form with the eyes of the designer. At this moment each bidimensional trace assumes unexpected characteristics:

1. It is the representation of manifold and possible three-dimensional events that define a universe in transformation. A universe whose forms oscillate following our possible keys of reading that are the representation of our creative and designing strength. But they also follow the interpretative oneness of every single moment of ours activity. Only by reading bidimensional objects as possible representations of three-dimensional events can we find an unexpected universe of possible and manifold parallel spaces. All these spaces, however, are characterized by our identity. Parallel and possible spaces are endless, but all mirror a specific approach to the world, a subjective interpretation of what surrounds us. If we don't succeed in operating manifold and amazing interpretations of our sketches, how would we be able, at the end of our design or artistic project, to reach the quality that allows us to overcome time, englobing in our work a multiple stratifications of possible meanings, an adaptive sense that allows any user to read and to choose the specific and unpredictable

meaning that he is looking for? How will we be able, in other words, to build an idea, a concept that gives quality to our works?

2. It is the representation of a dynamics of transformation where the sketch is only the first static trace of a process, of a progressive transformation that reveals our evolutionary idea, that tells us as we would like to transform the environment in which we live. We immediately realize that a unique dynamics of transformation doesn't exist in our interpretation of the trace. The possible transformations are manifold and they tell, in a direct and essential way, our oneness and the oneness of designers. The stratified multiplicity of these transformations is the representation of our design code.

From the sketch, a code emerges, a design idea as a code of transformation. This reveals once more a theoretical and practical aspect that is often forgotten: the designer doesn't create a form but operates transformations. The generative project is the construction of a corpus of laws which shows not only the complexity but also the synthetic and communicative clarity of the transformations, not of all possible transformations. Each designer, each artist is unique, as is every man. A generative project relates to and makes performable a set of particular and subjective codes. The oneness of these evolutionary codes emerges from the interpretation of what surrounds us as a dynamic moment toward a possible increasing complexity and, particularly, it emerges from the possible evolutionary visions that the designer himself can find in his sketch.

To memorize our own code of harmony we can use various languages. The codes of Leonardo da Vinci are written and drawn codes: they are sketches for personal use, for rediscovering interpretations and supplying further interpretations to annotate a later one. But there is a language that makes these annotations directly usable, and that operates and directly represents the transformations: the algorithms. To a designer, it doesn't matter if $A=n$ but if $A=A+1$, that is if A transforms itself and “how” it transforms itself. If we use an algorithmic language to represent our idea we gather two opportunities: we use the proper language of transformations and we represent our idea in an “executable” form, that is directly operational. We realize in other words a Generative Project, an operational subjective meta-project, a full idea-product that has in itself the fullness of possible results, manifold events identifiable in the same idea.

Construction and use of a Generative Project.

When we identify a logic, a “how” an object can transform itself, we read the object of this transformation from a particular point of view which is able to represent it through a system of roles and relationships. In other terms, we decipher the structure of the object that we want to transform through a paradigm. This paradigm is not intrinsic to the object. If the object is our occasion of the project, the paradigm cannot be only represented by functional roles and relationships, even if obviously such functional needs exist on each specific occasion of the project. The paradigm will be built by interpretations, in terms of roles and relationships, of the functional needs that the customer has expressed and of his subtended needs, external and subjective. Each designer has his own paradigm to approach the objects that surround him and, naturally, of thinkable and possible objects. This subjective paradigm is the main part of the interpretative and evolutionary code. It belongs to the idea.

This paradigm of interpreting the possible world comes from the search for harmony, for awareness, for the complexity and beauty of nature. Often it comes even from the idea of the human body as a code of interpreting every possible object: the “legs” of a table, the headlights of cars as “eyes”, etc.

The interpretative paradigm is a constant, even though it is in evolution, in the activity of every designer and it identifies him. The man of Leonardo, with his arms widespread in the circle and, in the same time, in the square is an organizational paradigm of the possible. The structure of the human body is meter and code of interpretation, proposal and evolution of each possible artificial events, identified with the square and the circle. It is, at the same time, the organizational and logical structure that allows the designer to act the “design transformations” from the square to the circle, and vice versa. The squaring of the circle: myth, the unreachable goal of designing minds.

To build a Generative Project it is necessary to put together the two logics that identify the designer’s activity: the paradigm that defines roles and relationships inside possible incoming events and the laws of transformation, the algorithms that explain our idea of the possible events as an evolution of the present. A generative code with these elements, paradigm, and laws of transformation, can become, in a progressive increase of complexity, a code of meta-project rules that identifies the character, the recognizability and the communicative clarity of every possible event that we could still design; before not only designing it but knowing what the object will be: a table, a school, a skyscraper, a lamp.

Paradigm and algorithms of transformation define in fact the “how” to operate and not the “what” to do or to choose. These tools define therefore the job of designing and not that of buyer and client. The client chooses between one form and another, between one object and another, and his specificity is to identify the object of his taste. The designer transforms the events into possible objects, and his specificity is to see over the existing events, to be a “visionary” man. The limit of the client is to ask for the impossible world, the challenge of the designer is to transform it into a possible one.

Borromini, in this approach, has been a great teacher. I imagine the request made to Borromini for the church of Sant’Agnese in Piazza Navona: I want the church be present in the whole square, inside the square but, at the same time at the limit of it; the dome has to be present in all the square, it has to move itself amplifying the character of the square that is a lengthened elliptic Roman passage. Impossible applications that, indeed, were made possible by a series of design transformations by Borromini operating with his architectural code. The dome “walks” and is the “central” presence in the square. It is amplified, not obscured by the fountain of Bernini, as well as by the turrets and the curved geometry of the facade. Bernini, in fact, with his fountain succeed in developing the idea of Borromini because this idea, as all timeless ideas of the architecture, is able of to live and to nourish itself on the unpredictable, stretching itself in multiple and amazing representations, but maintaining unchanged character and quality. This is so even today: an incomplete restoration has given Sant’Agnese two colors: the dome, although darker, maintains its strength and its dynamics presence in the square, highlighting even more the conceptual structure of the idea.

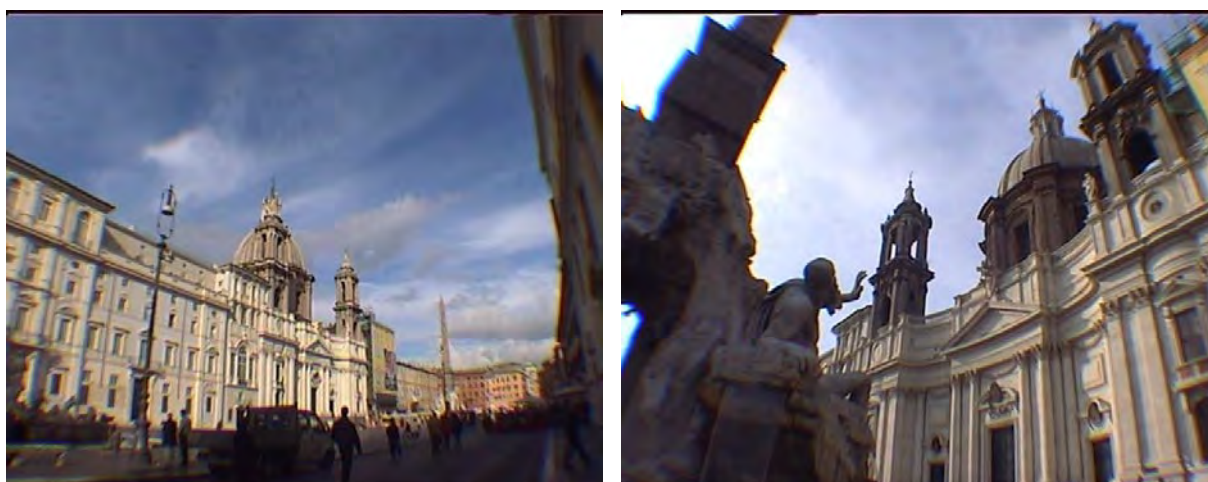


Fig. 5,6 Sant'Agnese by Borromini

To operate with Generative Codes.

A generative code, composed of an interpretation paradigm and of transformation (algorithmic) engines, can be realized as a logical and operational control structure of the project or, better still, of the possible projects. This is due to the fact that the algorithms are logical structures of the representation of the transformations that can be operated with manifold and different objects and on different occasions.

Inside a generative code, we can find all that needs as to “how” to transform events, but there is not the object, the occasion of these transformations. To pass from the code to three-dimensional scenarios of architecture that represent, for instance, the museum located in Fresno, with a defined number of exhibition rooms, each one with its peculiarity, with a defined number of offices and services, with precise relationships between public and work spaces, with specific sequences of paths, etc., it is necessary to turn these applications into an organizational paradigm, a mirror of that interpretation paradigm, that contains and interpret the specific requests of the client, the functional aspects and the technical and material options. All these “choices” are, or they can be, the expression of the customer. The organizational paradigm doesn't define ex-novo how to organize roles and relationships but it connects the roles and the relationships identified in the interpretation paradigm with the functional specifies required by the client. This connection, these “fitting” is made possible by two facts, an extraordinary and one ordinary. The first concerns the possibility of defining some exceptions that are specific to the design occasion. These exceptions may also be the occasions to increase, to evolve the structure of the generative code. Following this method, project after project, the code grows I quality and uniqueness. The second concerns the usual design activity. The connection, the “fitting” is made possible by the fact that the logics, roles, and relationships present in the interpretation paradigm, can be slotted in one inside the subsequent. The same paradigm is a fractal object. Every role present in the paradigm can and must contain in itself the whole paradigm, and so on. The structure of the functional needs of the client finds, in this increasing complexity and in the potentiality of functional performances, a wide space to express itself through the paradigmatic interpretation, also multiple, of the possible evolutions. At the same time the more the paradigm consolidates, the more the occasions grows to apply the code of harmony. In other terms, we can affirm that the more the requirements of the client are complex and “impossible”, the more the potentialities of the generative code are made operational and, therefore, doesn't remain unexpressed. And consequently, if the control of the code, taking advantages of the

occasion for specific requirements, work on all levels, from the global to the detail, it increases the communicative clarity, the identity and the quality of the project.

Once we have inserted the organizational paradigm in the generative code, we have conceived a new architecture, (or better a new kind of architecture) that however will be inside the designer's concept of architecture. To create it, it is necessary to sparkle an evolutionary process, emulating design life. In this artificial life, as in the real design life, we need a first act, a sketch, a catalytic event that can be used for priming the dances of transformation, it is not being possible to transform the nothing. This priming can also be caused by using a random factor because the form is not important, but the topic is the dynamic interpretation, the possible following transformations. But this sparkle is what determines the difference among individuals, even if these individuals have the same quality, character and identity of species and, above all, each individual reflects the same idea of harmony and beauty. However, they will be unique and unrepeatable if the catalyst is always different.

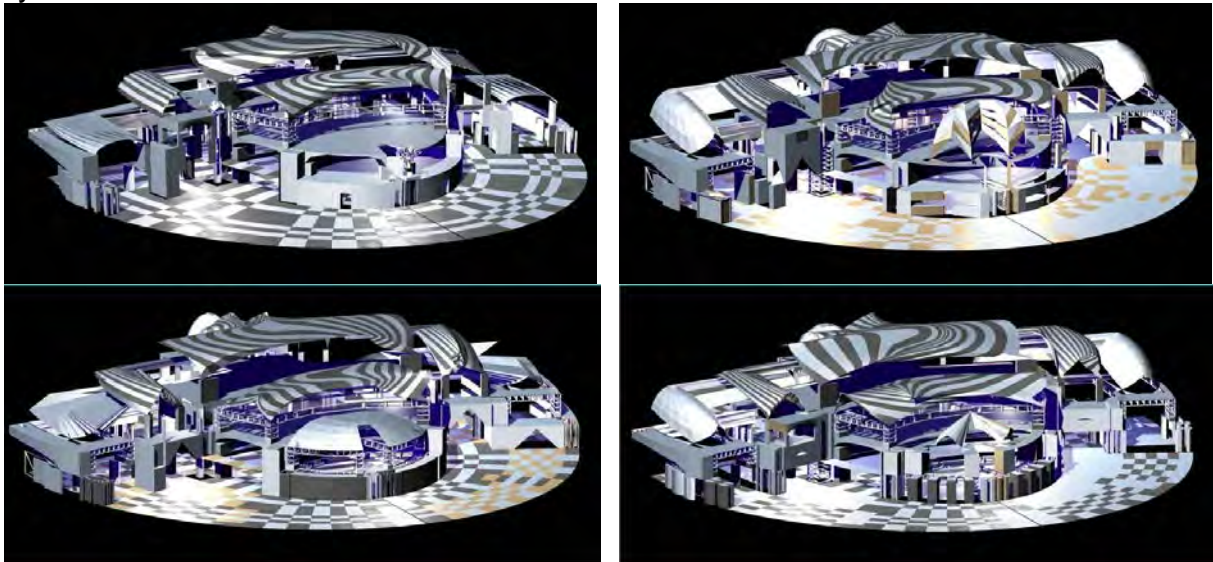


Fig. 7 A set of 4 different generated architectures. Generative project by C. Soddu.

The individual and the species. The reason for a production of objects, all different but all belonging to the same concept, to the same species.

If we walk in a pine wood, every pine is different from the other. Every tree is, by itself, unpredictable. But is it also surprising? Certainly not. We know it already even if we have never seen it. An exceptional tree can be amazing, but only the first time we meet it. Then it becomes indistinguishable from the others. It belongs to our memory knowledge. Last year I edited the proceedings of the GA'98 conference. Each book had a different cover. Or better still, on the cover of each book there was an image of a different architecture, realized with my generative code. I had put under a showcase, well lined up, about twenty volumes. At first, nobody realized that all the covers were different. But when this difference was discovered, each person wanted to choose the book "he liked most". Until that time all the books were identical.

I happen this way when we choose a bunch of flowers at florist's shop. They are practically indistinguishable at first sight, but we still spend a lot of time choosing "ours". It represents the identity of natural events, our identity. The rediscovery of the oneness in industrial



objects responds to the need to light again, in the artificial ware that surrounds us, the greatness, the charm and the beauty of nature, to rediscover these features also in ourselves.

Fig. 8 Generated Lamps. Industrial design generative project by Celestino Soddu.

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Generative Natural Flux

GA 2001

Preface

I believe in interpreting the thought of all the participants to this fourth conference on Generative Art affirming that generative art is a deep creative experience and, somehow, visionary too. This experience, in fact, anticipates the possible evolution of the fields proper of human creativeness, rediscovering paths and approaches to ideation that have been proper of one of the most fertile moments of the human history and culture as Renaissance.

In this paper, I would like to deal with some aspects, and also some different approaches of generative creativeness. In particular, the importance to use specific reading keys, both subjective and objective, the possibility to reach concrete and feasible design results entering a complex figuration of possible incoming worlds. In other terms, to reach projects directly interfaceable with productive reality. Lastly, I will evaluate if and how it is possible and profitable to use the random factor in evolutionary processes, investigating on the differences that the use of such factor involves in the creative and design experience and the quality of the obtainable results.

But how can we define generative creativeness?

Generative Creativeness

Imagine to be an artist, an architect, a musician or a designer that has an idea. It is the idea of a work: an architectural space for a museum or an object as a coffeepot to be produced by industry, or a piece of music for a particular occasion.

Imagine this idea to be particularly strong, felt, recognizable, intimately tied up to your personal and professional identity. In other terms, imagine that your idea is able to tell, in a strong and exhaustive way, your point of view on how to interpret the world surrounding us, on how to transform this existing world into a possible one, much closer to your expectations, on how to be creative and designer.

Then imagine that every sketch you trace, every possible result, each form you think of will give you satisfaction, but only partially. Every formalization is not more than one of the possible representations of your idea, but it is not the idea. Your idea is fleeing. Your idea is all the possible, endless formalizations, all together, also the formalization that you have not traced yet but that, however, are essential to represent it.

Imagine that you succeed in finding a way to represent and realize this idea as a concrete, usable and communicable event without losing nothing of its richness and the complexity of its strength: an idea that becomes product without losing its potentialities.

Imagine therefore that you can sell this idea as an idea and not as one of its possible results, objects, projects, artworks, music. You can sell it to an industry as it is usual for any project, and this company will use the idea-product to produce the possible results. An endless number of objects, music, architectural spaces, communications, that you have never seen before but that, also in their difference and unpredictability, won't be a surprise for you: every object will be one of the possible representations, figurations of your idea, each one will be an individual of the species that you have created and designed.

Then imagine that this industry, operating on the market with the actual web technologies, decides to produce every object because it is chosen by a specific final consumer in a way that the oneness of every object find and fit the oneness of every final consumer. Every user has unpredictable and subjective needs that go beyond the standard performances of the object, subjective needs that can be both aesthetical and symbolic, but also further practical possible uses reflecting the multiplicity of subjective ways of life. This operation can fit, as a finality, the unpredictable further needs of each final user with the unpredictable uniqueness and specificity of each product.

This is Generative Art: the fitting between the idea of the designer (artist, architect, musician), strong expression of his creative and professional identity and the choice, that is unpredictable, of the final user, strong expression of his personal identity.

Designer/User, the random factor

A first field to investigate is: which is the relationship between these two identities, the subjectivity of the designer and the subjectivity of the final user of the product? And, as a consequence of that relationship, which is the role of a random factor in the whole process, and how such factor contributes to determining extremely different conceptual and operational results and how this factor can mine or improve the design quality of the results too.

A first consideration is upstream of the generative process. The use of the random factor inside the design path, according to the different uses, can create a watershed between the project and unconscious formalism, that is not-project, twisting the mutual roles of designer and client.

The respective roles, in fact, can be identified as follows: the designer defines how to evolve and transform the existing world into a possibly better one, the user/client chooses what is better for himself, following his own needs, also the strictly subjective ones.

A possible scenery of unconscious formalism emerges if we assume the possible substitution of the design process with the random act, and we try to do that through the randomization of forms. This hypothesis denies the design act, the idea, and loads the following choice of the user with a value that seems to be a design choice because it gives the user the last word about the result, but it is not a design act. The user continues, more concretely, to play the customer's role: it chooses between different possibilities that are offered to him but it doesn't operate as a designer because he doesn't define the evolutionary process, he doesn't possess creative idea. The results of this approach are very disappointing, obviously.

One example. I casually take a series of points in space and I represent them through a curve built by using the algorithm of Bezier. If I expect the final project of a coffeepot, or the final project of a vacuum cleaner or of a commercial center to emerge, this is as to expect that, extracting some letters at random, the Divine Comedy comes out. Possible, but highly improbable.

If the goal is the figuration of a not-abstract event, it is necessary to have an objective that drives the process, its increasing complexity, it is necessary to have an idea, it is necessary to design.

Contrary to using random forms, generative design works through the possible randomization of interactions, or better the use of the random factor to make the (virtual) context of reference in the designed evolution of the system unpredictable.

The creative idea, following the trace, admirably pointed out by Florensky, is active on three different fields, space-geometry, the time-environment-flow, the object-form. (Florensky pointed out the triad space-environment-thing, where space factor is fundamental). If the random factor is applied to the object-form or to space, the result cannot be a project but only unconscious formalization. The reason is that we cannot define the idea but only the choice of before-shaped results made by the final user inside the time environmental flow. Alternatively, and this is my operational hypothesis of generative art, the idea can be the idea of space, whose possible bending are an integral part of the idea and whose organization is the reference paradigm for the not-abstract figuration of each possible results. The time can be the random factor of environmental interaction that activates and clocks possible transformations of the system whose generative rule-codes, absolutely non-random, are an integral part of the idea in the field object-form.

The generative project as projected evolutionary code that works and generates events inside an environment whose unpredictability contributes to strengthening its possible identity. As in nature. The artificial evolutionary procedures of a generative project recall the natural evolutionary flow. The more the interaction with the(virtual) environment is unpredictable (random), the more the idea (how to transform the existing one in possible) acquires an identity, recognizability and strength. As in nature. The more an olive tree is beaten by the (environmental random), the more, twisting itself and growing, it acquires its own identity of species (idea) - the olive tree becomes more olive tree than before - and, in the meantime, it increases its own oneness of individual. And such oneness can fit the oneness of a possible user.

Also appearing as opposite, the two "generative" approaches just delineated, (form-random and interaction-random) are the two extremes of a continuous series of possibilities where, alternatively, it is increased or decreased the hierarchical importance of the casualness in the three fields of the idea: space-geometry, form-object and the time-environment.

What also appeared non-project in preceding example, it appears as a project if the design intention is confined in the character-identity of the abstract form that can derive from the use of particular geometries, relations and logics. It appears clear that the design intention is the character, extremely recognizable, of the curves of Bezier. The idea is Bezier's.

The Generative Design, objective, subjective and adaptive aspects.

If we would really like to trace a possible border between designing and abstract playing with random forms, this border has to refer to the "design intentions" and to all the components that compete to the formulation of an idea.

If the Idea intends to reach a “figured” result, that is a result that defines concrete and possible events as an object of use that can be industrially produced or an architecture in its complex configuration, then we could individualize, for convenience, three aspects in which the design intention is shaped.

Objective aspect. It includes the list of the performances to be carried out whose characters appear broadly sharable and whose evaluation and subjective appreciation of consumers appears univocal and taken for granted.

Subjective aspect. It defines how to reach and to satisfy the objective aspects and, with these processes, it renders explicit the specific characters of the identity and recognizability of the product, of the designer and of the firm that produces it.

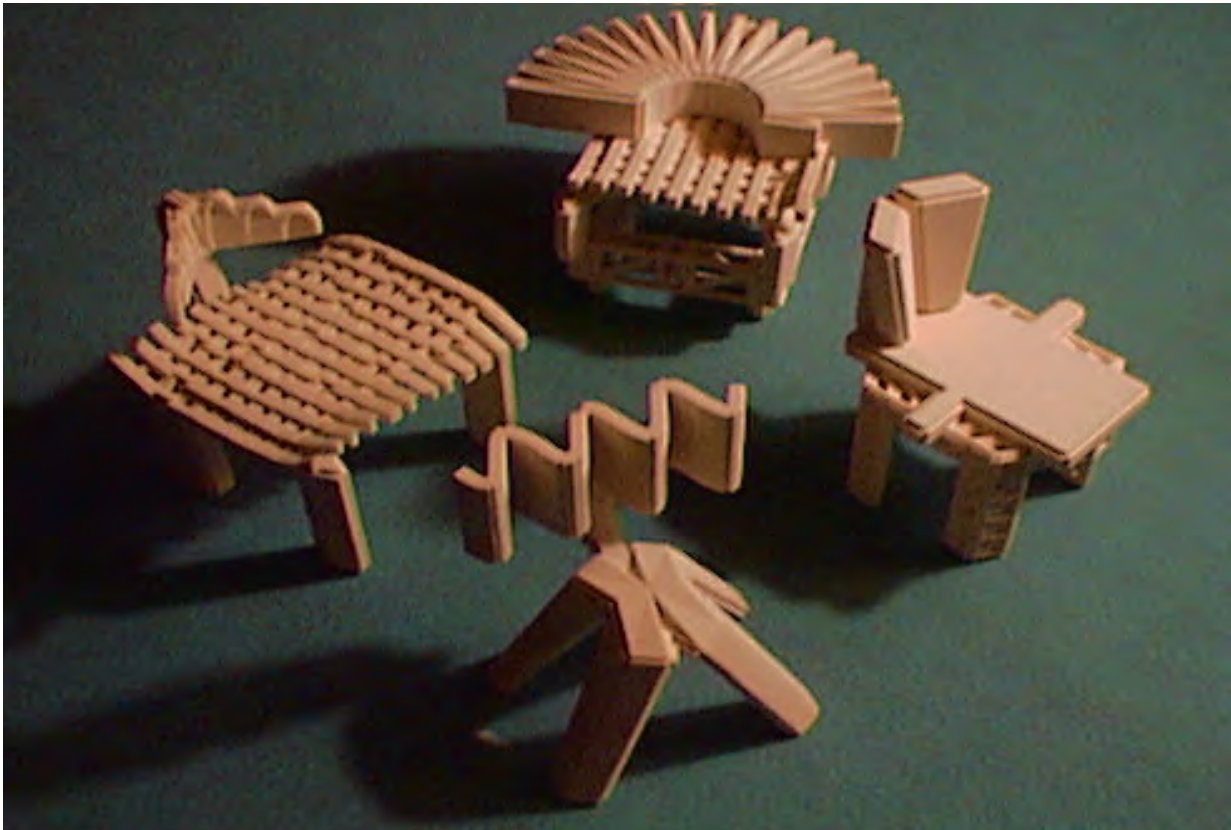
Adaptive aspect. It defines how to open to possible performances on practical, aesthetical and symbolic fields. These performances may be requested by unpredictable possible consumers whose subjective needs cannot be listed previously, not being known, but that, however, must be satisfied. If not, an absolute lack of market for the product will result.

In an architectural or industrial design project, we cannot omit any of these aspects, if it aims at reaching the “figuration” of the result. I would say however that, also in the most abstract field of figurative art or music, these three aspects have to be considered, however, if we intend to reach results whose complexity of performances, intentionality and possible interpretations make the created artworks appreciable.

If objective aspects are missing, aspects that we can also call the theme, the occasion of the project, we cannot arrive at not-abstract, identifiable and recognizable results. Such results can be achieved only through the definition and the activation of “how” to manage the process. Hiding or underestimating the choice of how to operate, or to operate this choice unconsciously, doesn't deny that this choice has been done. Also activating a structure of artificial life that manages and decides “autonomously” the evolution from the idea to possible results implies the existence of the idea as the intentionality of reaching specific objectives. It also implies the design of the artificial life's engine that defines how to reach such goals.

The adaptivity is a fundamental factor of the quality of the results, and therefore of the idea. It presupposes, in the banalest cases of industrial product, at least, the choice of the color or the most proper measure. In the architecture, it presupposes, at least, the possibility of using/personalizing the spaces where we live and, in art, at least, the possibility to choose a painting inside the production of an artist and to choose a context where to insert it.





Generative design of a Species of Chairs and Rapid prototyping realization of them.

al input



to bring forward very precise objectives. Rather we look for such unpredictable inputs to solicit our

creativity, to look for inspiration. Such aleatory inputs support us to strengthen and to shape our idea. They can help us to verify in progress that the results that we will reach will be appreciable from a multiplicity of different subjectivities.

In the generative project, we realize the system in its total dynamic structure. We define either the rules either the unpredictability of the occasions in which to apply them, either the possibility of exceptions.

Generative design experiences

In the generative projects that I have realized, beginning with the projects that had as operational field the transformation-evolution of town landscape, going on with the project Basilica for architecture generative design, continuing with the generative industrial design projects Argenia for chairs, sofa, lamps, coffee pots and jewels, and ending with the GWP, the generative project of portraits of women, I have been developing this type of approach, confining random in the field of the time-environment flux..

Where and how, in these generative projects, objective, subjective and adaptive aspects are faced and defined?

Objective aspects. They define the theme and the base performances of results. These aspects are so peculiar and referable to a specific occasion that, in my experimentations, I have had to realize a generative project, an original software, for each design theme. I don't believe that it is possible if we intend to reach and fix final figurations of the project, to make a generic generative project, or rather to realize a software able to produce coffee pots, vacuum cleaners, chairs, televisions, cars, rings, lamps and so on. Each theme presupposes specific objective aspects and, therefore, a different project, a different generative software. In my experimentations it has not been possible, if not in the banalest cases as, for instance, applications on the quantitative plan (a space of defined square meters), to manage the functional applications with interchangeable data. Such performance requests, in fact, must be interpreted by the designer in terms of logics of transformation (algorithms) and of structures of relationship (paradigms). Managing these requests, we enter immediately the field of "how" to operate, therefore, the subjective aspects.

Subjective aspects. They define how to reach the objectives of the project. A simplification (and an opening to the generic generative project, a tool for designers) could be that we don't define how to reach the objectives but we identify a series of solutions, a database of randomly accessible forms that are modifiable and personalizable by the designer using an appropriate interface.

Apart from the conceptual choice that, in my opinion, change the nature of generative design, this is a simplification that makes impossible the attainment of the objectives of performance if these are complexes and multiples. The management of the complexity is, in fact, one of the strong themes of the contemporary project, in which is necessary to activate a multiplicity of approaching keys, that are often different and belong to various disciplinary fields, and that must be realized by a team of experts. In fact we cannot stratify manifold forms for diversified performances and we cannot use simultaneously them. It is not possible to pass from complication to complexity, and to synthesis.

Contrarily, the definition of the "how" and, therefore, the subjective indication of an evolutionary path to follow for the attainment of the objectives, is not the definition of a form but of a process. A process can be used inside a multiplicity of processes in which every output is input for the following one. In this way, we can realize the possibility to increase through an evolutionary sequence of processes, quality and complex performances of possible results. I would also say that the interest for the generative design is based on the multiplicity of the processes simultaneously activable and is really founded on the concrete complexity of the obtainable results.

A further field in which we can define subjective objectives, and therefore of "how" to manage the evolution, is the definition of a structure of relationships, an organizational paradigm that defines and manages, in their mutual hierarchy and in mutual resonances and contaminations, how the processes work. We could say that while the definition of the processes is inside the field identified as object-forms, the definition of a paradigm belongs to the field space-geometry-topology, and it's possible bending.

Denying or not taking into consideration the subjective component of the generative projects can mean destroying the only access key to complexity. Although the interest arisen from this possibilities is very high, the experimentations that people have made so far, concerning generative "objective" engines, tools for designers, are confined in the field of the evolution of CAD tools and intelligent interfaces. That's not a limit, but it's different from generative projects. If they are "generative", these projects don't allow, inside the generative process, a progressive growth of the complexity of a multiplicity of results that is acceptable in an object not "simplifiable" and "reducible" to a single form as, for instance, a bottle or a pendant.

The architectural generative design of castle. The two series are realized with a different geometry curvature. The automatic realization of thickness following the different generated materials, and a rapid prototyping physical model.



An exception, even if partial, to the necessity to realize different software for each different design occasion, has been realized in the generative project Basilica. Even if, obviously, Basilica operates always and exclusively in the theme "architecture".

I have built an interface that allows me to manage three aspects that I believe fundamental in the definition of an idea of architecture: 1. The geometric space and its bending, 2. The specific paradigm of a theme and its net of relationships between spatial events. 3. Some characters of the activated evolutionary processes as the type of usable "cellular automata" and the existence and the topological structure of the exceptions.

However, this operational interface doesn't transform Basilica in a do-all tool. In fact, Basilica always realizes architectures and not generic objects and every produced architecture are strongly characterized by my personal idea of architectural space that is, I think, strongly recognizable. Besides, the idea of space-geometry that I have realized in Basilica is referable to the same concept: a homothetic structure based on precise design choices in which the number 27 is fundamental, as in the Renaissance codes. Every space-event generate 26 things-events, and so on. The evolutionary codes, the processes of transformation of the objects have always same logics founded on my interpretation and dynamic proposal of the harmonic relationships proper of the Renaissance.

Despite, to face to each design occasion it was necessary to increase and upgrade the generative motor and contextually to evolve the project Basilica in front to realize the architectural "figuration" required by the customer.

Adaptive aspects. They are fundamental for the charm of each result in front of final users. The use of the random factor is essential, to reach this purpose. It creates possible (and not predictable) fields of verification and time-environmental input for possible further keys of reading. If the use of random forms hampers the complex performances of the results, reducing them to a precocious stadium of evolution, the random interaction gets unpredictable environmental input that detects and makes possible to get results that are the fruit of possible

contaminations and resonances between the evolutionary processes activated in series and in parallel. Each of such processes, in its different parallel lives, realizes the attainment of its own objective. But the interactions and interferences concretize, in the flowing of artificial life, the identity and unrepeatability of each produced individual-event.

The random of the time and the mutual speeds create a very sensitive tool able to enter into resonance with existing points of strength, even if not directly anticipated, in the idea. When this happens, it is possible to concretize them suddenly in one of the possible results. As when a subjective sensibility is able to wave and to



Generative Design of Jewels

to be

disseminated. As the strength of beauty.

The generative idea: an operational code of a possible natural flow that realizes unique and unrepeatable individuals belonging to the same species.

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“La Citta’ Ideale”

Generative Codes Design Identity

GA 2002

Abstract

The aim is: how cities could fit the quality idea, the urban lifestyle that is our welfare dream?

But what is our dream? A city that reflects, as in a mirror, our identity.

We know very well what we want: beauty, harmony, naturality, and safety. For gaining them, we need to define "how" to satisfy these needs.

1. We look for **naturality**, but at the same time, we love sophisticated answers to our needs. And naturality that fits human needs is a result of high-quality design and management approach.

2. We are looking for **beauty and harmony**, but we are losing these qualities, that we had in the past, in these convulsed improving density cities that satisfy only pre-defined and functionally optimized necessities

3. But first of all, we need **clarity** and **safety**, and we discovered that also what appeared as impossible and unthinkable catastrophe happened. And Safety can be realized only if each people can share a process of evolutionary conscience.

The complex structure of a city can be identified as a non-linear complex system, and we need a tool that can emulate and manage, operate in real time, the transformation process of cities.

As all the dynamic non-linear complex systems, every city has a proper attractor, a specificity that countersigns it and that we can represent with a series of specific codes of transformation, with a Generative Project. Like DNA in nature, we can design the city's identity



Ideal City, Piero Della Francesca atelier

1. Ideal Cities

The ideal city has always been a fascinating matter.

The thought of possible urban scenarios were **always representations of cultural approaches.**

These searches and utopias have produced visionary scenarios that tried to conjugate

functional, aesthetical and symbolic aspects with those belonging to a good government able to realize the aspirations of citizens.



Lorenzetti, the good city government

The ideal city is a concept of possible, not a defined form. An adaptive concept that is able to fit the dynamics of the incoming transformations.

Ideal Cities are ideas in progress, cultural approaches, tensions toward possible existing cities, proposals that people can share giving his contribution that mirrors his uniqueness, his own ideas, desires, traditions, and aims. It is ideal for how much it unites in a project an identifiable and characterized physical and social organization.

The idea of an ideal city is a philosophy, is a challenge, is how to look at future, how to think the increasing quality process. And this process must fit and support local culture and traditions.

Every cultural identity has, as an art expression, its ideal city. This possible city represents the possible evolution of a *particular* existing city, traced using **codes belonging to local cultural reality**, to genius loci, to a recognizable urban identity expressed by its history. The ideal city of Venetians is Venice in its future possible configuration in progress. The dream is Venice incomparably much more Venice than before.

The idea of a city is, therefore, a visionary representation of modes of changing the city itself. When this idea is realized, the possible moves forward, looking for a new possible.

More, some cities are open cities. Who arrives feels so well as if he always lived in that place. And these cities are really impressive for the fact that, despite their inhabitants have different traditions and cultures, and different needs, the city's identity remain however so recognizable and unique. And **all different people recognize themselves in this city.**

2. How to look at future

*The city must answer to the increasing requests and needs of its inhabitants, but above all to the **unpredictable subjective needs of each individual**, who "lives" the city following his own thoughts and his own desires and his own conceptual paths.*

The fields of relevance of these requests are manifold:

1. Contradictory requests concerning artificial and natural ware;
2. The needs concerning the recognizability and the preservation of differences;
3. The esthetical needs;
4. The needs of security;
5. The functional needs concerning the adequacy, in real time, to the evolution of human life;
6. The need to find in the cities the patina of time that tells us we are alive because we had the past.

But all these needs are not so easily classifiable in optimized data that are legitimate for all people. Each of us is unique and unrepeatable, and our needs are, above all, subjective needs. The city, to be livable, must know how to respond to the unpredictable subjective requests of each of its citizens.

The city must be adaptable to the multiplicity of subjectivities, but in the same time must be recognizable, unique and, more, it must preserve its identity.

A precise relationship exists among the subjectivity of needs, the city identity and security of living there.

Everyone needs to live in an environment that respects the uniqueness of its inhabitants. This is possible only in a city in which identity, difference and oneness of environment are saved too. A town environment homogenized by an approach following only optimization standards contrasts to our subjective search of the happiness, to the sense of our presence and existence. (Soddu, Colabella, “recreating the city’s identity”, Freiburg 1995)



3. Generative Projects

Therefore, we can identify a possible approach to pursuing the urban quality in even more complex cities: not the construction of a static system, with previously defined events, but the **construction of a dynamic system and its logical rules** in which the initial paradigm, the

conceptual structure of the city, is the first step of a reference process able to support and carry the subsequent dynamics toward the attainment of the quality.

The urban quality is tending towards quality. Quality will be reached when the build events represent our time of human beings in the history process.

The most opportune operational approach to the future of quality, safety and harmony of the cities is to manage the non-linear dynamic system that represents each city with a **Generative Project**.

Manage, re-design, and design the town system. The generative urban design must define a paradigm of management, in progress, of the increase of complexity and not a plan proposing, in an axiomatic way, forms and static orders.

This design act and the strong clarity that springs from it is essential.

The impressive matter is: identity, complexity and quality of cities can be **designed**. We can create the identity of a city putting together a sequence of creative acts, stratifying manifold different points of view, manifold concepts of the city belonging different fields of interest, and constructing something like an artificial DNA performed like a table of transforming codes. These codes are not only theoretic but operative devices too.

We can use this **artificial DNA to emulate evolutionary sequences of city's life through increasing complexity processes**. Doing that we can generate new cities with a strong identity belonging to this artificial historic life. But thought these visionary scenarios we can, above all, identify and manage the existing cities and their quality.

The essential points of reference of generative projects are identity, complexity, harmony, clarity and safety.

4. Identity

Cities are extremely complex systems. Each city has and must have its own strong identity, due to its own cultural tradition, strongly recognizable and loved from people living it. If a city has not identity, it's not a city; it's only a built-up area, a primordial broth without structure. We can transform it into a city, if we identify a concept strongly related to the environment and to its inhabitants. Our challenge in globalization era is: **a city equal to another city doesn't exist**. Each one is unique and unrepeatable. We have to work for that. This is the reason why it is not possible to look for optimized solutions usable for all urban realities.

But, as often happens, increasing complexity due to the increasing needs of contemporary life can deteriorate this identity. And **cities can loose their identity**. Contingent solutions owed to specific needs and new functions can weaken this identity until losing it.

It happens, above all, if the city's management forgets the harmony and the cultural specific identity and operates transformations that are repetitions of evolutions used in the other cities. The immediate functional objective can be reached but this approach can damage the harmony and the clarity of the town system.



Generated city. The identity belongs to the transforming rules used and to the self-organizing paradigm that manages the process. The identity generative code used in this town design is my interpretation of New York City Identity through an operative generative meta-project

But what does the "identity" of a city means, and **how is it possible to save this identity** from destruction, from the homologation of the image and from the flattening of its performances?

*We can follow **two** different paths that come from different and contradictory presuppositions.*

1. A way is to save the existing events by freezing them because we read the environment identity as belonging to a particular static equilibrium. But this approach runs the **risk of transforming each city into a museum** and could not be an approach that brings us far. At most we can apply this approach to some exceptional existing events. The city, considered as a structure which identity is static, doesn't evolve and die, totally losing its real living identity.

2. The other approach, even if it is more difficult to manage, sees **the identity as developing procedures**. These procedures, sometimes consolidated by time, act controlling the increase of complexity and represent the culturally unique and unrepeatable matrix of the site.



Singapore. Generated architectures with the aim to fit a particular town concept that identifies Singapore.

Like an olive tree that, overworked from the wind and from the rain becomes more and more an olive tree. It enhances its own identity, while, if grown protected in a bell of glass loses its own identity because it has not the occasion to explicate and represent its character. Following the same way, each city explicates its own identity living the perpetual shifts of cultural moments and unpredictable events, living and using the occasions created by the increasing of the complexity of the life of the man, and of his needs, but also created by the changing of each subjective approach.

This way is, however, much more complex than the first one, and more difficult.

After 11th September, I think that we must rebuild Ground zero with a strongly positive image of our era because we believe in human progress and, as our fathers made before, we must leave to our sons a Hope space and a Beauty place.

If we choose this second dynamic approach, **we certainly cannot identify the city's identity with a database of forms or solutions** that reflect, in their specificity, different historical and evolutionary moments. Identity is not already savable through the repetition of

facts and events. Identity is a *modus operandi* toward the future.

We must conceive something different from old planning tools: **a generative code, an evolutionary code that interprets, in the specificity of the contemporary moment, the bringing forward an idea, going toward the increasing of identity and recognizability of each city.**

We could identify as “**clarity**” the goal to be reached. Every new event that is realized in a city, also in specificity, unpredictability and novelty that can countersign it, it has to bring an increase of clarity.

Every new realization must increase the identity of its city. The city must make a footstep toward the attainment and improve its unique city’s idea, that is not necessarily tied up with specific forms, colors or recognizable events but to a recognizable logic representing the cultural and ideal character of this city.

Because each city, to be livable must have a recognizable idea. There is not a static possibility: **the identity can be or improved or loosed.**

5. Clarity and Safety, the Livability

The relationship between the citizen and their city is a relationship of mutual clarity. Each people recognize his own city and, recognizing himself in this city, works for increasing the livability of the environment in which he lives.

Recognizing the city in which lives, each people finds, mirrored, his own identity of the man. Livability is harmony, safety, feeling good, feeling to be at home and sharing a city concept that reflects own history.

Clarity is, above all, sharing the evolutionary process of conscience, knowing what surround us and feeling it.

If we share the cultural concept of our city as code, we feel home, and we perform, in a fractal way, all spaces following this code. From urban spaces to architectural spaces until interiors.

The urban scenarios emerging from these operational logics have, simultaneously, clarity of image and structure, recognizability and harmony and, at the same time, they fit the complexity of contemporary cities.

But this not means that urban spaces are all equal. On the contrary.

They are only like individuals of the same species. **Every urban and architectural space, unique and unrepeatable public - private events, will propose, in its oneness, multiple variations of the identity of the same place.** A city inside the city, each one different but able to interpret and represent the same urban idea.

Everybody as part of the same living entity, as inside a historical district in which life flows without interruption and all people know very well where they are, also if they never visited this particular place before.

Identity means that each inhabitant has a clear concept of his city, also if it is a megalopolis.

Because the complexity is understandable applying a fractal logic.

Each quarter, each place, each square is different and, perhaps, unpredictable for the citizens. Because it was realized in different moments and with the support of different designers. Each place may be unpredictable and fascinating for its uniqueness but it will be not a surprise for inhabitant people. The place is recognizable as belonging to the same

city's idea.

Each people recognize each space, knows it and, discovering its unpredictable uniqueness, unconsciously improve its quality and clarity. As happened in historical ancient quarters. Or in natural environments where each people can evaluate if something can be a problem because he knows clearly the structure of nature and he wonders looking at the multiplicity of uniqueness.

6. Naturality

In other terms, we can evaluate incoming **megalopolis as a new naturality**. Where complexity is not a character that brings difficulties but, as in nature, can help the approach to identify and manage problems and new needs.

More, this approach to complexity can, unpredictably, satisfy the need of naturality of town's inhabitants. All different events, but clearly recognizable, perform a natural quality. Where artificial **events are all different like in nature**. And, with their uniqueness could mirror the uniqueness of each human being that lives the city.

Generative approach performs these possibilities.

Using a Generative Project, we can generate a sequence of different possible incoming scenarios, and evaluate them. In the meantime, we can verify and control the structure of evolutionary process we have designed. All the results generated by this project are different, really complex like natural sites and fitting the complex needs of contemporary life.

These results define, in the plurality (we could say the endless) of possibly figured scenarios, the identity concept of a city. Each generated town design is a performed Ideal City because this generative project is not only a solution but a way to look at future and to design the manifold future possible evolution of the city.

7. Complexity

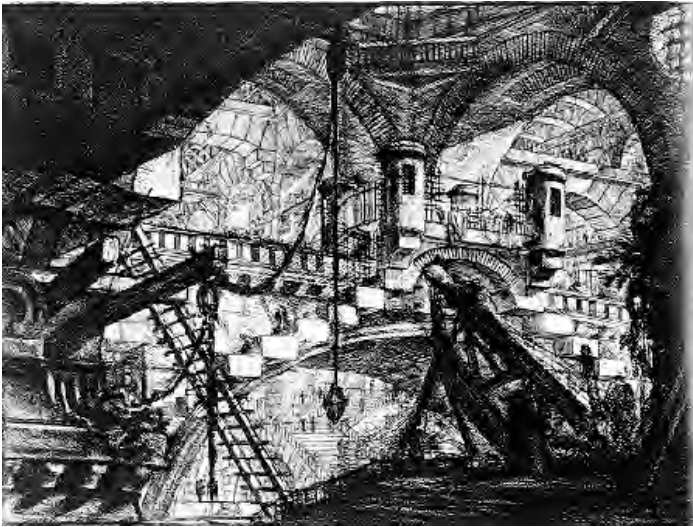
Complexity and not complication. Complexity fit clarity and quality. On the contrary, complication fits confusion.

It is extremely difficult to define the complexity as a static attribute of an event, of an environment. Complexity is not only the result but also the **same structure of an evolutionary dynamics**. It depends, essentially and entirely, from the "how" the system-object-project-environment-city that we are considering is evolved.

It is, in fact, impossible, and unthinkable, to directly produce complexity at once without activating and attending the evolution of a dynamic trial. A process of accumulation of following results and possible different points of view and, contemporarily, of progressive synthesis, acts.

If, as architects, we try to imagine ex-novo, and to extempore draw a city that has the character of an environment with complex historical stratifications, we will go toward to a sure failure and we would probably produce simplified sketches.

In the past Piranesi too, drawing visionary cities, used to stratify, in different times, a plurality of possible histories, transforming the previous one in the way to leave traces and forms that progressively accumulate and evolve themselves. His drawings are **complex because they represent traces of life too**.



Piranesi, visionary complex environment



Giotto, medieval city image

Complexity is ever connected to the dynamic path of transformation. It is born from this process. **To design and manage city's complexity we must run its evolutionary process.** And **Generative Design does it.**

But if dynamic trials of development are necessary to produce complexity, these are not enough to reach complexity and not only complication. Something further is needed.

A city increases its complexity from the length of the lived time, but also, and above all, from having crossed different historical and cultural moments, programs of development conceptually different and contradictory, and from the ability of simultaneously living these different points of view concerning its development.

A generative tool managing the increasing of complexity (and belonging complexity, quality) must emulate two types of growth: the **accumulation of events** and references (due to the trial), and the **performing of clarity**, due to the growth of the ability of continuous self-organizing of the system in front of what changes, also suddenly.

But not only. Complexity also manifests itself with the ability to effort (we could also say to react in front of) these events, satisfying incoming needs unpredictable before. This ability is an attribute that we can identify and define as the self-organizing power of the system. Managing the changes in progress to maintain entire, rather increase, town identity, quality, and characterization. (Soddu, Colabella, "Il progetto ambientale di morfogenesi", environmental design of morphogenesis, Esculapio Publisher, 1992)

The generative approach produces projects able to emulate self-organizing processes and to design complexity.

8. Case Studies

One of first case studies that I realized was the generative project of **Italian medieval towns Identity**. (C.Soddu, Citta' Aleatorie, Masson publisher, 1989 Milan, Italy)

The urban image painted by the Italian masters of '300 and '400 have been one of the occasions for my experimentation. Looking at these images I have tried to represent, through algorithms, design logic, and an urban evolutionary logic. The aim was to understand,

identify and represent the “urban and architectural character” of this city's concept.

For the characteristics of the research and of the tool that I had in mind and I was setting, this was a theme that has not been developed looking in preference at the philological and historical references, but operating only through harmony's stimuli that some pictorial images of medieval time are still able to give to me as a contemporary designer and architect.

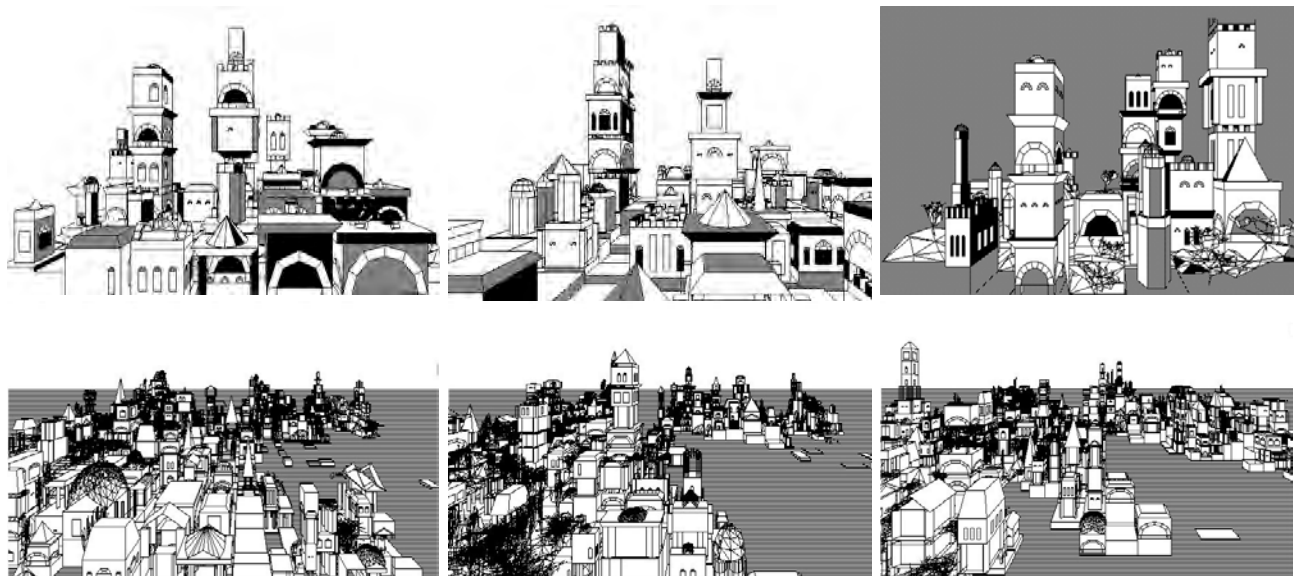
To do that, and to find a composition reference with the more univocal possible identity, I observed a whole series of images of urban spaces and architectures represented by Giotto and Simone Martini

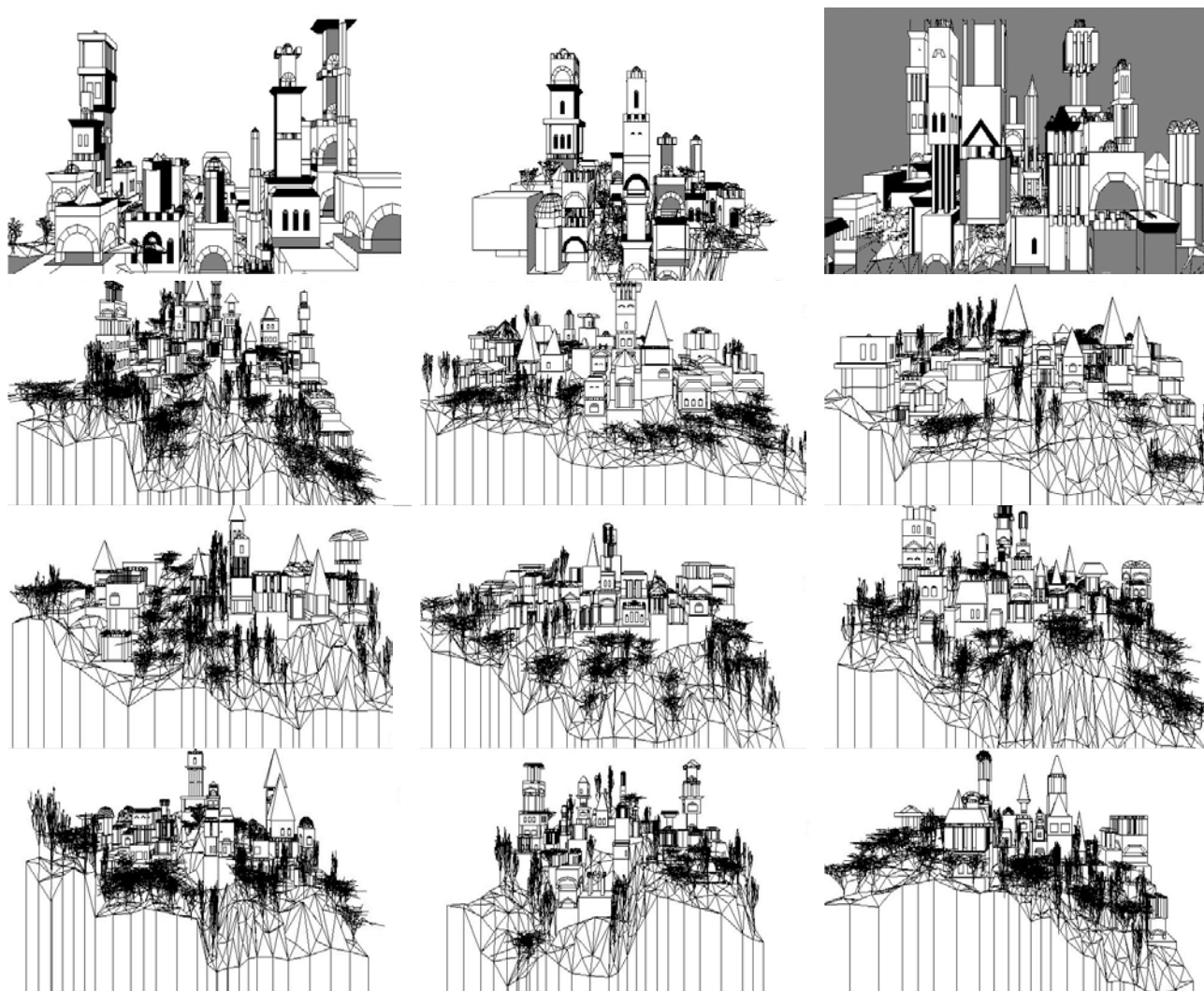


Simone Martini, cities scenarios

The operational choice has not, however, the setting up of a library, an abacus of elements to be composed, because this approach would have been able only to furnish “predictable” images, therefore far from the complexity of possible urban systems and urban shapes that I was looking for.

The aim has been, above all, the **representation of a conceptual dynamics**, of logics through which such elements (at the various scales) can be produced. And the representation, in parallel, of the temporal dynamics of construction of the urban shape.





Generated scenarios of medieval Italian towns (1989)

Each generative device, separately, acts on different aspects of the same element. They are activated by the simultaneous presence of different logics.

Artificial Life emulation is used and the generative project is structured in a way to produce also absolutely unpredictable elements. But such elements, generated using the formal logic rules identified to fit the medieval town identity, are strongly recognizable as “medieval”. The three-dimensional models generated with this project have the “patina of time”. They belong to recognizable spatial orders, scenarios that seem to be produced by a temporal run, by a common “history”.

Unpredictability comes from the different time of starting up the artificial design life, not from using random factors inside the code. Generative codes are strongly identified transforming rules and the aim is reaching different results but belonging to the same identifiable architectural concept and town idea.

Another case study was **Rome**. The historical center of Rome is certainly one of the more complex city environments. Its complexity is directly in relationship with the ability to preserve, rather increase, its identity and characterization through different and discontinuous historical and cultural moments.



Two scenarios of Rome's "Borghetto Flaminio". The increasing complexity sequence using medieval and baroc transforming codes

In this study case, the design approach for a new project inside this historical center was to identify different codes of harmony as transforming rules and apply them to manage increasing complexity. Particularly, these codes of harmony were performed trying to fit, with a design hypothesis, three of the most important historical and cultural steps of Rome: Imperial age, medieval age, and baroc.

These codes were dynamic contemporary interpretations of historical rules.

We applied, in sequence, these transforming codes of harmony to manage the "clarity" of final results. At the end, a **"Generative Project"** was realized. And this project was used to pursue the concept of increasing identity of Rome identifying and performing a contemporary approach to complexity where future scenarios will have the memory of stratified cultural references as time patina.

This approach works because the design idea is a concept of possible future scenarios performed as operative meta project, and is not only simplified with a form. The idea, performed as Generative Project, is a code of transformation, a set of rules that can start up an evolutionary process that can manage the increasing complexity and identity of an artificial environment in reaching ever more levels of quality and satisfaction.

The generative approach fit the new concept of town design.

The last experimentations were about **Hong Kong, Los Angeles**, and other cities.



Hong Kong waterfront generated a sequence of skyscrapers.



Hong Kong waterfront, increasing complexity and identity

I designed a DNA of these cities and I used that to perform incoming new scenarios.

The idea was:

1. Find the **identity codes of these cities, fitting the concept approach to multi-function semi-public semi-private architectures**. These codes avoid to simplified town organization but pursue a fractal complexity: each space is like a town inside the town, and so on.



Two different scenarios of the same evolutionary generative architectural project in Hong Kong

2. Design a **set of transforming codes** that can represent the identity of these cities.
3. Experiment these codes generating a sequence of different and unpredictable scenarios that reach the aim:
 - a. **An increasing complexity** of the city
 - b. **An increasing identity** of the city

To verify that, I generated sequences of urban scenarios as improvements of existing scenarios.

I presented these scenarios in public exhibitions to verify how this increasing complexity of their city could fit the evolutionary ideas of its inhabitants. Results were impressive and exciting talking with exhibition's visitors, especially young people.



*Hong Kong Central, behind the HSBC, increasing the site identity and recognizability.
A generated new building.*

The reason was that the inhabitants discovered that their city could increase its identity! Now, I am working in visionary evolutionary scenarios of other cities: Washington DC, Macau, Shanghai, New York.

The verified that citizens of these cities recognize themselves in these generated evolutionary scenarios.

So the subtended Generative Projects work. And it's possible to use it in managing the evolution of cities. More, it's necessary if we intend to preserve these city's identities.

9. Codes of Harmony

The first step, in generative design, is to construct the set of codes that identify each city. We could call them codes of **harmony**. And we can perform, with them, a generative town project.

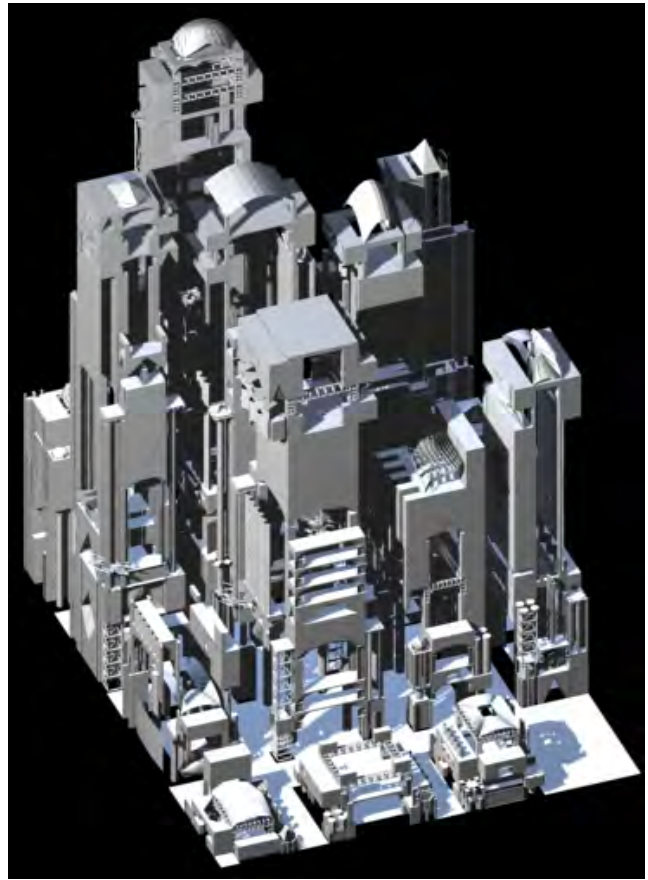
Italian Renaissance culture had identified the harmony as logic linked to the process of construction of artificial environments, to the systems of relationships and proportions that tie different events inside architectures and cities. The harmony, therefore, is a logic that defines the *modus operandi* of designing acts.



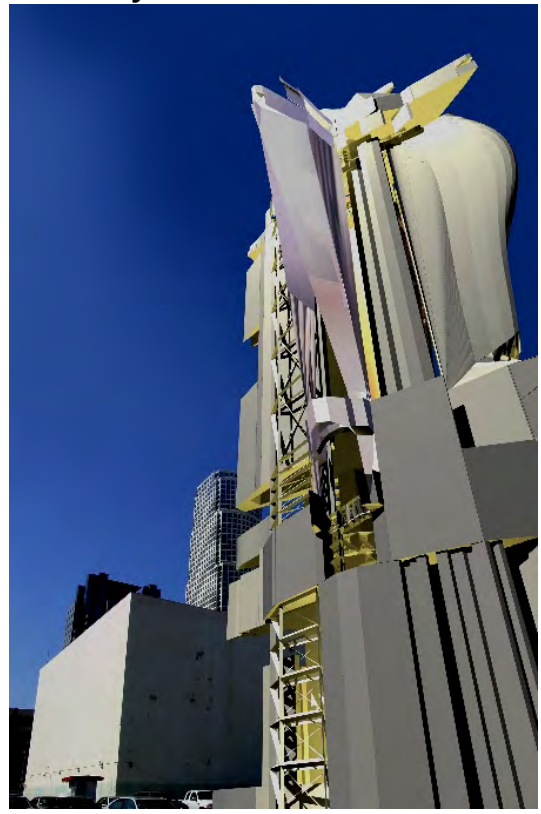
Hong Kong waterfront in the night. A generated new architecture.



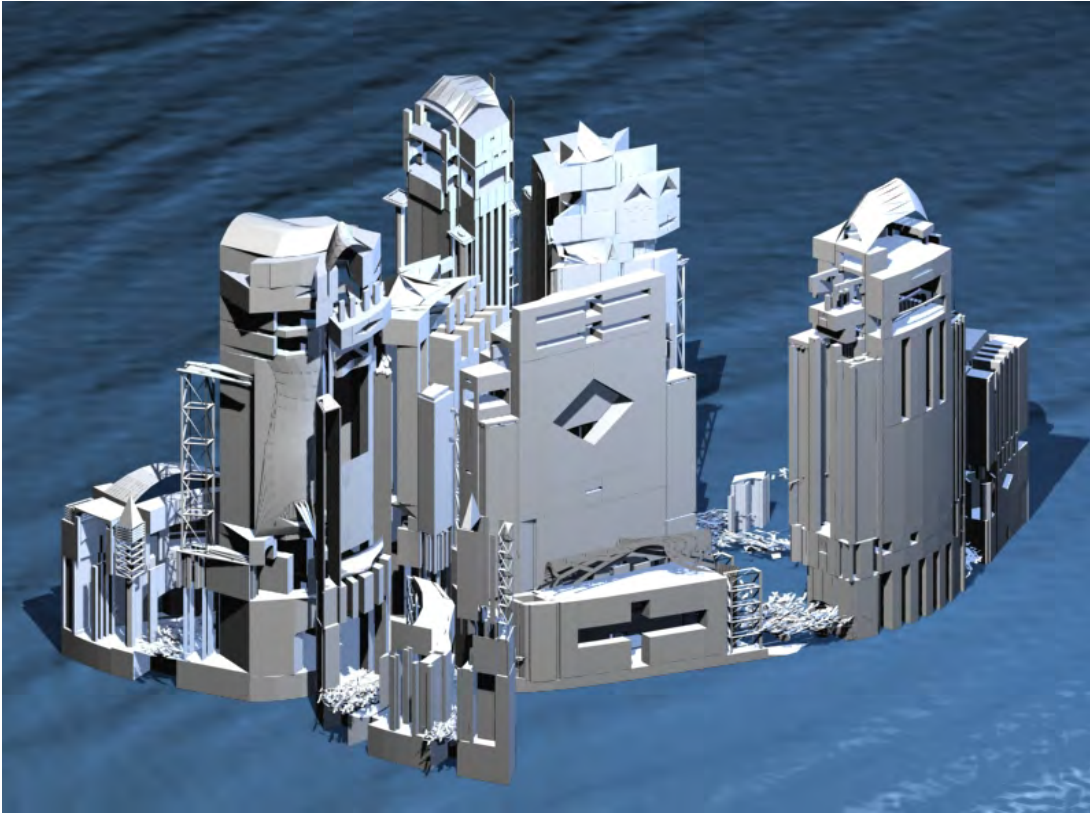
New architecture in Hong Kong Central



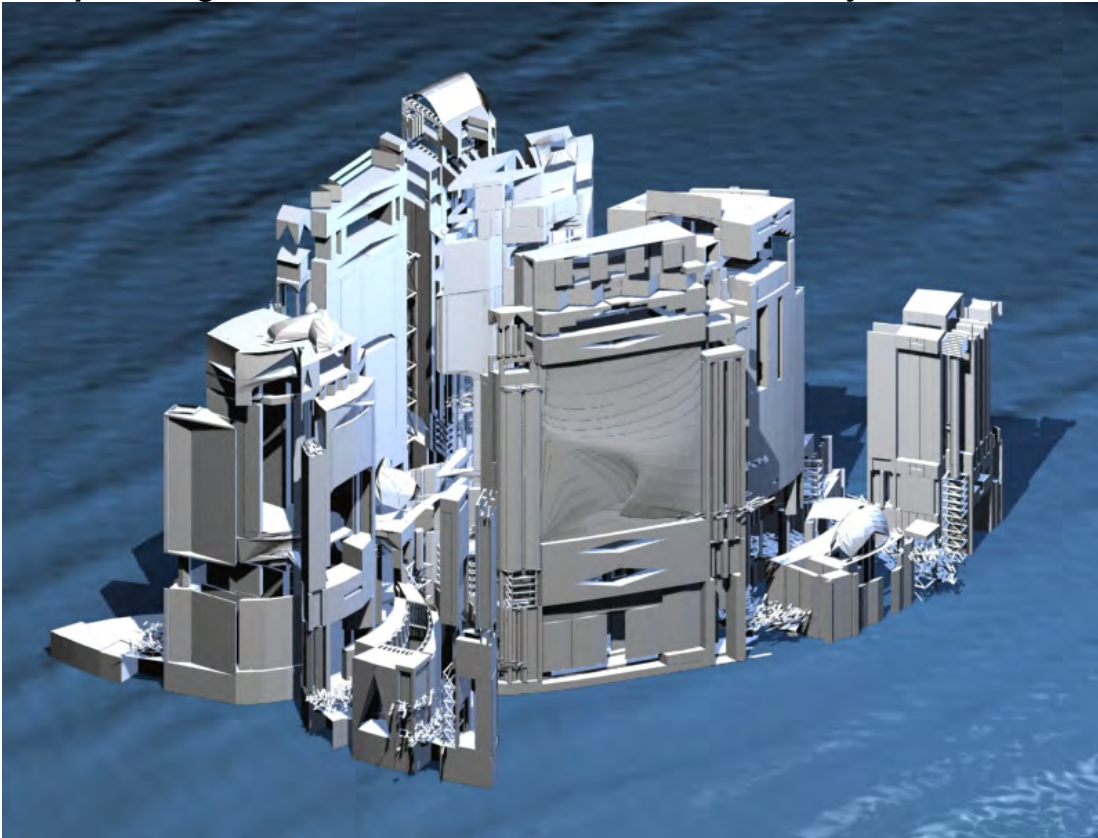
***A generated multi-function semi-public
semi-private city block***



Los Angeles generated architectures to increase city identity.



Two parallel generated urban scenarios for an Asian city on the sea



The codes of harmony, in the different cultures, has always been the way to find and use, in the construction of artificial environments, the logics that is possible to read in the natural world.

These logics are strongly tied to each different culture even if it is possible to find a common substratum between different traditions in the processes of interpretation of nature.

These logical rules, interpreting nature, define dynamics of transforming environments toward harmony. These rules are a design synthesis of the manifold aspects belonging to the construction of possible scenarios.

The operational hypothesis to manage the evolutionary dynamics of cities is to identify and to realize, as generative executable projects, the codes of harmony that represent specific urban identities.

We can do that through some different phases:

A. **Identification of urban dynamic transformations** proper of a specific city, reading, as rules of transformation, the historical evolutions of the city and the contemporary tensions. Particularly it is possible to identify and to codify these evolutionary rules as:

- Structures of dynamic progression of the **spatial dimensions**;
- Structures of progressive transformation of the **topological relationships**;
- Rules able to control the progressive scenarios represented through **perspective visions**;
- Sequences of **rhythms** and progressive discoveries of urban space;
- Contemporary presences of events structured in dynamic relationships among the **dimensional multiplicities** of the built;
- **Coincidences and contradictions** between the existing spaces and those possible;
- The relationship between whole and parts, activating controls on the dynamics of **fractal sequences** proper of complex systems.

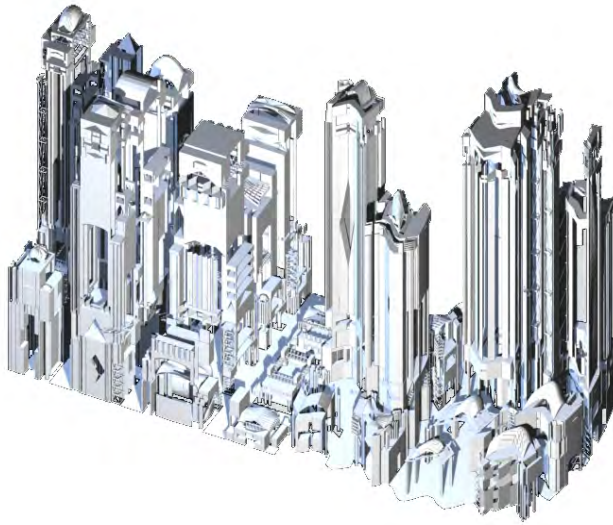
B. Construction of whole codes **of transformation** that represents the identity of a city through operational tools of emulation and simulation of the existing executable dynamics.

C. Construction of a **paradigm of control** of complexity that represents, in the city's evolutionary dynamics, the structure of relationships subtended in the system of the city, and that fit, at various scales, the same codes. This paradigm becomes the operational tool to manage connections, contaminations, and mutual conditionings among the dynamics of growth of the manifold events that transform the city.

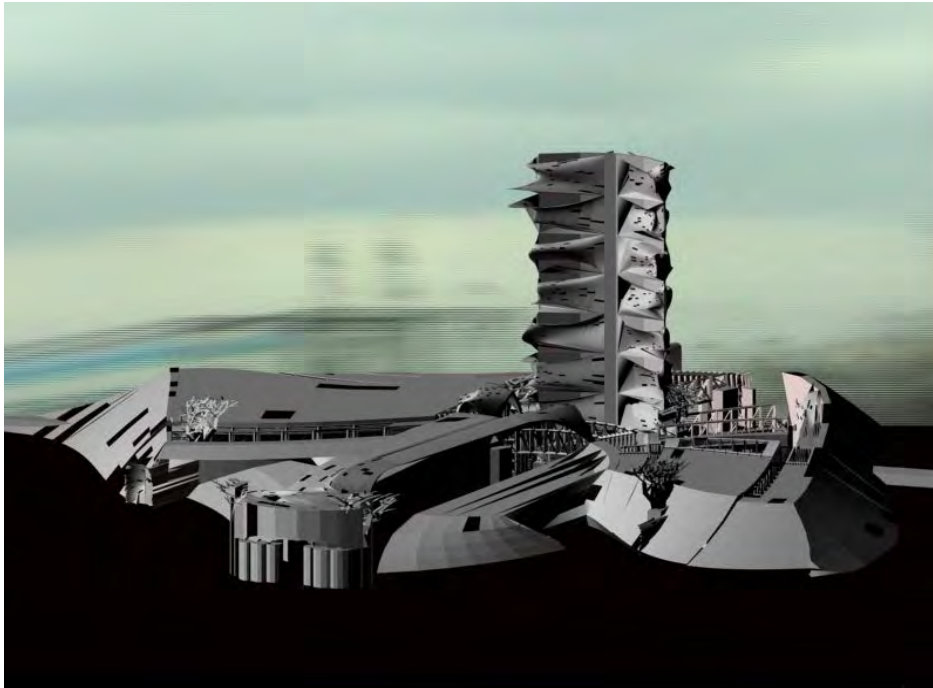
D. Identification of **bifurcations** in the complex system representing the city and that determines the **plurality of possible identities** in the various districts of the same city. These manifold identities represent possible scenarios belonging to same species, to same urban identity. Urban identity, in fact, is such if it succeeds in generating different individuals of the same species, quarters and places that, also in their oneness, represent different evolutionary possibilities of the same city.

E. Identify and design the role of **possible exceptions** as an incoming engine for increasing dynamic order and clarity.

The result is enthusiastic: the city grows following its own vocations and each incoming need becomes occasion for an increase of quality, identity and uniqueness of the city



A generated sequence of two different “quarters identity” and their relationship.



Semi-public semi-private space: commercial center, entertainments, private offices and residences, a city inside the city.

10. Structure and use of Generative City Projects

Building a Generative Project is putting together:

1. **The paradigm that is the plan that defines relationships and structure of complexity;**
2. **The rules of transformation**, the algorithms that explain and design how the present can evolve through the future.

A generative code with these elements, paradigm, and rules of transformation, can become, in a progressive increase of complexity, an **executable meta-project** that identifies the character, the recognizability and the communicative clarity of every possible event of city's development. If we use it, we can generate an endless sequence of incoming town shapes and city's scenarios, all different and unpredictable but all belonging and representing one of the possible results of the same city identity.



Los Angeles, a skyscraper as exception that enhances the town identity

This is due to the fact that algorithms are logical structures of representations of transformations that can be operated with manifold and different objects and on different occasions. Paradigm and algorithms of transformation define in fact "how" to operate and not "what" to do or to choose.

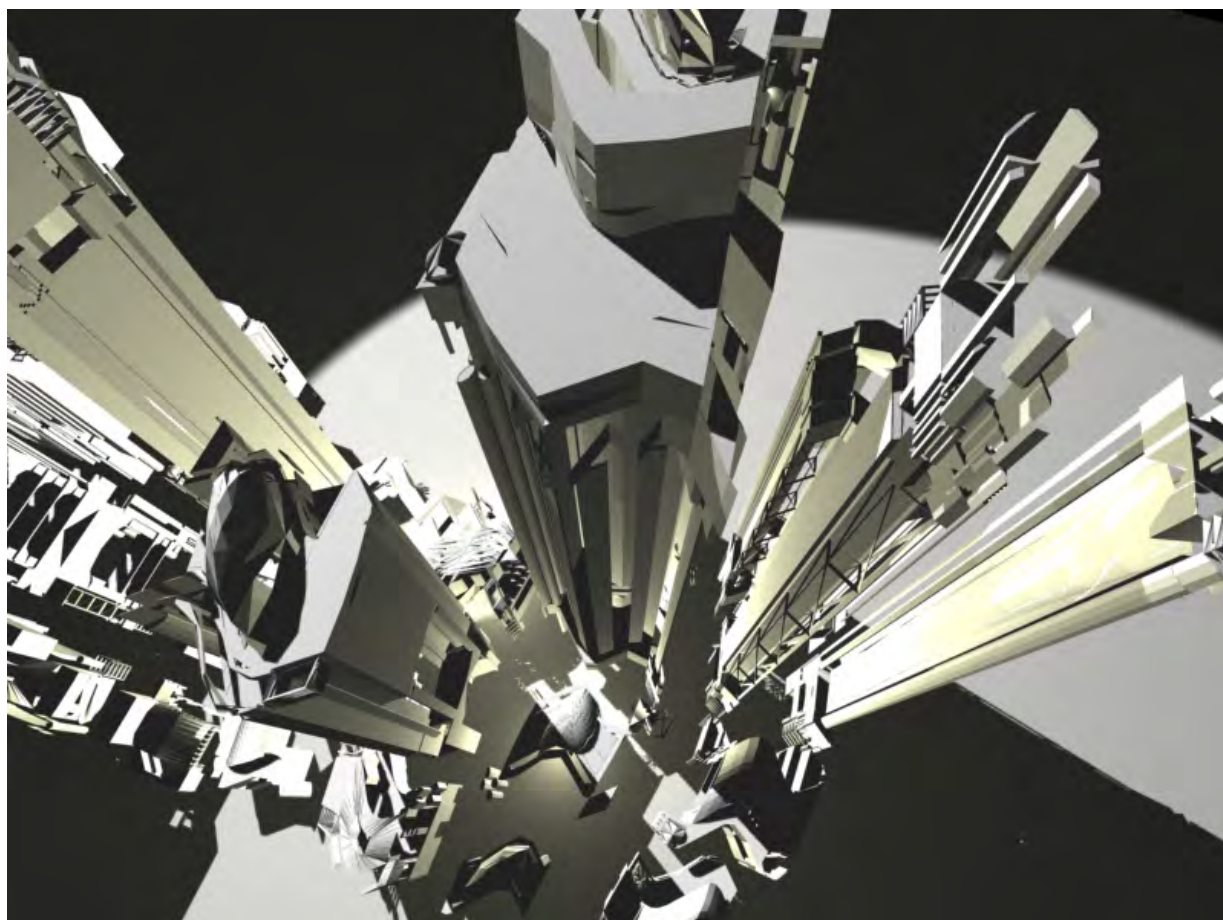
The interaction between citizens peculiar needs and city evolutionary project is made possible by the fact that logics, roles, and relationships present in the generative project are not simplified and are in progress.

The structure of the functional needs of each inhabitant finds, in this increasing complexity and in the potentiality of functional performances, a wide space to express itself through the paradigmatic interpretation, also multiple, of the possible evolutions.

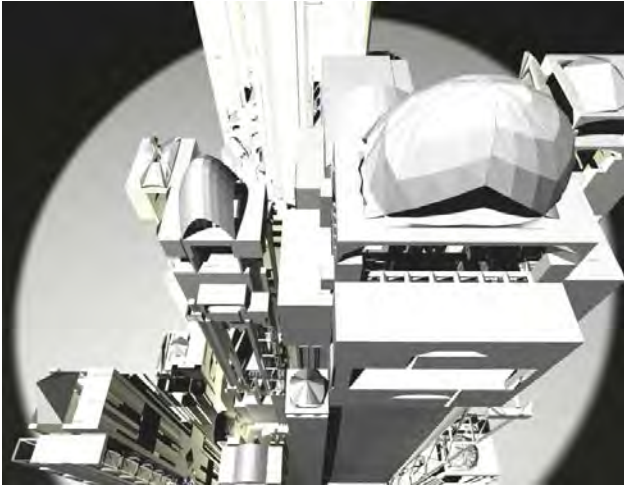
At the same time the more the paradigm consolidates, the more the occasions grows to apply the code of harmony, as in nature.

In other terms we can affirm **that the more the requirements of the citizen are complex and "impossible", the more the potentialities of the generative code are made operational and, therefore, doesn't remain unexpressed.** And consequently, if the control of the code, taking advantages of the occasion for specific requirements, work on all levels, from the global to the detail, it increases the communicative clarity, the identity and the quality of the city. (C. Soddu, Generative Art Conference, 2000)

Requests and new needs are occasions and not constraints. This is the peculiarity of Generative approach.



Two city scenarios generated with a particular code managing building topology.



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Visionary Aesthetics and Architecture Variations

GA 2003

1.0 Abstract

This paper describes the use of Generative Approach to construct the transformation processes of an artificial environment. In particular, urban and architectural environments with a long history are considered.

The aim was to design generative codes able to generate detailed architectural projects of new buildings and new imprintings inside existing historical environments. These new architectures had to fit, or better to increase the specific town evolution.

These design experiments follow my first generative projects, dated from 1988, concerning Italian Medieval Towns and subsequent evolutions. These were conducted in 2002 and 2003 in Hong Kong, Macau, Shanghai, Nagoya, TelAviv, Rome, Los Angeles, Chicago, NewYork, and Washington DC.

The challenge is to generate Visionary Variations of complex environments by using Morphogenesis codes. As in nature to reach, by using generative codes, the complex contemporary quality of detailed architectural projects.

2.0 History and Nature

Our goal is to associate the natural environments to the artificial environments that had been marked by the time and cultural processes. Historical cities that have had a cultural stratification through the centuries seems to be more natural. They seem to fit our more deep needs in living environmental systems as a mirror of our life. This wonderful quality belongs to ancient cities like Rome and in modern cities like NY City and Chicago that stratified, in the last centuries, different cultures. This is a process that works as an identifiable and recognizable concept of ideal City.

This analogy with nature is due to a lot of factors. Each of these factors is a fundamental part of the natural image of these complex artificial systems. In my work, each one is described and designed with a generative morphogenesis code, with algorithms that, as an artificial DNA, work to define the evolution of town environments.

2.1 Uniqueness. Generation versus Cloning

First factor. Aesthetics of Transformation versus Aesthetics of Repetition.

The association of the adjective "artificial" with the concept of repetition of objects all equal can help us to consider a historical city as a natural world. No architecture, in cities born and evolved before the last century, is equal to another. Maybe that we can discover similarity, but not repetition.

Our good harmony feeling inside natural environments is also due to the appreciation of uniqueness and non-repeatability of natural realities. No tree is equal to another, also if it is similar. Each tree is unpredictable, also if it is not a surprise. It is recognizable.

In the artificial worlds, we can work to build this quality by using a morphogenesis approach. We can design "natural" species instead of objects. As happens in nature, these species generate endless sequences of individual realities.

Generative Design can fit these human needs. As Leonardo codes, we can do that by designing the DNA of possible architectural and urban scenarios.

After two centuries of cloned objects and versus the concept of architecture and design of artificial objects as equal repetition of the same result, considered "optimal", with Generative Approach we can find again the ability to design and to produce artificial worlds emulating the nature oneness and unrepeatability.

So, avoiding the random form approach, we can design extended artificial DNA, and we can control these artificial species from the whole to the details of each possibly generated individuals. Generative design is the construction of an idea/code as the similarity of individuals that belong to the same species. It is not only the generation of random results waiting for the emergence of unexpected form which could satisfy the expectations of people with not-well-defined aim.

The species is a design product. A new individual doesn't emerge from random. Each scenario is one of the possible endless representations of the same generative processes, of the same concept/idea. Each result is different because of unpredictable factors of the context in which each individual lives, but each result belongs the applied morphogenesis codes.

2.2 Complexity, Artificial Life, and Cellular Automata

Second factor. The natural organic structure of historical cities comes from progressive contaminations of different concepts in a running timeline. The complexity of a long-lived town's system cannot be emulated without running again the same type of progressive path. In this sense, the generative methodology has to foresee a series of transformation logics, which we could assume as concepts representation. Each generative project has to activate and to run artificial lives that manage, dynamically, the progressive mutual contaminations of these concepts.

"In order to realize complexity and clarity, one needs to define operational logics that are strongly structured and that explicitly mirror a simple subjective approach. First of all, complexity cannot be reached in a single step. If we try to draw a city we will always make a simplified representation of it, or, at most, one that is strongly allusive with respect to a particular and limited reading key. The urban images of Piranesi, the series of engravings on the "Carceri" are, perhaps, the highest visionary representations of the urban and architectural complexity in a single sketch. But even Piranesi, in order to reach complexity, stratified one sketch onto the other, using an already carved plate and stratifying new visions, often contaminating one perspective logic with another, creating ambiguity and new possible overlapping reading keys that follow different temporal and emotional moments contaminating one another but that are not contradictory.

Complexity is always the result of progressive paths of contamination and stratification. It is generated from the dynamics of a process and often from its non-linearity. That's not all. Complexity also emerges from the ability of an idea/hypothesis to confront unforeseen events within a process of temporal transformation. If the idea, considered as a visionary of the future, comes across obstacles, overcoming these obstacles and constraints creates knots of complexity in the system. At the same time, this increases the recognizability of the idea, that is, the complex identity of every single event." (Generative Design Visionary Variations. Morphogenetic processes for complex future identities, Celestino Soddu, Communication, and Cognition Journal, 2003)

Complexity, as stratification of different and subsequent approaches, needs to have a process time. Also, a subjective approach defined today is different from tomorrow's new one, the same if it belongs to the same human viewpoint.

Complexity is created by the simultaneous existence of different concepts and, in the same moment, of contradictory ones inside the same visionary approach.

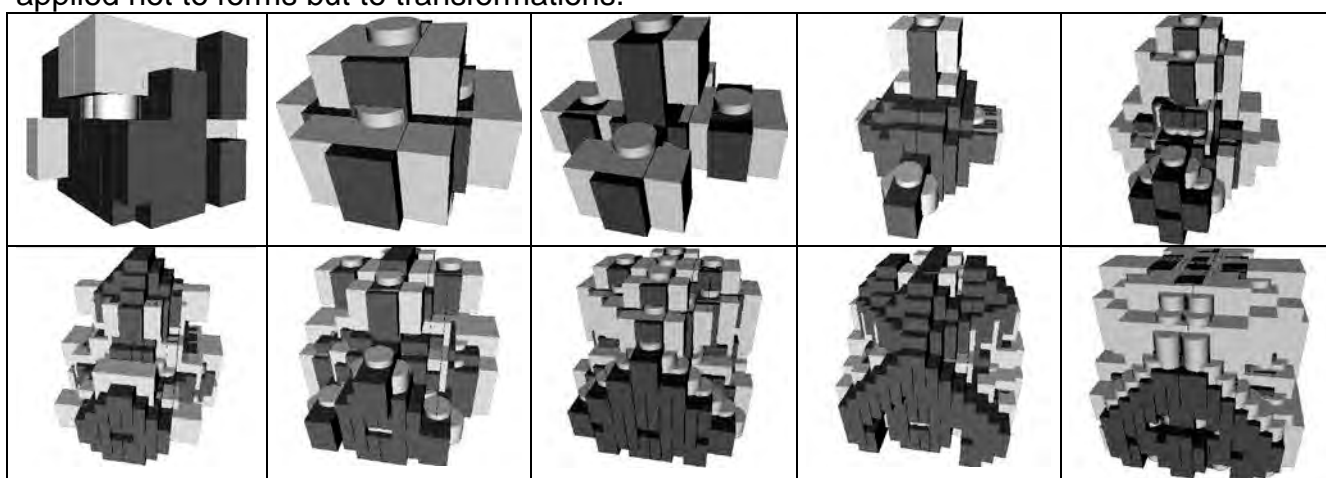
If our aim is to design morphogenesis codes able to construct a contemporary complexity, we need to stratify, inside the generative project, a lot of different subjective concepts mirroring our personal history of designers, our different moods and the sequence of hypothesis belonging to our cultural viewpoint.

Doing that, we need to interpret each design occasion as a particular contamination way of our stratified morphogenetic codes. So we need to redefine a paradigm that will control the evolutionary path.

Following the concept that complexity arises only from a temporal path, we can manage the second possibility using evolutionary systems. This second possibility can be used only together with the first one because it can only consolidate the increasing complexity of a topological relationship.

In order to design this system of rules, we could also use Cellular Automata logical approaches. But such evolutionary structures don't succeed in satisfying the complexity as figuration proper of architectural events. In my generative architectural projects, I used three-dimensional cellular automata for increasing the complexity of a topological system but not directly for shaping possible architectural events. Each of these architectural events follows genetic structures built considering the specificity of feasible buildings. This peculiarity is defined through rules of transformation. Cellular Automata is really a generative phenomenon but only as a schematic support of possible configuration.

Cellular Automata define a progressive structure of different codes that are applicable to each event, at the different scales, considering the structure of relationships with the surrounding events. It is very important for the possible starting up of generative processes. Each architectural event is identified and it is generated by considering what happens in the 26 surrounding positions. These relationships operate enhancing the rules of transformation already working in each single event and in its 26 interfaces shared with other events. This process occurs from the whole architecture until its details. My process uses logics similar to fractal systems. The difference with fractal systems is that the homothetic approach is applied not to forms but to transformations.



The sequence of increasing complexity in 3d cellular automata experimental program by C.Soddu

2.3 Figuration and Idea

3dr factor. Like in nature, the constraints belonging to the increasing functional and technological factors that occur during the design life will increase the quality and natural character of the artificial environment.

The strong relationship between figuration, feasibility, and architectural concept can be managed in a way that the feasibility doesn't reduce the idea but can be the key to gain complexity by opening a lot of parallel possibilities to develop the architectural concept until the implementation of final design results.

I defined, inside my generative projects, a structure of different, parallel and possible devices of transformation that represent a lot of different constructive approaches to the architectural shape feasibility. The choice among these possible evolutionary paths is done not only at a low level but with the purpose to enhance the idea/code during each increasing complexity process. The evolutionary process is managed by fitting the progressive results with different construction approaches and their progressive contamination in an open system. In this way, all the practical needs, that could seem to be bonded, are really used to enhance the architectural idea. As normally happens in nature, difficulties don't reduce the input but are the occasion for increasing the complexity implementation.

Like an olive tree. More it is beaten from the wind and from the bad weather, more it has been marked by time history, more the quality of the result is amazing and fascinating. Time and constraints have enhanced its identity of the individual, it's being an exceptional and unique expression of the species code.



Olive tree aged of two thousand years in the Getzemani Garden, Jerusalem

In our town environment (and in architectural design processes too) the same process happens. More the town was passed through strong and different cultures, and, in sequence, different needs was applied to transform this reality, more its artificial environment has a high quality.

In generative processes happens the same. More the requests of the client are strong, contradictory and impossible, more the quality of the results can be high. The difficulties push the evolution and each step is an occasion to use an architectural code, using its ability to transform the request in increasing complexity and the first draft in a progressive good project.



Loa Angeles downtown, Visionary Variation. C.Soddu generative project 2003

3.0 Generative Codes and Visionary Variations.

Our aim is to construct Morphogenesis codes able to generate endless Visionary Variations. We can use, simultaneously, a set of different devices of transformation, made with the aim to represent the manifold faces of our architectural hypothesis.

As in nature, no one of this device of transformation is necessary or is exhaustive of our idea. We can use all them together. But we can also insert later other devices in order to upgrade our architectural idea during the time of our designing experience. The generated results will represent our subjective experience, our cultural references. Subjective codes in collective modality.



Chicago, one century ago. Visionary Generative scenario fitting City Identity.
C.Soddu generative project 2003.

My challenge was to design a generative code able to represent fascinating environments as historical cities. By representing the process and not the results, by constructing an artificial DNA.

I considered these subsequent issues and I used them to design an open system of generative codes:

1. In the historic cities everything seems always been so, that everything could not be anything else then so, but, at the same moment, everything is surprisingly unpredictable and complex, full of contradictions and of unexpected contaminations.
2. Everything is organically structured but every detail, every event is unique and unrepeatable. The codes of transformation, that I designed, manage opposite characters: uniqueness and recognizability, complexity and identity, unpredictability and organic system, order and chaos.
3. It is possible to find codes of identity and associations among characters and specificities of the events that compose these complex systems. But every code is interpretative code, is a hypothesis that represents the subjectivity of whom builds it.
4. The codes of reading are endless and each of these is like the codes that we use to recognize the objects surrounding us, the same codes that we learned to build when we was children and we needed to distinguish a chair from a table, an automobile from a truck, a picture of Van Gogh from one of the Picasso, the teachers of mathematics from those of gymnastics. Generative codes have to manage recognizability and clarity of possible scenarios.
5. The amazing thing is that, even if these codes are built so strongly by following our subjectivity, they perfectly work and are able to give us the ability to recognize unpredictable events. These rules of identification, also if they are different from the rules used by other people, can fit the same results. This happens even if these subjective rules are founded on different lived events and on different logical associations. So, Identity codes can be written referring to our subjectivity. They will work well if these codes will be a lot inside an open system.
6. The codes of transformation that build the artificial DNA have to simultaneously fit our subjective way to read the surrounding environment and its transforming processes and, in the same moment, the inter-subjective feeling of how (in our interpretation) the inhabitants look at the past/future of the city environment.
7. The idea of a city that springs from these subjective and inter-subjective approaches operates toward the realization of the city itself increasing its own fascinating aspects, its own characters, its own identity. This Idea represents an evolution and progressive stratification of complexity and it traces, unequivocally, the existence of a temporal run in action. The existence of the past, that is represented by the visible and by interpretable transformations gives the possibility of looking to a future. The need to interpret the existing town environment puts us into the game. We feel us inside the time, we feel alive, we feel well. A city without history is unlivable because it is without the time and therefore without future. At least, until first transformations will be implemented, by opening the games to the creativeness and to the future.

The generative codes must be rules of transformation. Nothing has to be defined as form: this is a static approach. Everything has to be identified and to be designed as a process of

transformation, by following our need to feel alive. The more interesting and "natural" architectures were born by a transformation, not by a single act. The Pantheon too, one of perfect architectures, was born transforming a previous existing temple.



Shanghai. Visionary variation of city evolution. C.Soddu generative project 2003

4.0 Visionary Variations

My last generative works have been characterized by the attempt to design the complexity of the urban-architectural environments of the modern tradition. While my first generative projects in the 80' have been characterized by the reconstruction of generative codes of the Italian urban tradition, from the Roman Empire to the medieval cities, from Renaissance to the Baroque, my last works focused the comparison with the urban environments of the modern tradition, as Chicago of the beginning of last century. This approach was enthusiastically performed and I found a good field to verify the possibility of using the generative approach directly in one of the most important design activity: the design of the quality of the urban environment, of the urban-architectural character and of its identity. Above all because in the city as Chicago, Hong Kong, and New York we can easily read the passage to the modern not only as innovation but also as the construction of a cultural ideal shared among its inhabitants: the ideal city.

The challenge was to identify and build, with generative codes, visionary variations of ideal cities that are readable and interpretable in these real contexts and in their active and evolutionary processes.

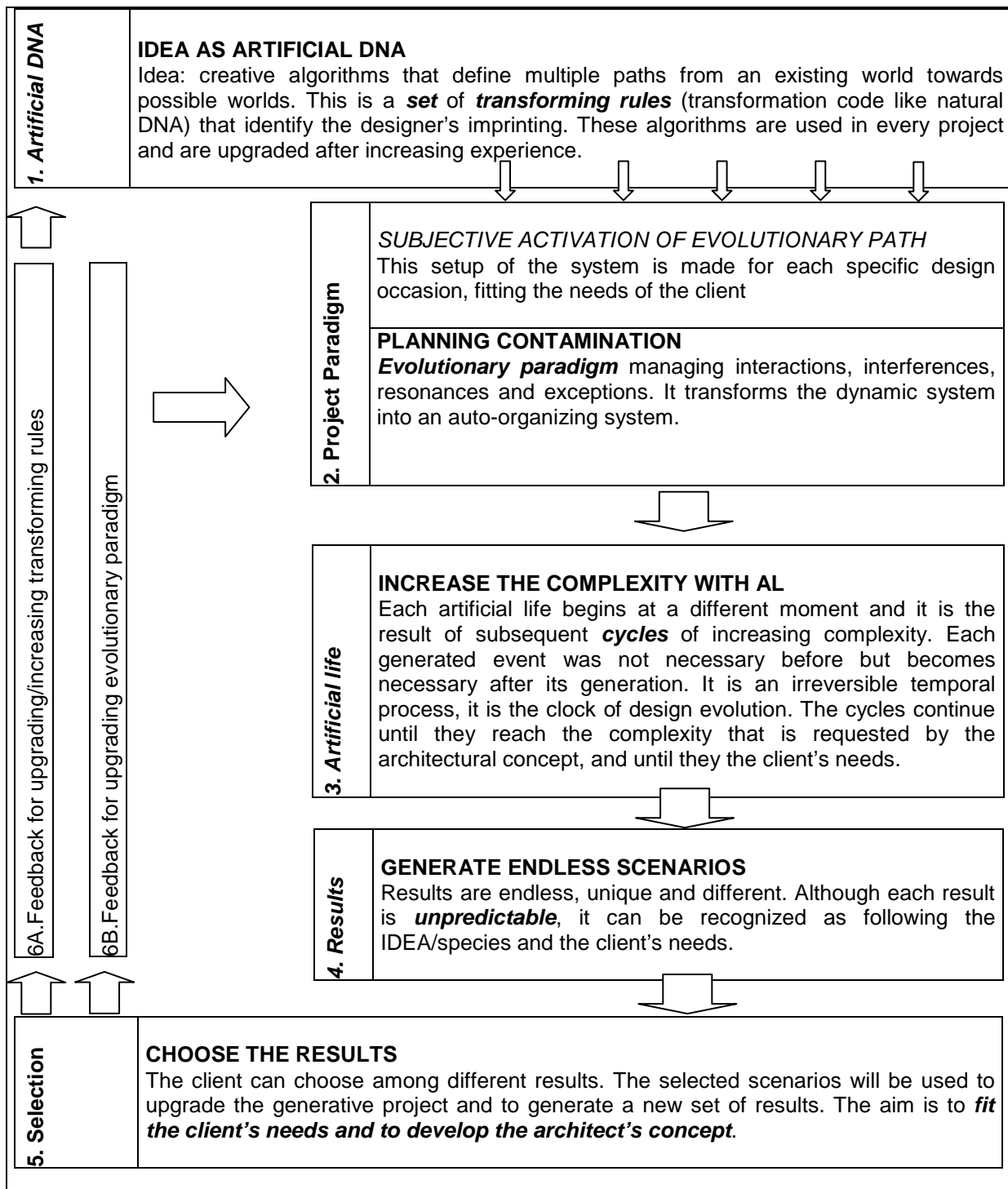


Table 1. ." (from: "Generative Design Visionary Variations. Morphogenetic processes for complex future identities", Celestino Soddu, Communication, and Cognition Journal, 2003)

The generative process (cycle 1-2-3-4-5) uses algorithms managing the transformation and evolution of a non-linear system, but not the evolution of the system itself. The IDEA is the evolutionary system. It uses generative algorithms for representing a particular subjective concept defined as a process. Each generative project can generate, using a lot of parallel artificial lives, an endless sequence of possible parallel results for fitting the architect's imprinting with the client's needs. The system has not automatic upgrading (like genetic algorithms) because the aim is not optimizing/homologizing the idea-system but representing a subjective human creative identity with the fullness of all possible results. For this reason (cycle 6A, 6B) the upgrade is manually made by the architect. As in Renaissance, this upgrading activity is one of the most important human creative act during the design process. The only one that, following subjective interpretation, is impossible to emulate with AI and AL.



Nagoya. Visionary variation of the district of the harbor. C.Soddu generative project 2003



Nagoya downtown, Japan. Visionary Scenarios of increasing complexity 2003

4.1 The Visionary approach

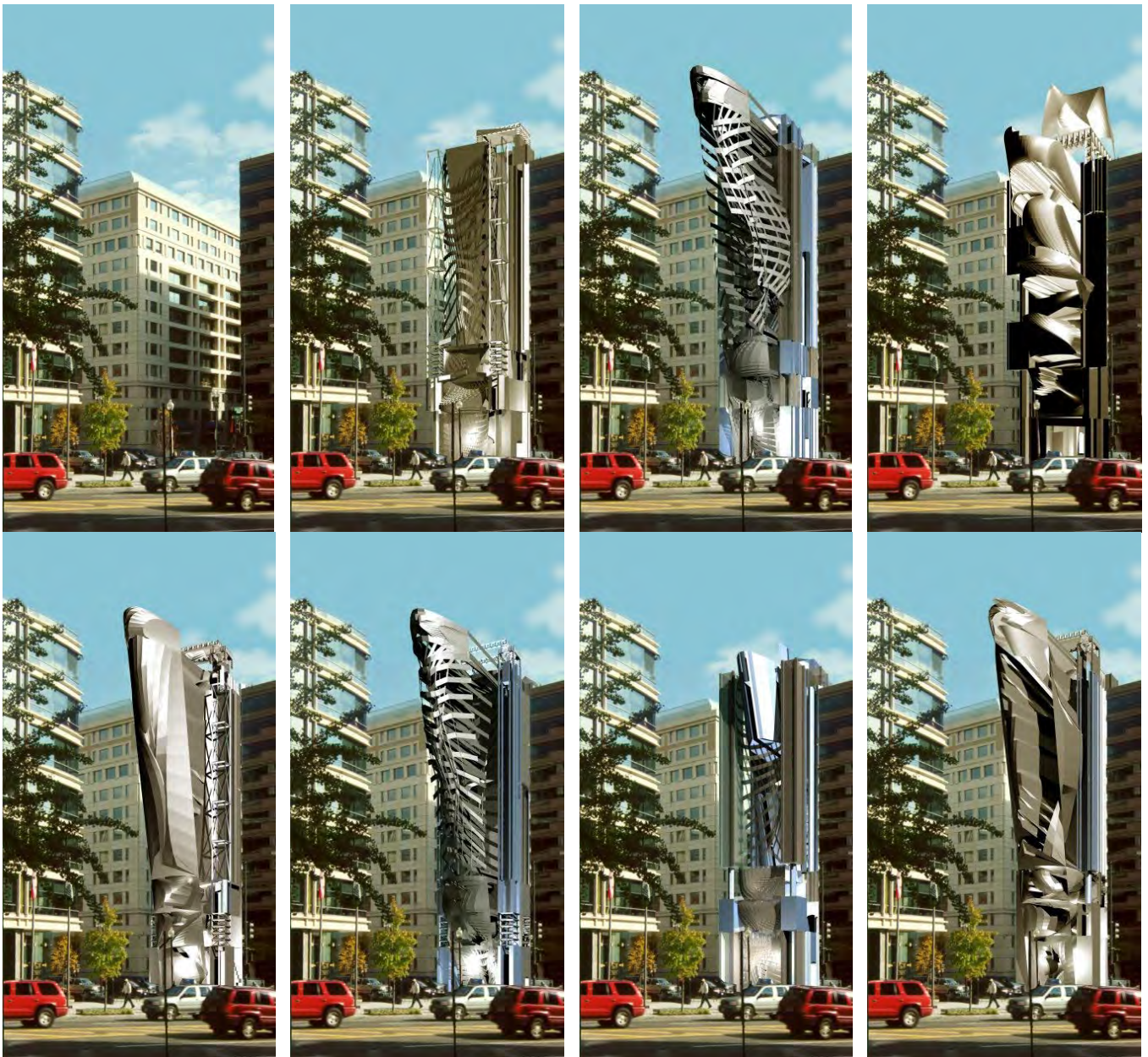
To implement a visionary approach we have:

1. To operate by generating variations and not permutations of pre-designed components (also if these components are parametric). My approach uses a set of parallel codes of transformation that represent a subjective vision, an interpretation of the reality as the first step to implementing possible worlds. Following that, my generative work doesn't use databases. It is an open system able to generate endless results.
2. To reread the historical architectures but not to re-design their forms. The concept was to re-construct the complexity as harmony able to put, in only a scenario, the plurality of events that represents the natural multiplicity of the possible.
3. To build an artificial DNA that can be, at the same moment, innovative, contemporary, and the mirror of the architectural tradition of Renaissance. Where the generated scenarios, also if they mirror the tradition, they consolidate themselves in complex forms constrained by rules, they overcame the limit of these rules by using them. These scenarios have to deny the aspect of these rules to find again, in the constraint, the occasion to explain the concept and run the process of discovery. We are working, as in the Renaissance, in the field of art and science.
4. To maintain, rather amplify the recognizability of each of these cities, also operating through architectures whose image is strongly linked to contemporary concepts of architecture.

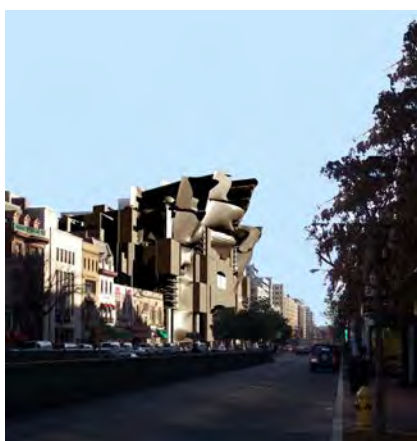
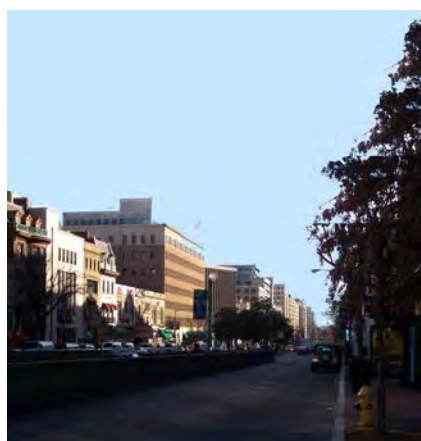
5.0 Conclusion. Generative Art: technology or philosophy?

The results of this challenge are the visionary variations of cities like Chicago, Nagoya, Shanghai, Washington, Los Angeles, Tel Aviv, and Rome.

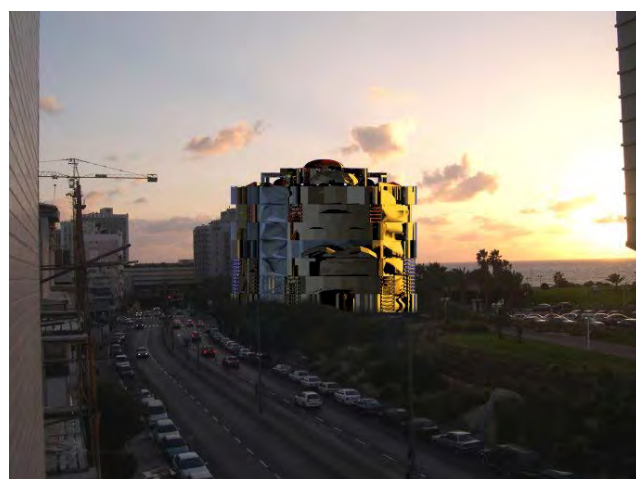
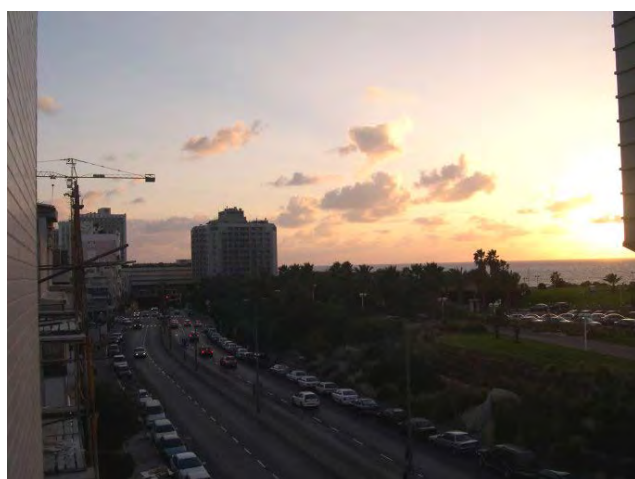
These visionary approaches trace not the solution but the process toward a possible, a look at possible variations of the environment that we are living. The aim is to design an idea of artificial objects that mirror nature, of architecture as the plot of endless variations, of simultaneous uniqueness, of complexity that suddenly appears as existing from a long time, as a natural character that we were looking for a long time, as a mirror of our life.



Washington DC, Inter-American Development Bank Visionary variations. C.Soddu generative project 2003



Washington DC, Dupont street. Visionary variation of town evolution. C.Soddu generative project (IDB exhibition 2003)



TelAviv. Visionary variation of the seafront. C.Soddu generative project of a new hotel, 2003

The generative approach overcomes the technology, it goes beyond the limits of the tools and it is the occasion of deep evaluations on the structure of the environmental systems surrounding us, the occasion of the discovery of creative spaces that we, for a long time, were looking for.

The idea can be concretised in a project of the ideal city without having the necessity to represent it as a solution, but only as a code of the possible, as the process of transformation that we can run: this is the Generative Art. Opening unexplored roads to the creativeness redefining the concept of design GA is more than a technology, a philosophy.

Generative Art is not (only) a technology also if it uses information technologies. It is not only a tool that we can use to generate forms. It is a philosophy with a strong and humanistic imprinting: each generative project can be implemented only starting from a hypothesis, like all scientific discovery paths, from a subjective vision of possible worlds, of possible rules, of possible increasing complexity.



Rome. Visionary variation of Ghetto-Trastevere new link. C.Soddu, E.Colabella, A.Sonnino
Generative project 2003



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Meta-Code, Identity's Borders

Visionary Variations of Milano.

Generative Projects Designing the Identity of Milano

GA 2004

Abstract

City's Identity is how people look at the future referring to their tradition. Performing this designing procedure I investigated to find out a hypothesis able to identify and design segments of the artificial DNA of Milan. These codes were designed as an interpretation of some Milanese references: futurism, design tradition, unpredictable fashion, love for advanced possibilities, passion for innovation and the peculiar Milanese approach to complexity.

I designed all these rules like dynamic processes running to transform existing environment into possible visionary one. And I made executable these processes designing original Generative Projects with my software Argenia.

"Visionary Variations of Milan" was an exhibition at Hong Kong International Finance Centre in June 2004 and presents a sequence of Generative Projects for Milan that try to fit the "Idea of Milan" and its peculiar identity. Each generative project is a Scenario defined by an artificial DNA. All the variations follow the same Idea of Milan using the same transforming rules but each one is unique and unrepeatable like in Nature.

Keywords

Generative Design, Identity, Complex Dynamic Systems, Artificial DNA, Code of Harmony, Visionary Variations, Transforming Rules

Generative Design, the concept.

Generative Design is the idea realized as genetic code of artificial events.

A generative project is a concept software that works producing three-dimensional unique and non-repeatable events as possible and manifold expressions of the generating idea identified as a subjective proposal of a possible world. It works generating a sequence of scenarios, which have, all together, a strong identity: they have to be recognizable by their belonging to the same DNA.

This approach opens a new era in architectural/city design and industrial production: the challenge of a new naturalness of artificial object and environment as unique and unrepeatable scenarios. These mirror the uniqueness and unrepeatability of man and Nature. Once more man emulates nature, as in the act of making Art.

This genetic code of artificial ware identifies, like DNA in nature, the identity of a species of objects. In the future, the design will be the idea and the realization of an artificial species, which its character, identity and peculiar cultural references.

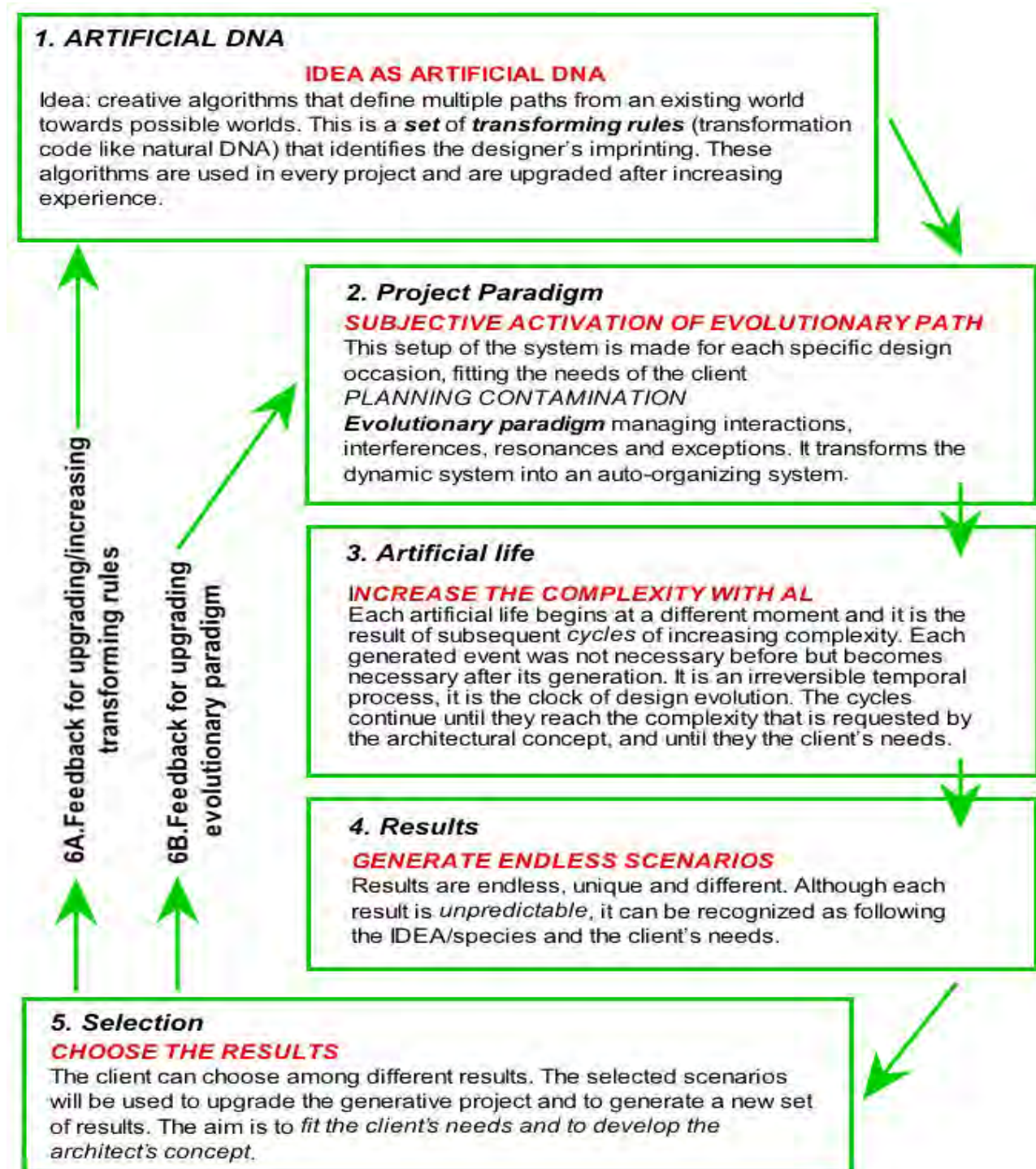


Table 1. The generative process (cycle 1-2-3-4-5) uses algorithms managing the transformation and evolution of a non-linear system, but not the evolution of the system itself. The IDEA is the evolutionary system. It uses generative algorithms for representing a particular subjective concept defined as a process. Each generative project can generate, using a lot of parallel artificial lives, an endless sequence of possible parallel results for fitting the architect's imprinting with the client's needs.

The system has not automatic upgrading (like genetic algorithms) because the aim is not optimizing/homologizing the idea-system but representing a subjective human creative identity with the fullness of all possible results. For this reason (cycle 6A, 6B) the upgrade is manually made by the architect. As in Renaissance, this upgrading activity is one of the most important human creative act during the design process. The only one that, following subjective interpretation, is impossible to emulate with AI and AL. (C.Soddu, *Generative Design/Visionary Variations. Morphogenetic processes for complex systems*, C&C Journal 2003)

Designing these artificial genetic codes was an enthusiastically creative operation. I had found myself returning to the Renaissance cultural approach, capable of combining Science and Art. I have created ideas formulating a code of the Harmony that belongs to the history of man and his relationship with nature. Each one of these codes identifies and represents our subjective vision of the possible, our imprinting as architects. The code of Harmony, like all codes, contains some rules that trace certain forms of behavior. Therefore, it is not a sequence, a database of events, of forms, but a definition of behavior patterns: the transformations from what exists into future visionary scenarios managing the increasing complexity of contemporary environments. The design act changes from forming to transforming because each form is only one of possible parallel results of an idea.

My design challenge started up in 1987 with the realization of Generative Projects of architecture, cities, industrial design and visions of Art. Today these projects are extremely complex and are able to be directly operative as interfaces with productive systems.

In an epoch marked by repeated attempts at the cloning of natural beings, Design finds again, in advanced technological fields such as non-linear dynamic systems, artificial life and artificial intelligence, the notions of the aesthetic and ethical pleasure of rediscovering the processes and characters of Nature and its unrepeatable uniqueness.

Generative Visionary Variations for Milan Identity. Designing the Code

City's Identity can be represented with an open system of transformation rules, of developing procedures able to identify how each city performs his increasing complexity.

"These procedures, sometimes consolidated by time, act controlling the increase of complexity, and represent the culturally unique and unrepeatable matrix of the site.

Like an olive tree that, overworked from the wind and from the rain becomes more and more an olive tree. It enhances its own identity, while, if grown protected in a bell of glass loses its own identity because it has not the occasion to explicate and represent its character.

Following the same way, each city explicates its own identity living the perpetual shifts of cultural moments and unpredictable events, living and using the occasions created by the increasing of the complexity of the life of the man, and of his needs, but also created by the changing of each subjective approach.

If we choose this dynamic approach for designing architecture and urban development, we certainly cannot identify the city's identity with a database of forms or solutions that reflect the specificity of different historical and evolutionary moments. Identity is not already reachable through the repetition of facts and events.

Identity is a *modus operandi* toward the future.

Every new realization must increase the identity of its city. The city must make a footstep toward the attainment and improve its unique city's idea, that is not necessarily tied up with specific forms, colors or recognizable events but to a recognizable logic representing the cultural and ideal character of this city.

The first step is to construct the set of codes that identify each city. We could call them codes of Harmony. And we can perform, with them, a generative town project.

Italian Renaissance culture had identified the harmony as logic linked to the process of construction of artificial environments, to the systems of relationships and proportions that tie different events inside architectures and cities. The harmony, therefore, is a logic that defines the *modus operandi* of designing acts.

The codes of Harmony, in the different cultures, has always been the way to find and use, in

the construction of artificial environments, the logics that is possible to read in the natural world.

These logics are strongly tied to each different culture even if it is possible to find a common substratum between different traditions in the processes of interpretation of nature.

These logical rules, interpreting nature, define dynamics of transforming environments toward harmony. These rules are a design synthesis of the manifold aspects belonging to the construction of possible scenarios.

The operational hypothesis to manage the evolutionary dynamics of cities is to identify and to realize, as generative executable projects, the codes of harmony that represent specific urban identities." (C.Soddu paper at GA2002 conference)

In the case of Milano, I identified a set of particular rules that, linked to the transforming rules that I designed for the Italian and European town environment, are inside the Argenia release used to generate the Visionary Variations of Milano. The results show how new architecture could increase the Idea of Milano and these manifold scenarios could be used for knowing if these Ideas fit the shared idea of Milano that its inhabitants have.

The transforming rules identified and designed in this generative projects belongs to:

1. Structures of dynamic progression of the spatial dimensions;
2. Structures of progressive transformation of the topological relationships;
3. Rules able to control the progressive scenarios represented through perspective visions;
4. Sequences of rhythms and progressive discoveries of artificial space;
5. Contemporary presences of events structured in dynamic relationships among the dimensional multiplicities of the built;
6. Coincidences and contradictions between the existing spaces and those possible;
7. The relationship between whole and parts, activating controls on the dynamics of fractal sequences proper of complex systems.

These rules are used through a paradigm of control of complexity that represents, in the city's evolutionary dynamics, the structure of relationships subtended in the system of the city, and that fit, at various scales, the same identity concept. This paradigm becomes the operational tool to manage connections, contaminations, and mutual conditionings among the dynamics of growth of the manifold events that transform the city.

But we cannot use the same rules in the entire city's environment.

Identification of bifurcations in the complex system could manage and determine the plurality of possible identities living in the various districts of the same city. These manifold identities represent possible scenarios belonging to same species, to same urban identity. Urban identity, in fact, is such if it succeeds in generating different individuals of the same species, districts and places that, also in their oneness, represent different evolutionary possibilities of the same concept.

To interpret and design the transformation codes of Milan I decided to record some perspective views. I use the perspective views, like photos and pictures, because they represent a memory, where the past points out the trace of a possible path toward the future. The perspective views are so useful, also if they don't belong to our own experience. The medieval images by Giotto and Simone Martini were, for me, a lot more interesting, allusive and conclusive than the real images of these cities when I got the interpretations of the medieval town codes. Following that, in 1987 I designed with algorithms the identity of these Italian towns, tracing the transformation rules that are the main structure of their identity.

More, the perspective views are a really useful record for fixing your interpretation. You are, again, at the peak of the perspective cone and you can redefine the fundamental relationship between your oneness and subjectivity and the oneness of the city disclosing itself for you in this particular perspective view. This is the reason why I use the perspective views also for communicating my architectural projects. More, a set of perspective views, taken in sequence, could disclose a dynamic system that I like to represent tracing a code of transformation. And if you discover that these dynamics sequences can perform an anamorphic dynamic system, multiplying the possibility to get different means following each subjective vision, you can directly operate representing this complexity with transforming rules, designing segments of the artificial DNA that could be used to manage the unique and unrepeatable identity of a city.

Concerning Milan, I used some perspective views: views of Brera, of the Gallery, of the streets of the downtown, views from the Terrazza Martini end from the Duomo's roof. The only images useless were the images from the Terrazza Martini that, being taken from the point more high of the downtown, we could value as the more important ones. In fact, the view from this point is an almost axonometric view, without scenes that bring back to the subject, to your own vision of the city. So they are too technical views for helping you to identify your interpretation, for helping the abduction. Interpretation and abduction are the first steps for constructing the rules of Milan's Identity.

From the Duomo's roof, on the contrary, Milan discloses itself when you start up to look at the city through the steeples.

Particularly I designed nine "Milan Transforming Codes" and I have added these rules to my generative software Argenia. The aim was tracing the increasing identity of Milano with the realization of generative projects and their visionary variations.

The nine rules are:

Rule 1 - Code of Ordo/Chao

How the urban-architectural complexity increases. It identifies and manages the relationship between different scales and the relationship between interior and exterior. The particularity of Milan increasing complexity, following my interpretation, is the sliding from large scale systems ordered with easy and clear geometries, like the progressive circles that define the city map, into a chaotic, complex system of the small scale, like the geometrical complex grid of streets.

Interpreting this structure, I developed a code to be used inside the architectural systems too, managing the topological structure of spaces and frames.

Rule 2 - Code of Similarity

How the artificial system manage the repetition of similar events. This rule was abducted by the logic of the sequences and development of the Duomo's steeples. Each repetition uses similarity and not equal events, and the rules of this similarity are designed looking at the steeples. Each one unique, each one unpredictable, each one a further step to understand the idea of which the architecture and the city are based.

Rule 3 - Code of Gaudi

How the artificial events end, part 1. The abduction was from the Duomo's steeples too. I have found a parallel logic of transformation among Duomo's steeples and Gaudis towers. Following that, I designed a code able to manage the top of the vertical systems but also

how each artificial event will end. This rule is not the only one that will manage the ending system.

Rule 4 – Code of Filarete

How the artificial events end, part 2. The abduction operates considering the sequence from the tower of Filarete, in the Castello Sforzesco, within the Velasca tower. One of the medieval codes of Milano could be designed as transforming rules able to control the extension of space when space itself is going to end. These rules use the “interior tensions” of the existing structure, of its interior complexity. This dynamic of space extension could identify a particular Milanese way to construct the projections used in medieval buildings.

Rule 5 – Code Borromini

Borromini was a Baroc architect and, in Milan, Baroc style doesn't exist. But Borromini was born in this area, in the Ticino valley, and his basic references are in this area. Following this and looking at some architectural events in Milano, I tried to add to the previous codes another one as an homage to this exceptional architect. In any case, in my architectural approach, Borromini is very important and I used his reference for designing many generative codes of mine. First of all, in my Argenia the structure of the paradigm of the organization of each artificial event is based, following Borromini, on the number 27.

Rule 6 – Code Gothic

How the artificial events transform themselves when folded. The abduction is from Gothic cultural references, a strong cultural aspect of Milano. One of the sub-rules of this code is how to emboss the folding line.

Rule 7 – Code Leonardo

How develop the increasing complexity of artificial events. This code is a set of rules that identify the geometrical increasing complexity following the increasing requests of functions. The abduction was from Leonardo da Vinci machines. Leonardo is one of the main cultural references of Milano and his cultural and technical experiences, written in the Leonardo Codes, designed Milano.

Rule 8 – Code Futurism

How artificial events show themselves. The abduction is based on my interpretation of Futurism images. Futurism was the main cultural event in Milan during the last century, and it was based mainly in Milan. Also, if Milan has no physical reference to Futurism in its town shape, Milan has a futuristic DNA. Its inhabitants have a way to look at the future with a strong futuristic imprinting. My challenge is to enlighten this cultural reference, now shaded, and use it for enhancing the Milan city's identity.

Rule 9 – Code Organic

How artificial events lean out. The cultural reference is the organic and futuristic architecture, mainly Erich Mendelsohn and Sant'Elia. These architects offer a vision of future in the field of industrial town shape, as Milan was in the last century. The external skin of the artificial events transforms itself in an organic way to fit these references, like the Einstein Tower.

The Visionary Variations of Milano Identity. Generating Architectures.

Looking from the Duomo's roof: the steeples, far the Filarete tower and, near, its first interpretation, the Velasca tower. In front of this tower we could find its negation but in the same time, it's re-launching, the Pirelli skyscraper. They are all around the Duomo, which measures, with its steeples, the boldness, the complexity and the aesthetics of each event. The variations of the projects n. 5, 6 and 8, the IASC towers, the twin towers “Mirror of Friendship” and the “Homage to Gaudi” tower enter in the strong system of relationships

among the steeples and the high buildings of Milano in a town shape that stubbornly remained linked to the 60's of the last century. The IASC towers redefine this relationship linking these building and the Duomo through a contemporary image of complexity belonging to the transforming codes of the Milan Identity.

The Velasca tower gave me one of the main interpretation keys. It is not only a citation of the Filarete tower and of medieval towers. The final projection, with its structure on the air, tells Milano. A strong tension of convergent and divergent strengths inside a geometric order ever checked, almost forced. Milan proposes the same type of complexity in its urban layout: the town is shaped concentric and apparently it is regular. But it develops its complexity with an interlacement of streets that confuse you and force you to look at the sun to understand in what direction you are going. The Velasca tower, with the design of its projection supports, expressly alludes to this double structure, it represents the soul of Milan, jealous of its own complexity and that loves to appear minimalist.

From this interpretation, the first hypothesis of code was born, and it is applicable to the structure of the architectures too. I have designed some rules of transformation that contaminate the structural system of the buildings operating on the order of some structural events. These events had to project but instead, they only sporadically appear in the exterior skin, almost hidden emerging, maintaining them inside the simple external geometry of the building. In the meantime, the interior structure of these buildings, as the interior grid of streets in Milan, appears with a not random development, strongly characterized by functional needs but amazing, almost labyrinthine. This code of transformation, besides, folding up space, exalts the topological structure enhancing relationships of proximity among spaces that, before the transformation, were physically distant but topologically were thought near. This code of transformation represents a way of developing, of growing, of building in progress recognizable events as belonging to the same logic, with a strong identity that emerges each time with unique and un-repeatable scenarios.

In the realized visionary projects, this system mostly explodes to the outside in the twin towers "Mirror of Friendship" next to the tower Velasca and the bell tower, while it is all to inside the building system in the project of the Traveller's tower next to the Pirelli skyscraper. But, as all the other transforming codes, these rules are present in almost all the visionary projects for Milan. These codes are in the towers "Homage to Gaudi" where the inside tensions appear only as contaminations of the complexity three-dimensional constructive order that find again the similarity with the steeples of the Duomo. The same rules are used in the Futurism Museum where the contamination is among tilted orders that sometimes are projected out of the skin and the closed system of the geometry of base.

The three visionary variations of the Futurism Museum follow three different ways to use this code. In the 1st variation, the code Ordo/Chao and the code Filarete involve all the spaces, from the interiors to the exterior skin, as is clearly represented in the axonometric and section views. In the 2nd and 3rd variation, on the contrary, the code Filarete involves only the structure of the system, as in Velasca tower. In the 3rd variation, the code Ordo/Chao works also in the geometry of roofs and terraces. In the 2nd and, also if less, in the 3rd variation, the transformations made with the code Borromini are clear in the shaping of the roofs. In the 2nd variation, it operates transformations with the contamination among the code Borromini and the code Gaudì. In the 3rd, the code Borromini manages the increasing complexity of only one of the roof's domes.

The 1st variation of Futurism Museum project needs some further specifications. Over the code of transformation “Filarete” I mainly used in the first variation the code Organic that operates the transformation of the skin of the building in an organic way referring to the imaginary based on the Einstein tower of Mendelsohn. The other two variations of Futurism Museum are based on codes abducted from Sant’Elia visionary architectures. These references are an important point in the construction of a possible identity of Milan because Milan is the city where the most advanced experimentations in the Italy of the beginning of last century happened. Despite it, Milan has not existing physical characters linked to this experiences. This historical memory could be part of the genetic patrimony of this city.

In the twin towers "Mirror of Friendship", besides, another important code of transformation, the code Gothic is activated related to the nerves of the building, based on the folding approach to architectural walls. For instance, these angles are embossed and white, in comparison to the dark red of the walls, as in the bell tower that is in front of the Duomo and that intercepts the sight toward the tower Velasca. In these twin towers, I expressly used a code of transformation that defines how to turn the angle. This rule is not only applied in the vertical angles but in other different orders, at different scales. Going ahead with other codes, in the Twin Towers Mirror of Friendship we can easy identify what from surrounding building is used to increase the Milan's Identity.

In the same way, looking at the visionary variations of the project Brera Utopia's Museum, it's possible to link the applied transforming rules to the façade of the surrounding buildings, particularly to the one on the left. And in the same time, the geometric structure of the building follows the reference to the concept of the castle, as it's possible to understand looking at the axonometric view of one of the variations of this project.

But these are only some examples showing where one or two codes of transformation had particular power. All the 11 generative projects were generated using all the rules designed by me for the Identity of Milan. The visionary variations were generated contaminating these particular rules with all the other that represent my cultural references and my experience as an architect. This is the reason why these rules are not so axiomatic but they emerge in all the projects, from the detail to the whole image, giving a Milanese feeling to these architectures. All these projects together show my idea of the possible future of Milano, of what it is possible to point out for increasing the wonderful cultural reference and identity of this city.

Filarete Tower in the town shape (fig. 1,3), view from the Duomo's roof (fig.2) and the steeples of Duomo with the Velasca Tower (fig.4)



The Generative Projects in Milano (increasing Identity of Milano)

1.FUTURISM MUSEUM (3 variations)



The site: Milan Downtown, Largo Augusto and Corso di Porta Vittoria. It's possible to see the Duomo in the background. The building on the left is changed by the Futurism Museum project.



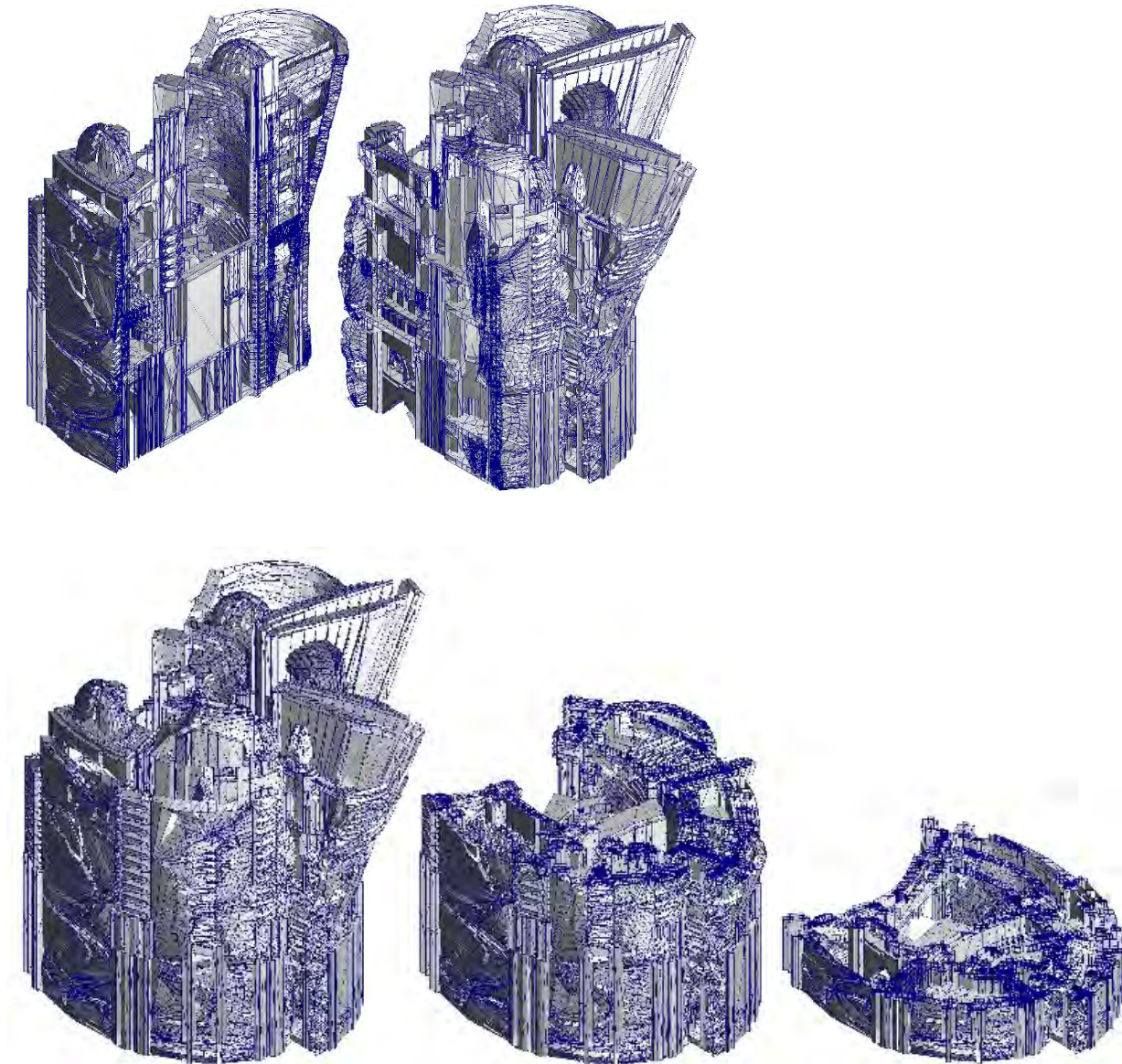
Futurism Museum in Milano. First Visionary Variation.



Futurism Museum in Milano. Second Visionary Variation.



Futurism Museum in Milano. Third Visionary Variation.



Futurism Museum in Milano. One of the 3D model generated by Argenia with its interior spaces. These axonometric views belong to the 1st variation.

2.FREEDOM HOUSE

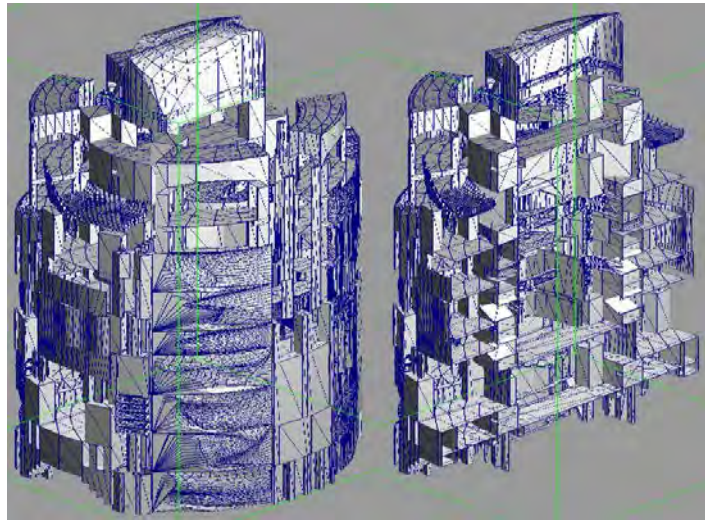
The project is placed in one of the more interesting residence districts of Milano, near to Santa Maria delle Grazie.

The building is multifunctional, with residences, offices and commercial devices. It is designed to set up, inside and outside, the character and quality of a Milanese city environment.

Particularly the terraces and the interior hall use the reference of the old “case di ringhiera” that have characterized Milan town environment in the last century.



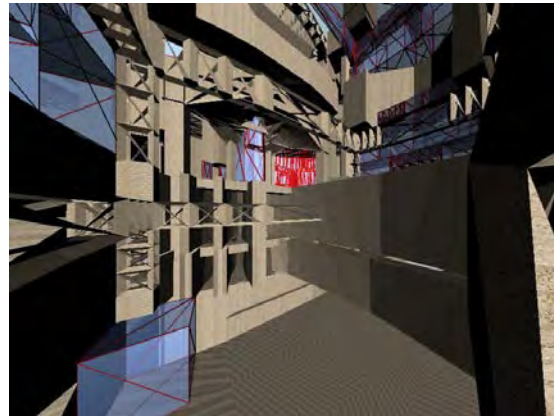
The site, in a central residential area of Milan.



Generated 3D model and an axonometric section of the Freedom House.



Interior space of Freedom House. View of the terrace.



Interior central space of Freedom House. The old “case di ringhiera” were the references used for designing the transforming rules of the interior spaces.

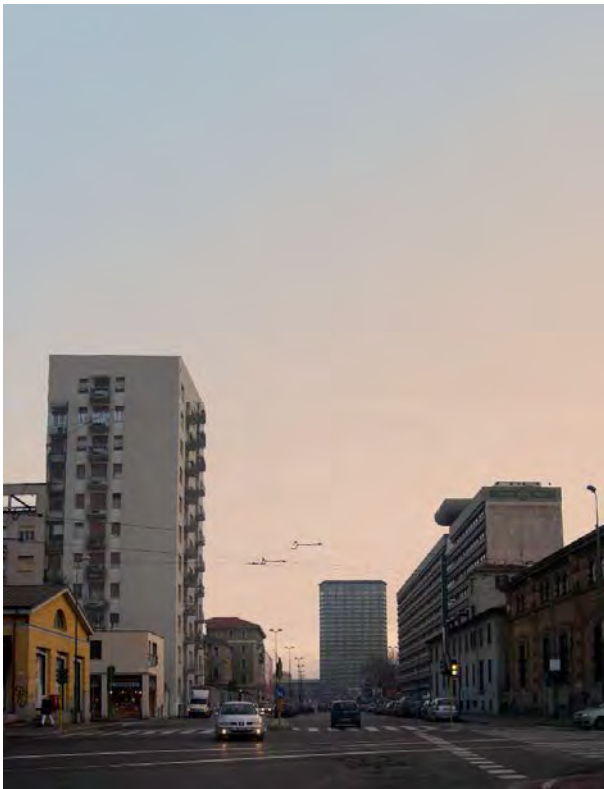


Freedom House in Milan. One of the generated variations.

3.INTERGENERATIONAL RESIDENCE TOWER FOR ADVANCED LIVING

(5 variations)

The project follows one of the most advanced proposals for the incoming new functional structure of town environment, the IRTAL, Intergenerational Residence Tower for Advanced Living that defines and set up a residence for students together with old professors in a system that mix residences, services, cultural activities and labs/studios. The residence system is organized for enhancing the cultural exchange and reciprocal helping. It is located in Via Melchiorre Gioia, near Brera, inside one of the Milanese districts that have, today, the more increasing complexity evolutionary processes in Milan.



On the left:

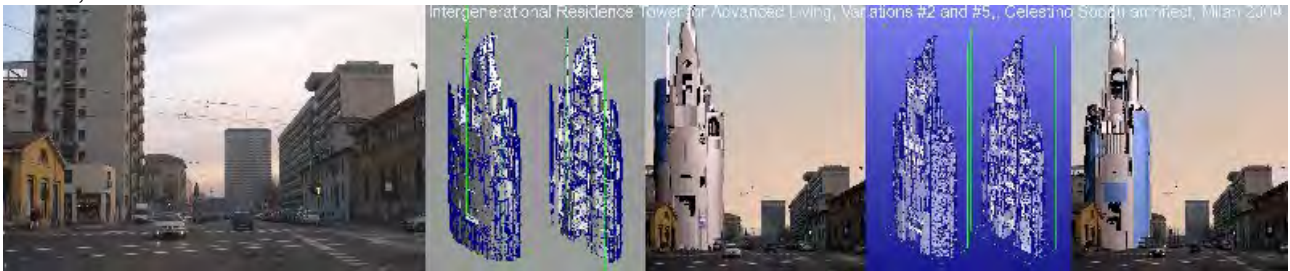
The site, via Melchiorre Gioia, the increasing complexity business district in Milano. The building on the left was changed for constructing the Intergenerational Residence Tower for Advanced Living.

On the right:

IRTAL, Variation #1



Intergenerational Residence Tower for Advanced Living, Variation #1, Celestino Soddu architect, Milan 2004



The site before the projects and two generated 3D models with their views



IRTAL, Variation #2, Variation #3, Variation #4, Variation #5

4. BRERA UTOPIA'S MUSEUM

(3 variations)

The project is inside one of the most famous districts in Milan, Brera. That is also the district of Art with the Brera Fine Arts Academy and the Pinacoteca. The street is via Brera, the Brera Academy is on the right, at the end of the street, and the Scala theater is at the end of the street, behind us.

The building substituted is a commercial building. The project proposes a new Museum, the Utopia's Museum, in front of the existing Brera Academy and Pinacoteca in a way to enhance the Art vocation of this district. The transforming codes used are the same used for the other projects with a particular attention to the interpretation of the existing building on the left of the view.



The site. Brera, the district of art in Milan. On the right, at the end of the street, the Brera Academy of Art and the Pinacoteca.



Brera Utopia's Museum, Variation #1



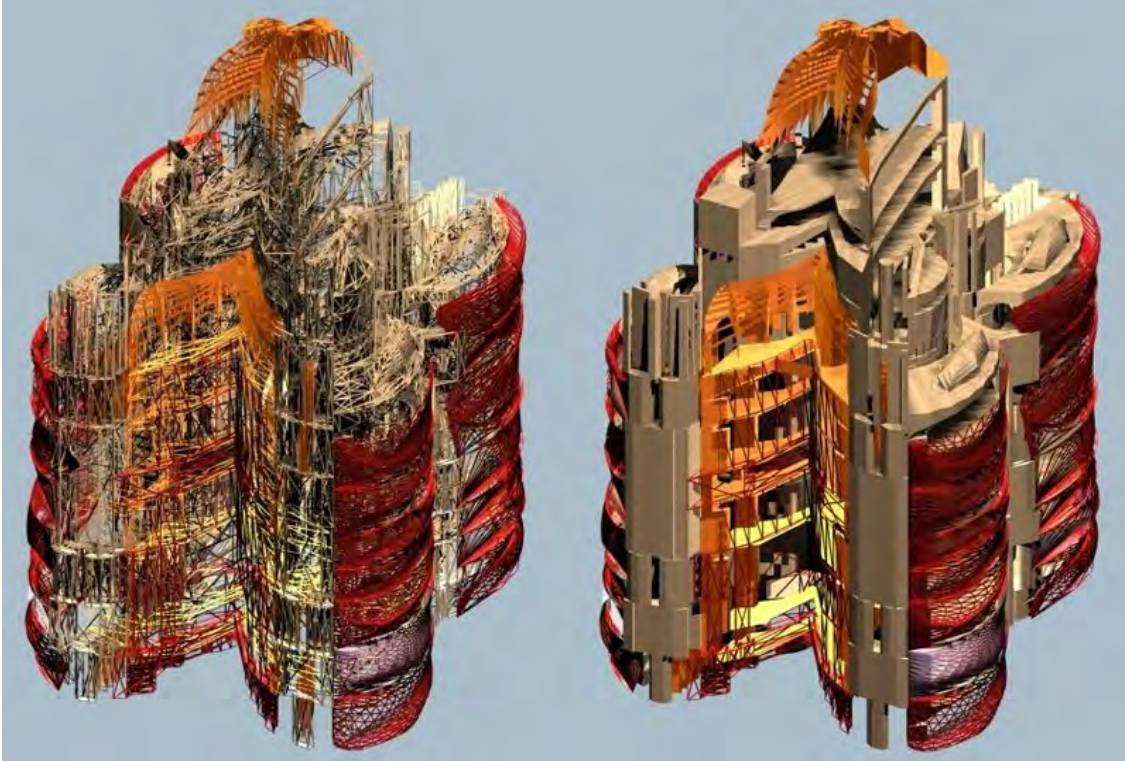
Brera Utopia's Museum, Variation #2



Brera Utopia's Museum, Variation #3

The position of the building is in the angle where the street made a sliding. This position gives to the project the possibility to enhance, with the geometry too, the role of the Utopia's Museum in the "Art" district of Milan. The geometry code of the entire building system is abducted by the traditional castles, as it's possible to verify looking at the axonometric views of the 3rd variation. The wire frame image shows the complexity of the geometrical system that uses the "castle" geometry for the envelope and the transforming rules, like Ordo/Chao

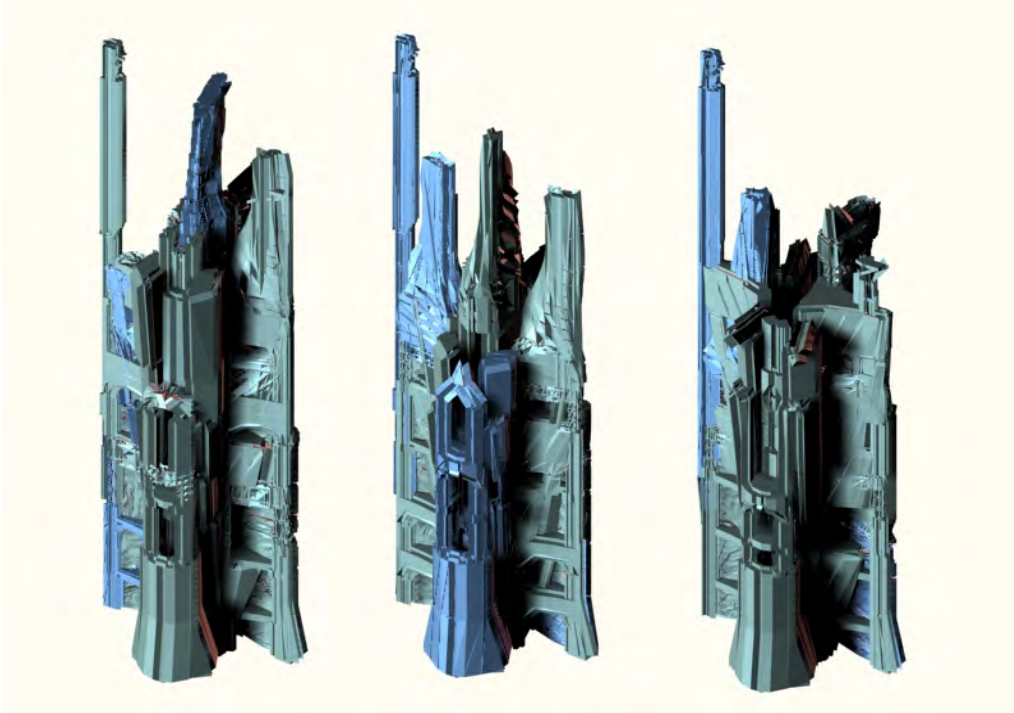
and Leonardo codes for the increasing complexity of the interior system of spaces.



Brera Utopia's Museum Variation #3, wireframe and shaded axonometric views.

5.HOMAGE TO GAUDI

A new tower in the town shape, looking at Milan from the Duomo's steeples. (3 variations)



These project and its 3 visionary variations are an extension of the Duomo's roof into the Milan downtown. The aim is to increase the complexity of Milan using, in a contemporary way and with contemporary town buildings the Harmony codes abducted by the history and

tradition of Milan.

All the transforming rules designed for Milan were used to design the artificial DNA of this project.



The site, looking from the Duomo's steeples.



Homage to Gaudi, three tower's variations in front of Duomo, Axonometric views.

These generated 3d models were produced using this artificial DNA with a mixed system of rules controlled by a paradigm abducted by Gaudi.

6.INTERDISCIPLINARY ADVANCED STUDIES CENTRE

(4 Variations)

The site, looking from Duomo's roof



Looking from the steeples of the Duomo at the Milan town shape.

The proposal is a building for the future of Milan, the IASC, Interdisciplinary Advanced Studies Centre.

It will redefine the relationship between the tradition and the recent history, represented by the high towers of the 60's.

All these four variations used the same transforming codes, the same DNA. They are 4 different individuals of the same species, as the steeples of Duomo are.



Interdisciplinary Advanced Studies Center. Variation #1,2,3,4

7.NEW MILAN GALLERY

(2 variations)



The Gallery is one of the most important spaces in Milan and, following that, it must represent Milan's identity.

This project of a New Gallery in Milan has two variations but, on the contrary of the other variations, these are not parallel results but they represent two following steps of the evolutionary path that I ran to fit the Identity of Milan.

While the 1st one is one of the starting steps, the 2nd represent the idea of interlacement among exterior and interior spaces and the contamination among urban and architectural spaces that reflects one of the segments of Milan's DNA.

In this 3rd Visionary Variation, it's possible to recognize the transformations made by the Milanese codes that I designed for the Identity of Milan



The New Gallery in Milan. Variation #1, Variation #2

The site in the downtown of Milano. The New Gallery is placed in the existing square between the two buildings on the left

8.MIRROR OF FRIENDSHIP EXHIBITION BUILDING (Twin towers)



The site in a view from the Duomo's roof. On the right the existing Veslesca tower.



The Mirror of Friendship Exhibition Buildings, The twin towers are a variation of the same artificial DNA.

9.TRAVELLER'S TOWER (3 Variations)



The site, the square in front of the Central Train Station, with the existing Pirelli skyscraper by Gio Ponti.



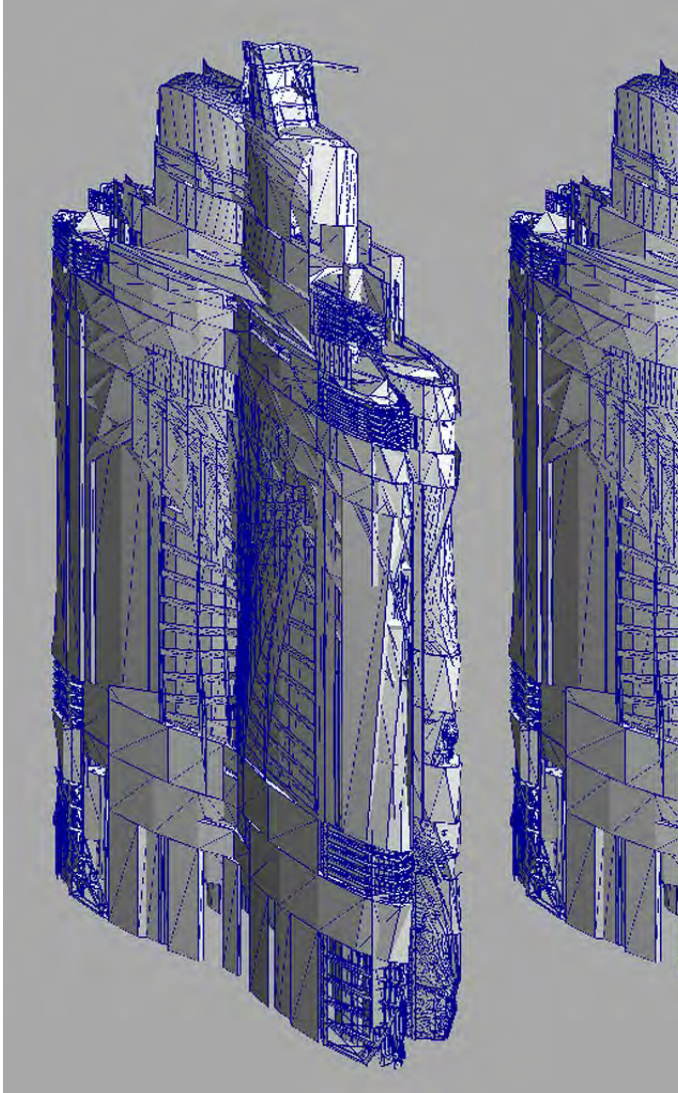
Traveler's Tower, Variation #1, 2, 3



Traveller's Tower, Variation #2, Celestino Soddu architect, Milan 2004



Traveller's Tower, Variation #1, Celestino Soddu architect, Milan 2004



The generated 3D models of the 1st variation and the section

10.THERMAL BATHS AND CULTURAL CENTRE (2 variations)



The site, in the business district. The building on the left is substituted with the Thermal Baths and Cultural Centre building.



Thermal baths and Cultural Centre, Variation #1and 2

11.RENDEZVOUS IN GALLERY

*The Milan Gallery. Generated chairs, coffee machine and a woman portrait.
Variation #1, 2, 3*





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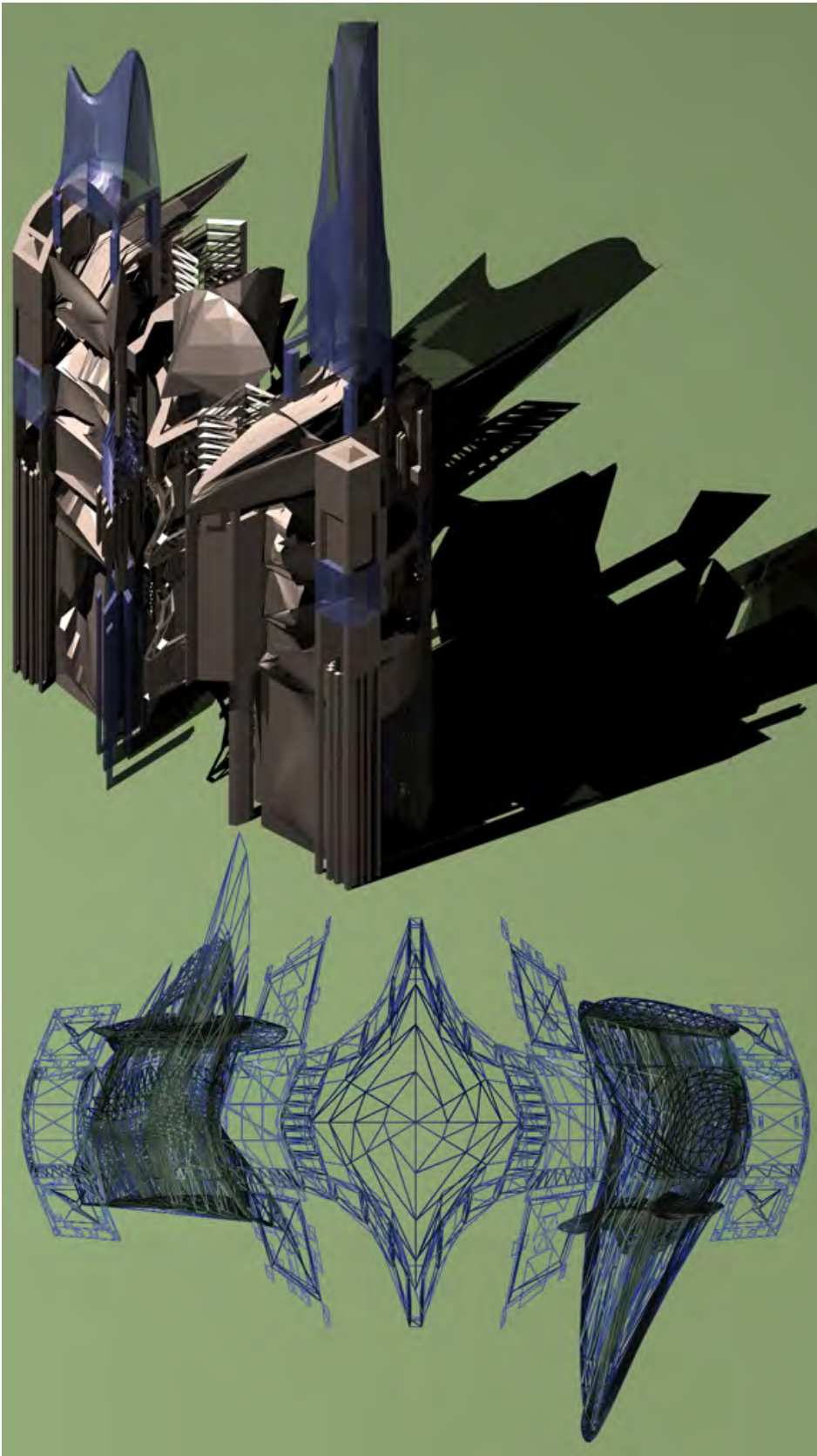
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Other generative projects in 2004

Rome, Ghetto/Trastevere



Shanghai, city door



Tel Aviv, Broadcasting Tower.





Tianjin towers



GENCITIES AND VISIONARY WORLDS

GA 2005

Abstract

When we look at clouds transforming themselves with the help of the wind we interpret them following our subjectivity and own cultural references. We use the same transforming logics, the same anamorphic logical approach for building our subjective system of codes that we use for recognizing and facing the events surrounding us.

This system of decoding, unique because it fits our subjectivity, mirrors our creativity and imprinting as artists and designers. Generative artworks spring from this subjective morphogenetical engine. Forms are only a subsequent step.

Investigating on these transformation logics and the subsequent anamorphic approach we can construct our generative engine reaching a strong identity and recognizability of our works.

One of the most interesting fields for investigating these logics is the generative engines coming from moving from different dimensions, from 2D to 3D and back, using different perspective approaches.

Each physical city, mirroring their own Ideal City and the multiplicity of its visionary variations, will be, finally, not clonable but unique, unrepeatable and unpredictable, natural and harmonic.

1. Forms, identity, recognizability, and morphogenesis

We recognize a form if we identify it as similar or, however, comparable to those already experienced. We recognize only a form through the memory of other forms. But they are not single remembered forms, neither sequence of different events. The memory is structured in a system built activating a logic that reflects our subjectivity linking and associating different forms by identifying particular aspects of them. We could affirm that each of us builds and identifies a proper morphogenetic code in associating different forms together. This code is a direct expression of our way of seeing, of our cultural references, of our identity.

There are many and different ways of experiencing and of recognizing the physical world. Some people identify and build the code through the logical-geometric reconstruction of the process of realizing the forms, other people approach it by recognizing, structuring and following the subjective satisfaction of particular needs, from practical to aesthetical or symbolic requests. Everyone identifies and progressively sharpen during their life a series of recognizability codes, a structure of species that fits their own subjectivity and that

progressively identify themselves following the increasing of own experience and of own culture. Everyone, therefore, has a unique approach to recognizing and appreciating the events surrounding him. Besides, each person identifies, following his personal way, what appears as normal (inside the species) and what as exceptional. Every system of subjective codification allows people, however, to share identifications with other people and to find the possibility that each form simultaneously belongs different species. Looking at a stool, we could affirm, for instance, that the object belongs to the "chairs" species, with the exception to have not the back, or that it belongs to the "tables" species, with the particularity to have a reduced dimension, or to the "staircases" species with the exception to have only a step...

If we consider the field of creativeness and of design, the investigation on species and on possible approaches activated by each people to build their codes of recognizability of forms is very useful to explain the logical structure of creation. This investigation expressly identifies different creative ways bringing to the conceptual creation of the idea and its structure and the specificity and identity of the creative approach of each one.

For instance, let's take a pyramid: a physically existing pyramid like the Pyramid of Cheops. Each people have a memory of this form and he associates it to other forms. If we call these forms as "pyramids" all people could agree because an individualized geometric common concept exists for all people with the name of the pyramid. Instead, if we want to go ahead, each of us could also associate the pyramid of Cheops to other events whose logical structure belongs to the species that each of us built for recognizing the pyramids. These logics can conceptually be very different, and they allow us to produce groups in which it is possible to overlap similar events. Some examples. A first logical approach could be defined by considering the pyramid as a solid cube from which a whole series of pieces has been removed through plain cuts. This vision for subtraction of the three-dimensional solid is the characteristic vision of the sculptor. Michelangelo affirmed that the statue already exists in the stone; it is only necessary to remove what is superfluous. If this logic is adopted for building a species of forms, any form that can be identified as what remain of a cube after cutting away some pieces, it belongs to the same species of the pyramids.

A second logic could be constructed starting from a plain matrix that produces spatial events. A square with two diagonals, when the center and intersection of the two diagonals is "lifted" and moved in space produces pyramids of which that of Cheops is only one among endless possibilities.

A third possible logic still could be born from the cube. If the superior face is magnified or reduced smaller, this transformation produces a whole series of solids where the pyramid is the moment in which the superior face is reduced to zero, while the trunks of the pyramid and the hourglasses are the moment when the dimension of the superior face is positive or negative.

We can identify a fourth possible logic considering the pyramid as a solid generated by the following facets of a half-sphere. If we progressively divide the half-sphere in triangles we produce a whole series of solid that, departing from one almost-half-sphere with a large number of triangles we reach the square based pyramid as next to the last step before the tetrahedron.

A fifth logic, that we could call ziggurat, considers the pyramid as an overlap of squared based prisms. The range can start overlapping two prisms and can go ahead increasing the number or prisms when each one becomes more and more thin.

But we could continue imagining the pyramid as one individual of a species in which each event is inside the progressive transformation from the cone to the triangular based pyramid

or to the triangle itself, imagining this last event as a pyramid with the base constructed with two or only one side.

Which is our subjective logic for declaring that an event is a pyramid? If we find us in front of the pyramid of Cheops anybody has no doubts because this pyramid is a common point of reference. But if we are looking at an event whose form is not so axiomatic, because it contains, for instance, also some curved surfaces or it has not peak, and so on, who will identify it as a pyramid, even if particular and on the boundaries of this species? Perhaps only who conceives the pyramid as an event inside the progressive transformation of a half-sphere, or of a cone. The other people will associate the form with other morphogenetic species.

Every form, when losing its geometric axiomatic aspect, that is when no one can incontrovertibly associate it with only one geometric species, becomes an anamorphic shape. It becomes a form changing meaning, changing character, changing "species" according to the subjective approach of the observer. In other terms, it is possible to associate each complex form to different species of events using different logics and association codes. These differences define the subjective recognizability, the matrix of reference based on own personal cultural background. We could define these approaches to forms as anamorphic interpretations, as the results of subjective anamorphic logics.

These approaches normally happen when we are fascinated by the contemplation of the clouds, interpreting their forms in multiple ways; or when we find human expressions in the form of some rocks or in the plot of a carpet.

The anamorphic logical approach is different from anamorphosis because it doesn't happen through an artwork, where the author stratifies meanings, but it happens when we look at complex forms, also natural forms, using our memory and our subjective codes of recognition. The anamorphic logical approach is the creative speculation on possible different readings of the existing form and of the possible variations of its image, meaning, and structure. Each of us implements this approach with the awareness not of the ambiguity but of the stratification of possible affiliations to different species, to different functions, to different aesthetical, symbolic and functional structures. In this sense, the anamorphic logical approach can be considered one of the bases of the creativeness, of the design imprinting and of the style. Following their subjective logic, each artist makes his artworks recognizable. His approach to interpreting forms is an essential part of the identity of his idea.

Generative Art has discovered the anamorphic logical approach as one of the possible motors able to produce endless possible events through the activation of codes, of morphogenetical logics. Generative Art also discovered the incontrovertible strength of species. Generative artists need to realize their creative identity in the endlessly generated artworks. Each artwork, also unexpected, must be recognizable not only as single results but as belonging to a species, to the artist's identity and style. If not, Generative Art will be confused with Random Art. Nothing is so far and different as Generative Art and Random Art.

2. The passage from a dimension to another.

The field of reference is the relationship between the three-dimensional form and its two-dimensional image in its manifold variations. But we could consider also the image and its possible forms, in its manifold interpretative variations. The "generative" reciprocity between the form and the image of the form where every form "produces" a plurality of images and where each image "produces" a plurality of forms, in an endless spiral, is one of the principal

fields of construction of the Generative Art, of the art that was born from expressing ideas as morphogenetic logic.

First of all, a difference of dimension can exist between the form and its image. Often this difference exists by considering the form as a three-dimension event and its image as a two-dimension representation. But this is only one of the possibilities. We can get a 3D representation of an event having a lot of dimensions or we can increase the dimensions of the representation in comparison to the dimensions of the event, when we, for instance, try to represent the image of a jewel pending from the neck of a noblewoman in a seventeenth-century portrait by building a three-dimensional object that interprets the image of the painting. In this case, only one of the possible two-dimensional representations of the constructed 3D event will fit the original image.

If we like that the result of this moving through different dimensions can be considered totally acceptable, it would be necessary that each point of the form corresponds to one point of the image and that the structure of the form system will have the same topological logic then the image-system. This obviously is not possible in the passage from a dimension to another. The "perspectiva artificialis" of Piero della Francesca is only one of the possible two-dimensional representations of three-dimensional events. With this approach, a lot of information are lost. The inverse run, from the perspective representation of the three-dimensional event, is, in fact, only a reasonable hypothesis. This passage could be considered as acceptable only if we built this three-dimensional event on the base of a lot of further knowledge (what we don't find in the image) as the point of view used in the representation. If we don't know previously it, we could identify it only through a subjective interpretation; therefore every interpretation "produces" different forms.

More. We can reconstruct only what we see and not what is behind or what is inside the represented events. As Florenskij said, the perspective image represents only the skin of the three-dimensional event approaching the three-dimensional event to the two-dimensional representation. But, also with this consideration, the bending of the skin won't be ever sufficiently represented on the plain sheet of the sketch. The relationship between bending of the skin and plain sheet can be compared to the relationship between Euclidean geometry and not-Euclidean geometries.

Not only. We have to operate a further interpretation choosing among the different techniques of perspective representation that we suppose could have been used for producing the two-dimensional images. These techniques are manifold and we could synthesize them in three types, each of which links the form to its image in a different way:

1. Perspective - 1*1.

Perspective with only one point of view and only one direction of the look. The observer and the represented event are faced.

It is the "perspectiva artificialis" of Piero della Francesca: only a point of view, therefore, only one eye and not two, and only one direction is considered. This direction becomes also the point of central escape in the geometric construction of the image.

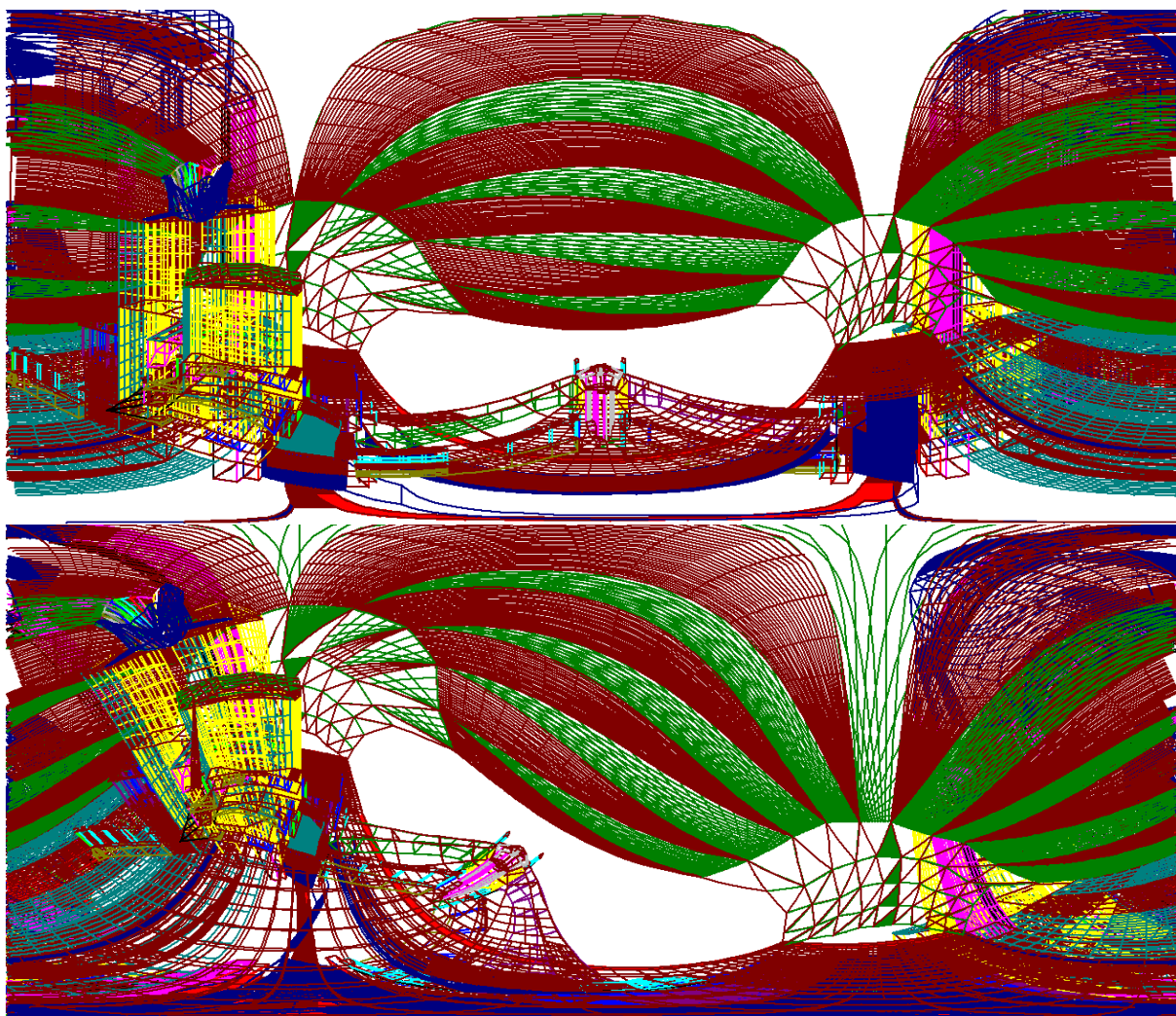


Piero della Francesca, "Flagellazione". If you reconstruct the represented space, as L.Ragghianti did, you will find a very long space, different from your expectation.

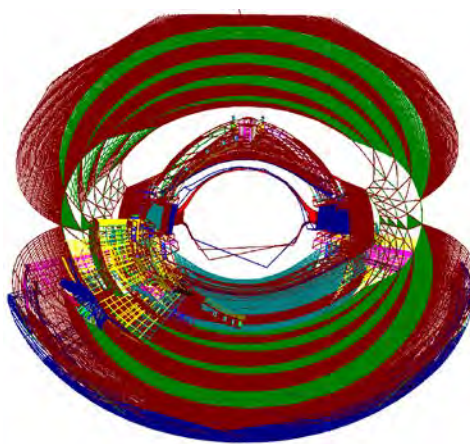
2. Perspective - 1*N.

Cylindrical and spherical total perspective: these perspective techniques consider only a point of view but manifold directions of the look, up to cover 360 degrees in horizontal (cylindrical-perspective) or also in vertical (spherical perspective). The observer is the center of the system.

The curved perspectives follow the naturality of the vision. In fact, if we are inside space, for instance, a rectangular room with the parallel walls and with the plain ceiling, and we look toward a side we will see all the parallel sides to the constructed image converge toward a point (the fire). Then, if we turn the eyes and we look at the opposite wall, we realize that the same lines converge toward another point, opposite to the first one. Quickly turning our look from one side to the other, we could realize that these parallel lines converge in two points of the image that we are building in our mind. A bundle of parallel straight lines converges in two points only inside a non-Euclidean geometry system. The amazing aspect is that if we pass from a perspective built inside a Euclidean geometric system to a perspective built inside a non-Euclidean geometry, as spherical geometry, the mathematical representation of the transformation, the algorithm representing the passage from 3D into 2D becomes, mathematically, very beautiful being possible to represent all through the measure of the angle. I have experimented these non-Euclidean total perspectives twenty years ago. These experimentations and the algorithms that I wrote for building and representing the "total perspective" are at the base of my generative software. They configure a generative engine able to generate endless possible results starting from a single image. (C.Soddu, "L'immagine nonEuclidea" non-Euclidean image, 1987, Gangemi Publisher)



Generated Castle by C.Soddu represented in Total not_Euclidean perspective in two different views, the first one with horizontal sight and the second inclined, using the software designed by the author.



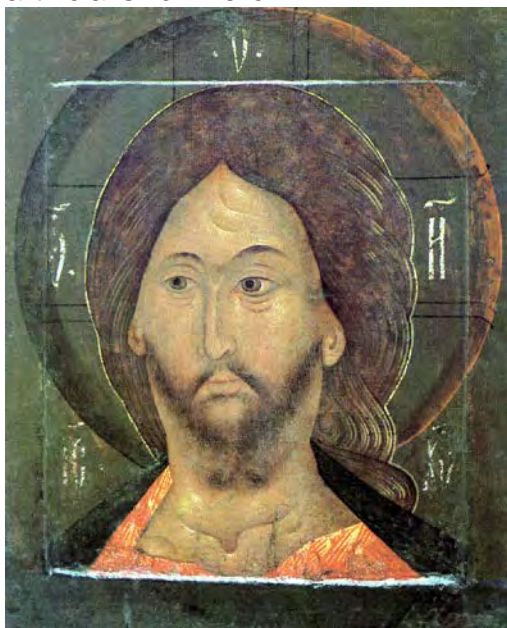
Generated Castle realized with rapid prototyping using 3D STL model directly generated by Argenia and the Castle of the other images represented with anamorphic total perspective using the software designed by the author.

3. Perspective - N*1.

Reverse perspective by Florenskij. This approach considers a multiplicity of points of view, the two eyes and their various possible motions, and only one target of the look.

The represented event is the center of the system.

This perspective intends to contain in one two-dimensional image the multiplicity of different visions. The practice construction of this perspective approach can be realized through an interesting conceptual overturn that I have experimented in my software. If the target of the look is unique and the points of view are different we can capsize the total perspective, that has only one point of view and different targets, setting the point of view on the target and the directions of the look in a lot of "eyes". The realized images could be assimilated to a representation of the skin of the object seen from the inside. The reverse perspective has been identified and explained by Florenskij looking at the Russian icons. Being sacred representations the fundamental choice is setting the represented event as the center of manifold looks. In these two-dimensional images, the representation of the face of the Saint is, according to my hypothesis, represented as seen from the inside of its same head. Since, as Florenskij affirms, we represent only the "skin" of the physical event we can capsize the face. Its projection on a sheet will result similar to the representation in reverse perspective of the Russian icons. In other terms I like to affirm that the reverse perspective is the overthrow of the spherical total perspective and not the overthrow of the "perspectiva artificialis" of Piero.



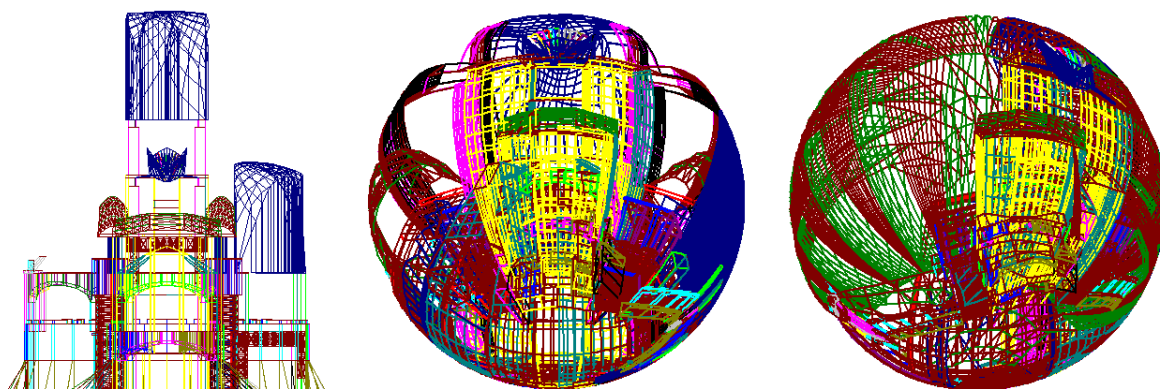
Russian icon with Christ represented in "reverse" perspective.

The passage from a dimension to another, and particularly from the three-dimensional to the two-dimensional events through different perspective logics, but above all the reconstruction of the object 3D using different perspective-visual logics introduces fields of variation owed to different factors inherent in the dimensional transformation and in the type of used representation. These fields of variation belong to the subjective interpretation of the image or better, to the interpretative reconstruction of the parameters that could be used for the production of the image, and of the reconstruction of the parts that are not represented because not in sight because behind or inside to the volume of which the skin is represented.

The hypothesis of reading an image decoding it through the *perspectiva artificialis* when instead it had been built through the Florenskji reverse perspective can produce unpredictable forms. For instance, a cube could be reconstructed as a pentagonal prism. This happens because, with the inverted perspective, the two opposite faces of a cube are represented as "insight" together with the face in front of the observer. The reverse perspective of a cube is able to show three faces in sequence because you can see the cube both from the left and from right. This happens every day when we look at a very small cube and we approach it with the eyes. An eye sees the right face and the other the face on the left. The resultant image is the synthesis of the two sights. The mental image reconstructs a cube representing three consecutive faces. If we look at this representation with a canonical Euclidean perspective approach we need to suppose something different from a cube. Space "behind" appears too much ample and the reconstructive interpretation of the three-dimensional form can bring us to imagine more than a hidden face, for instance, two, and therefore to generate an acceptable reconstruction of a prism with five or more consecutive sides. The cube, through these following passages of dimension (3D - 2D - 3D) is turned into a pentagonal prism.

These transformations are born from our interpretations: It is a "natural" construction of generative motors that mirrors our creative identity, our cultural references.

The idea of an architect doesn't base on forms but on transformations. This is a transforming approach that can be able to see the existing world as a dynamic world, and able to generate visionary scenarios and their endless variations. The generative engines are the structure of the designer's idea. They work on morphogenetic codes fitting the oneness of the approach; they are the anamorphic logics that allow the designer to generate endless visionary worlds by mirroring, in their multiplicity, the design idea.



Generated castle by C.Soddu, represented in elevation and in two different "reverse" perspective, using the software designed by the author following the Florenskji approach.

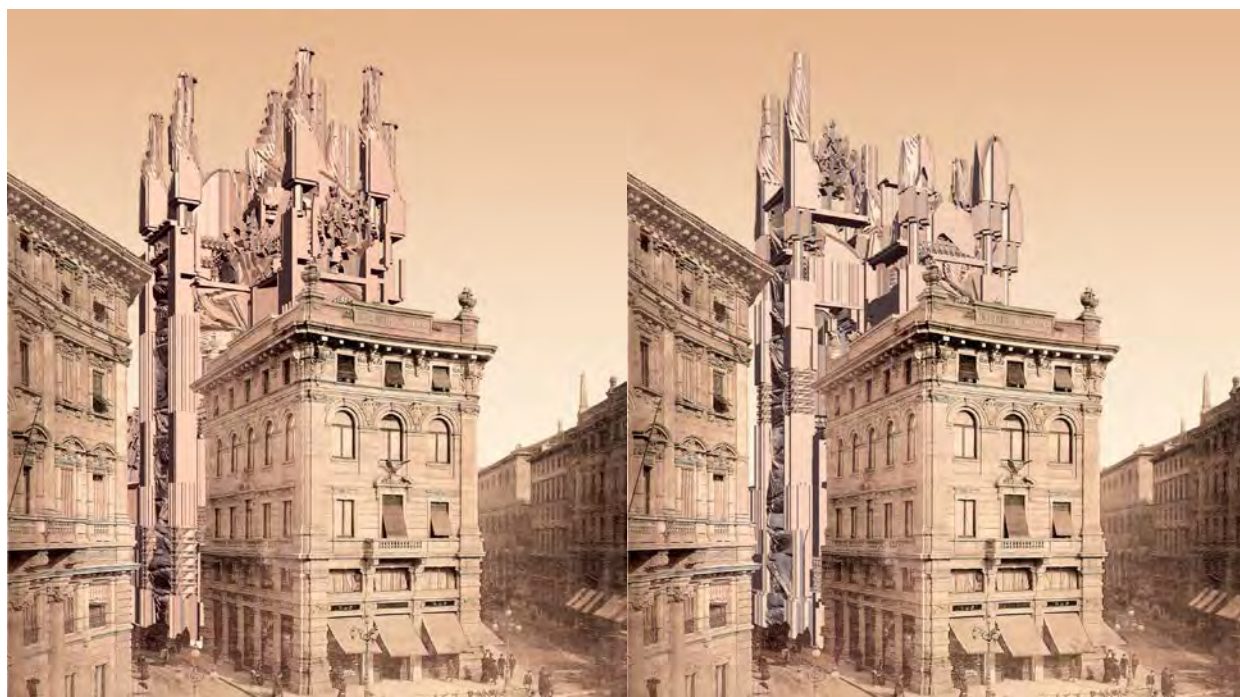
3. Construction of generative morphogenetical processes: subjectivity and variations.

The identity of an artwork exists if people can recognize it as belonging to a species. So, if we like to build the identity of our artworks we need to identify its species and to realize it designing an artificial DNA. This approach is Generative Art: building a series of logics of transformation able to generate endless possible results recognizable through the morphogenetical paths used for their creation and through the reference to possible anamorphic logics belonging to our creative and cultural identities.

The results, in terms of quality and extended appreciation, are the best where the anamorphic logics produce answers pertinent to different subjectivities, therefore where the

generated complex system don't give only the possibility to be understood as axiomatic structure of a shape or of a function but its complexity performs the availability to subjective and unpredictable uses. This usability is realized and appreciated when the suggestions, the logics of use and the aesthetical appreciation of each user is related to the complexity of the designed system and to the potential anamorphic interpretations that this complexity makes possible.

Not only. The identity has to belong to a species without denying, rather strengthening the identity as individual, as unicum. It brings to consider that the design of morphogenetical paths rather than of shapes doesn't remove anything from the final results identity but strengthens then, especially because of the parallel presence of "variations". As happens with the music, from Bach to Mozart and to jazz. Variations are built consolidating different forms in different moments, but these results are reciprocally congruent because of the common morphogenetical paths that, from the detail to the whole, are at the base of an idea. These "endless" variations could seem aesthetically less strong and functionally, less recognizable than only one result was chosen because considered the best at the end of the optimization of the form-function relationship. This approach is misleading. The affiliation to a species, with the possibility of mirroring each result in the infinity of the parallel variations, creates two congruent layers of recognizability and identity that are strengthened one each other: the identity of the species and that of individuals.



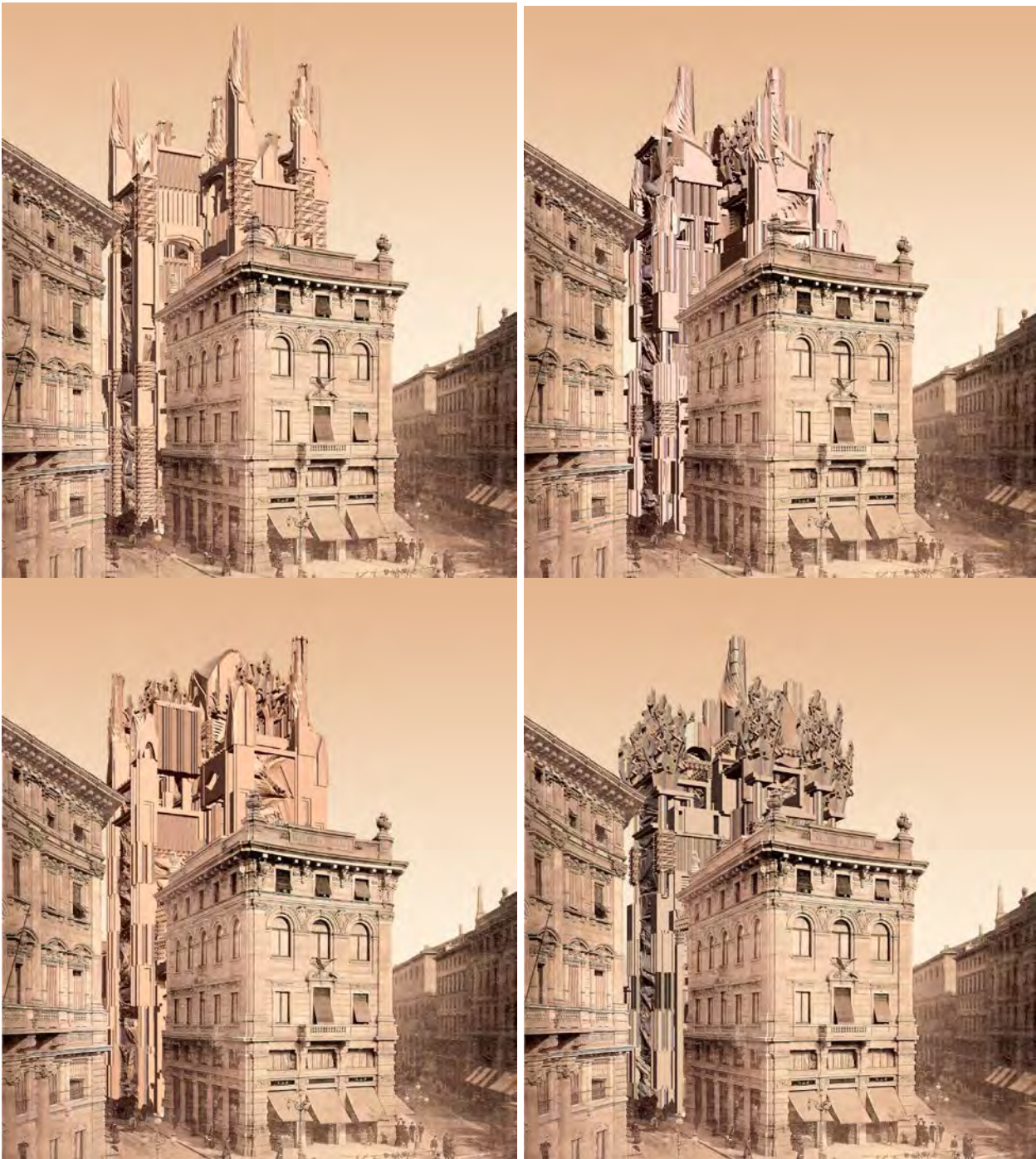
Two variations of "Cordusio" project by C.Soddu. All these 3D models are fully working in the field of functional and structure system and are completely generated by Argenia.



“Cordusio” project by C.Soddu. the aim of this architectural project was to fit the Futuristic cultural reference of Milan building an architecture able to fit the Milan identity as represented by the cordusio square at the beginning of last century. This because the twenties of ‘900 were really important in constructing the “idea” of Milan. 2005.

This approach finds the quality also in the oneness conjugated with the recognizability. For instance, the oneness of a painting of Van Gogh is also appreciated through the possibility to recognize it as painted by Van Gogh, as belonging to a species with unique characters and unrepeatability. This happens in the appreciation of the Nature where the multiplicity of the variations mirrors the multiplicity and oneness of everyone.

This process of appreciation happens not only on the aesthetical layer but also in the aspects more directly related to the functionality. The use of the object becomes "intuitive" really because linked to subjective runs of appreciation and recognizability. As, for instance, sometimes happens in the structure of software interface. For using a function, manifold "logical" runs are designed mirroring different and subjective possible approaches.



Four more visionary variations of “Cordusio” project for Milan, realized by the author using “Argenia”, his generative software. Milan, 2005

4. Generation versus Cloning.

In a production process of individuals belonging to a species, the copy doesn't exist and, we could say, it is not possible. We are able, in fact, to copy an object, to reproduce it until the least details, but we are not able, with the same tools and with the same philosophy to copy a species. This because the anamorphic logic that has been activated during the design of the species is, for its own nature, different from the anamorphic logics of whom analyzed an object, or also a series of objects belonging to the same species. The subjective and interpretative component is so strong and involves the passage from a conceptual system to a plurality of physical events that is not possible to "reconstruct it"; it is possible only "redesign it". A "generative" design is not reproducible departing from the results. It is possible to produce only "clones" of single variations. The only certainty that we can acquire is the feasibility of the generative project because someone has already realized it. We cannot copy it. We can recreate it only ex-novo using the personal subjectivities and interpretative ability. But it will be another project, however.

5. The generative city and the visionary worlds

The future of the ideas and their realizations is a city living of unique events, unrepeatable and anamorphic events able to answer in a pertinent and recognizable way to a plurality of citizens with their unique identity. But also, a city that progressively discovers its own identity approaching to the Ideal City that is in the mind of who lives and designs it. As each ideal city and the visionary worlds representing it, also, every physical city could be, surprisingly, unpredictable, not homologable neither clonable and therefore, finally, natural and harmonic.

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变化多端的

Generative Design. A swimmer in a natural sea frame

GA 2006

Abstract

Generative Design is a logical synthesis of a creative process using transformation rules (algorithms). It can be realized designing a program able to simulate this process and to generate outputs as 3dmodels of architecture, cities, objects. As all creative processes, it involves subjectivity in the definition of how the process runs and how the transforming rules are created and organized into a system.

As in all creative processes, two main factors are involved: the unpredictability of external factors linked to each design occasion, like the environmental context and client's requests, and the subjectivity of designers when they interpret these external factors.

Being a logical synthesis of this complex dynamical system, Generative Approach can be successful used in teaching architectural design as a subjectivity-oriented approach.

Morphogenetic Meta-Project versus Project

Generative Design could be represented like a morphogenetic meta-project, an organized idea of "how to run" a design process. In the sixties of last century, meta-projects were the structure of organization of incoming projects. They were constructed with the aim of identifying the best structure to answer to "objective" functional needs. It was not possible to fully develop this kind of approach because functional needs, extended to practice functions but also to symbolic and aesthetical functions, are strongly related to the subjectivity of customers and to the subjectivity of designers.

Generative Design is a meta-project with two fundamental extensions:

1. it involves subjectivities going more in deep into the complexity of (architectural, town environment, industrial objects...) designed artificial systems.

Perspective versus Axonometric

It's like moving from axonometric to perspective view. Adding subjectivity you can move from the axonometric representation, "objective" because free from subjective views but limited by the dimension of the sheet, to the perspective view that, using subjective points of view, can represent the infinite in one sheet and, following that, the increasing complexity of represented systems.

2. it can run the design process a lot of times, being sensible to little variations of inputs (similar to the different feel of the designer in different moments) and it can generate a sequence of endless results, all different but all related to the designer idea.

Anamorphic versus Axiomatic

It's like moving from normal perspectives view into anamorphic perspective views. Each different point of the view transforms the anamorphic representation into unpredictable scenarios. Looking at each of these outputs we can discover one of the possible representation of the idea.

Process versus Output

Generative Design, as subjective operative meta-project, can be used to design a kind of artificial objects, an artificial DNA of a species of objects because is oriented to set up a process and not only to reach one result. More, it defines and renders explicit all the steps of a "normal" design process, from the first sketch to the final executive project. And, in this way, it's a wonderful support for teaching (architectural and industrial) design.

Idea versus Solution

If you are a designer and someone ask you: “which is your idea, which kind of forms are you thinking to” or “which character do you love for your architectures” or “ which kind of impact do you prefer to have when you enter in an unknown city”, you can explain it using words but you cannot show it if not using a generative approach because it represents an idea and not peculiar solution of problems. Each idea can be developed with multiple solutions but each solution is not exhaustive of the idea.

Synthesis versus Simplification

Interpretation versus Analysis

The reason is that you cannot use drawings, forms or images able to explain your thought in an exhaustive way because you have to perform a synthesis of all your beloved forms, including possible unknown forms that could fit your needs. You cannot simplify.

More, answering to all these questions, you have to explain the complex system of relationships and possible interfaces that a town environment must have for linking your needs and your interpretation of unpredictable user’s needs.

Generative design is not an analytical process but a synthesis process. The core of each generative project is the synthesis, using algorithms, of own subjective approach to context and to own subjective cultural, technological and functional references. In brief, generative design performs own modes of approaching the transformation of existent worlds into possible environments more closed to own idea of quality.

Following that, In generative design processes, but also in all creative processes, the subjective interpretations of the existing world are the main creative acts.

Subjectivity versus Objectivity

Imitation versus Copy

The role of subjectivity is really important in design activity. Without subjectivity, we loose the main stimulus for evolving our functional scheme into a project, and we lose the possibility to use our cultural, symbolical, aesthetical, technological references because these references can be used only if we have our interpretation of them. If not, we can do only copies.

Variations versus Optimization

In last century, we experienced a design approach focused on optimization. It came from the need to identify “the best” and realize it with industrial assemblage chains. This approach belongs to the concept that all people are equal, all people need the same equal product. This approach is not more accepted and it’s known that we can realize a product with the best performances but with a different form. These differences fit the need of personalization of products, fit the need of customers to find his own product, fit the need of each person to find out a product, a house, a car, a square, a city, an environment that fit his needs and that is the mirror of his identity and uniqueness. The subjectivity of designers fit the subjectivity of customers.

The possibility to manage variations is inside the quality of a design process. Generative projects face directly this need generating unpredictable, but recognizable outputs.

Identification versus Homologation

Because the recognizability of outputs is the explication of the architect’s (or artist’s) imprinting. But it’s also a function that each customer appreciates when looking for something facing his own subjectivity. We can recognize a print of Piranesi, also, if we never

have seen it before, because we recognize the style or, we can say, the DNA of his drawing process, his stratified interpretations of surrounding environment that make unique his drawings.

Recognizable versus Anonymous

In the same way, we need to identify our home when we go home, to identify our city and to love the link between its unique character and our way to look at the future.

Generation versus Cloning

Generative Design realizes a species and not only single outputs. It's like in Nature. Generation is strongly different from cloning like art craft is different from assemblage chain. But now an industrial production of all different objects is technically possible using the existing industrial equipment and generative projects. More, variations, as in nature, enhance the recognizability and peculiarity of each idea facing, in the meantime, the need for personalization of each customer. In this era, when someone tries to clone, like in the last century industries, the natural events, we like to rediscover, in the artificial world, the uniqueness of generation, like in Nature.

Unpredictability versus Repetition

The unpredictability of variations of natural objects, like a rose or a cat, enhances the rose and cat concept, the identity of these species, like the unpredictability of an each variation of Bach enhance the identity of his music and our ability to identify and appreciate it. On the contrary, repetition destroys identity. A compound of all equal houses has less identity (and is less fascinating) of a compound where all the houses are different but each one follows a recognizable common idea of quality. Variations as a mirror of the subjectivity of each inhabitant.

Random of requests versus Random of outputs

The use of random factors is important in constructing this process as software. It follows two different approaches. Random as a possibility to create unpredictable requests, constraints, needs as occasions to improve the complexity of the process and testing the recognizability of the idea in all generated events, or random as a generator of casual forms. The difference is, substantially, the recognizability of the artist/architect/designer imprinting.

Teaching How versus Teaching What

I am teaching architectural design for 30 years and, after having developed my first generative software in 1987 and published the related book in 1989 (C.Soddu, Citta' Aleatorie (Random Cities), Masson Publisher), It was me clear that, as my Argenia Generative Software worked simulating the design processes and generating architectural outputs able to fit different occasions and client's needs, so I would have been able to use Argenia as model for investigating about designing process. It is, in fact, an effective logical synthesis of normal design processes.

So I used it as the base of an operative and effective teaching structure for Design Studio Labs in architecture, environmental and industrial design.

Outputs of students were soon really encouraging because based on discussions about "how" develop their work and not about "what" they are designing, giving tools for managing their work without discussing about their partial and temporary results but looking at them as the first step of a transforming process. This teaching approach enhanced their subjectivity

and the possibility to use at the best their own cultural references. In other words, they succeed in using all their previous learning work by interpreting these references as transforming codes. But this aspect created also some difficulties. We can synthesize these difficulties as belonging to the student's denial to render explicit his subjectivity, his cultural peculiarity, also if only in the field of the design approach. The common request of some students (but only in the first steps of the learning path) was the request of a more "objective" teaching process where each student can work "analytically" for reaching a surely acceptable result. But design process is not an analytical process. If the teacher doesn't talk about subjective approach (as done by design teaching in the last century for ideological problems) he misses the possibility to enter in deep into discussion on design processes.

It was also difficult to clear to the students that the assessment of their projects developed at the Design Studio Labs is done evaluating:

1. the congruence between the aims indicated by each student at the beginning of their work and the structure of the transforming rules that they designed during this experience.
2. the progressive transformation path in terms of increasing complexity difference between the initial sketch and the final drawings.
3. The possibility to manage again, in different design occasions, the same reached quality. This point is the main point because it demonstrates the increasing professionalism of the student.

Teaching structure. A subjectively oriented design approaches for teaching design.

Transforming versus Forming

The steps for running a generative approach in teaching design are:

1. *Each student is required to identify the character of his idea by interpreting his references into transforming rules. First the student can list a sequence of characters using words, like adjectives. Each student is required to identify 3 adjectives for describing his design aim. (3 and not less or more because it's interesting to make synthesis and to be not too much axiomatic. The choice of three adjectives was used, the first time, by E. Colabella that experienced in her courses the same logical process). Students have to identify some references as a representation of each character.*

2. The second step is identifying the different design moments when the designer has to choose how to fit the incoming functional, aesthetical and symbolical requests. These moments can be identified like:

How to fold an element

How to divide an element into different parts

How the element ends

How the element lean on

How make holes into elements

How ...

3. the third step is the more creative one and each student is required to explain and use his design subjectivity. Each personal reference can be interpreted as transforming rule applied to each different design moment. The request is: how I can transform the previous step of my project into an incoming one fitting a concrete request and reaching, in the meantime, the identified character? For example, if the student has to open a door into a wall, to divide a wall into parts, to shape how his building can end, and so on, how he will manage these incoming transformations using his own references? He will identify previously a sequence of transforming rules that could be applied to the project in progress for fitting different requests. The result of this creative work is a set of rules that could be considered like

designer's subjective DNA. The reference to DNA is correct because these rules when used, bring the project to be transformed in progress fitting two main questions: the increasing functionality of the project referring to the client's requests and the increasing identity and recognizability of the project by fitting the characters representing the designer's imprinting.

4. the subsequent step, that is the first one directly linked to the starting a particular project, is to set up a paradigm of an organization able to support the transforming path increasing its peculiarity and its functionality. The main difficulty regarding this step is to design an open system, really adaptive but, at the same time, really characterized.

5. Now we have the two engines: the paradigm of organization and the set of transforming rules. It's time to run the generative process using the rules in front of each incoming request. This action will generate a scenario. That is only one of the possible results. This work is exactly the same of normal design activity. But the structure is really clear: these scenarios are generated using predefined transforming rules (focused on defined characters) into a peculiar field of relations designed for representing the project functions. The interesting question is that this design path is clear and understandable by each student that can open a discussion with the teacher referring to his peculiar interest and references. Also, if the students, as normally happens, don't use a software to manage this path but run the process with "normal" tools.

6. The last moment is the possibility to generate variations. Using the defined rules in different moments of the evolving design history, each student discovers that he can reach his own aim with different results. More, students discover that variations are a good representation of their idea that cannot be represented by only one result. And they discover that they can manage the reached quality of their project also in other incoming projects because the transforming rules that they have designed are useful to be used again reaching the same character and imprinting. They have discovered how to manage their professional identity and recognizability when managing their incoming projects.

7. In practice, each student has done his subjective meta-project that represents his identity as an architect.

Using this approach, finally, teachers and students can discuss design process, about how each designer can go ahead with his ideas, following his specific means, needs and aims and not only discussing on the (final) output.

Layering versus Permutation

One of the interesting quality of generative approach is that students learn how to manage the complexity using layering of different transforming rules. As it's known, complexity cannot be reached in only one step. The quality of architectures and cities spring up from history, from the personal history of a design path when the designer fill the project with different feelings of different moments (the more interesting example is that architects, when they need to go ahead with a project that doesn't seem to grow, turn the drawings to the opposite site for having a different view of their work, for finding out an unpredictable point of view) and, regarding cities, from the history of different cultural moments.

More, the generative approach using transformations instead of solutions give a further possibility: a good work for a team of different people with different field of interest. If each partner of a design team gives his contribution to a solution, it's really difficult to put together all the contributions into a final output. Forms/solutions cannot be stratified but only permuted. But if each partner gives his contribution with a transforming rule it's easy to run, one after the other, each rule. At the end, each partner will find, in the final result, the representation and attainment of his own idea.

This teaching approach was experienced by around two thousands of students of Politecnico di Milano, Faculty of Architecture, Industrial Design and Engineering in the courses held by me and by Enrica Colabella starting from 1989. In 1992 E.Colabella and me wrote the book “Il progetto ambientale di morfogenesi” (the Morphogenetic Environmental Project) published by Esculapio Progetto-Leonardo Editor, Bologna, explaining this teaching approach. In the meantime, more than one hundred of the master thesis with my and E.C. supervision were made using this approach. All the student’s experience were, starting from 1995, posted on the website www.generativedesign.com.

The main results, as confirmed by students that are now running their professional activity, are:

1. they are facilitated to increase in progress the quality of their projects because they know how to reach, in each subsequent project, the quality already reached in the previous ones.
2. they succeed in realizing their projects in less time because they use the experienced transforming codes. In this way, they can find time for increasing their transforming rules taking advantage of the peculiar requests of each project.

Philosophy versus technology

The generative design approach is not a technology but a philosophy. It identifies a particular approach to understanding, design and manage the incoming complexity of artificial systems, cities, architectures, environment, objects. It can be easily transformed into technological tools because it uses transforming rules that can be easily written in algorithms.

Rules versus Forms

Organizing versus Choosing

The creativity is focused on logical processes and not on results, on organizing the system and not on choosing solutions. Choosing the emergent event using random forms could bring to shape a good result but, in this case, the quality is not repeatable.

Impervious versus Flat

Occasion versus Obstacle

The client requests, the constraints, the difficulties of a project are welcome. Each new request open the possibility to increase the final quality. Complexity is considered as the ability to answer to the different, sometimes contradictory, unpredictable needs of users.

Organic versus Minimalist

The design process is similar to processes in Nature. It uses something like artificial DNA performed like a set of transformation rules. The aim is a natural organic architecture able to answer to unpredictable requests through complexity, as natural events. On the opposite side, we could find minimalism if we consider it as an attempt to fit different needs with something that looks like an optimization.

The design approach is focused on transforming and not on forming. This approach is considered related to the real approach experienced by designers. The generative philosophy of design can be synthesized by:

Proportions versus Grids

Dynamic versus Static

Parameter versus Measure

The design approach focused on transforming and not on forming have a long history in Renaissance. The attention, experienced in the past industrial era, to modules, and to grids change into a new, but traditional, attention to proportions and parametric definitions because they are more closed to the management of dynamical evolutions. Modules and fixed measures are not more useful for managing the industrial production that uses numerical control equipment and robots.

Permeable versus Waterproof

Improving versus Substituting

Facilitation versus Hindering

And versus Or

Transformed versus New

Memory versus Lost

Palpable versus Untouchable

Contaminate versus Pure

Perfectible versus Perfect

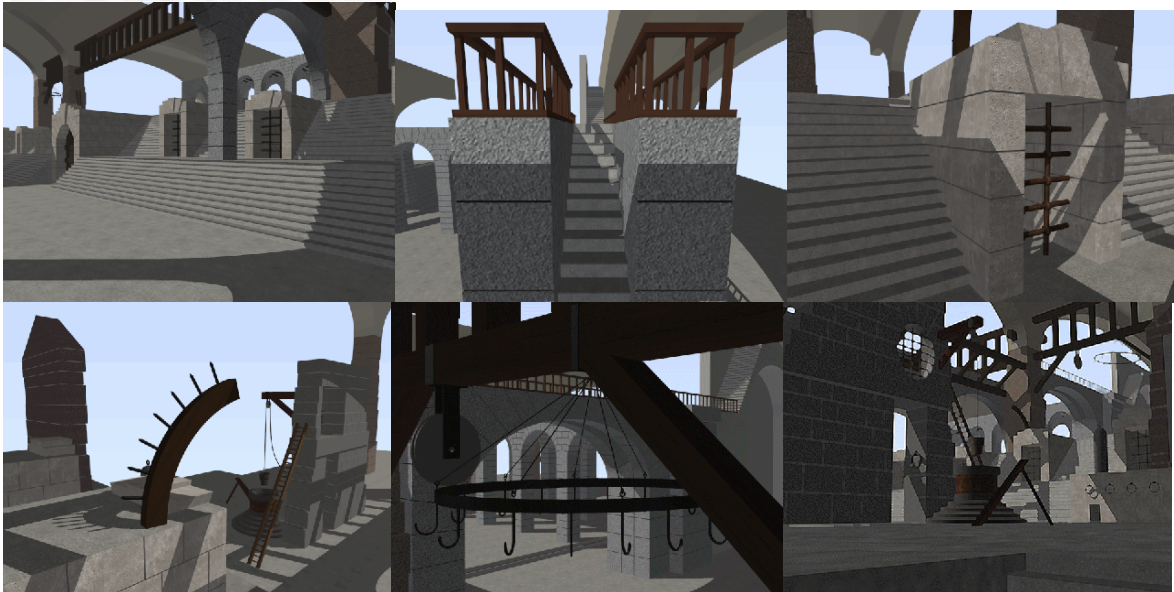
The quality of a design process can be evaluated through complexity, that is not a complication but a synthesis of different and contradictory abilities. This complexity can be reached through the layering of different inputs, needs, references, feelings. And the project in progress has to be read, to be improved, transformed, contaminated without losing his character and identity. But enlarging its own memory. This is possible only if the identity is managed by the modus of running the process and not by the used forms.

Works of my students at their Master Thesis (www.generativedesign.com):

Interpretation of a tree from Van Gogh and generation of 3D trees. Emilio Molinaro 1996

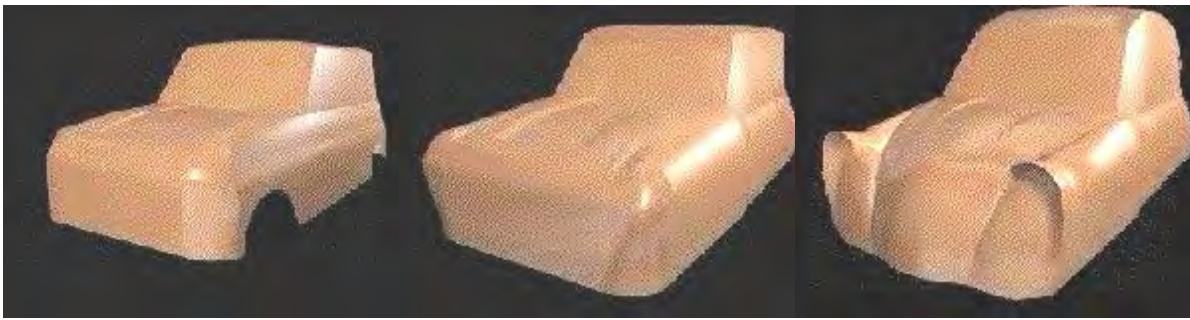


Interpretation of “Le Carceri” by GB Piranesi and construction of subjective 3D model. Enrico Mazzei 1996

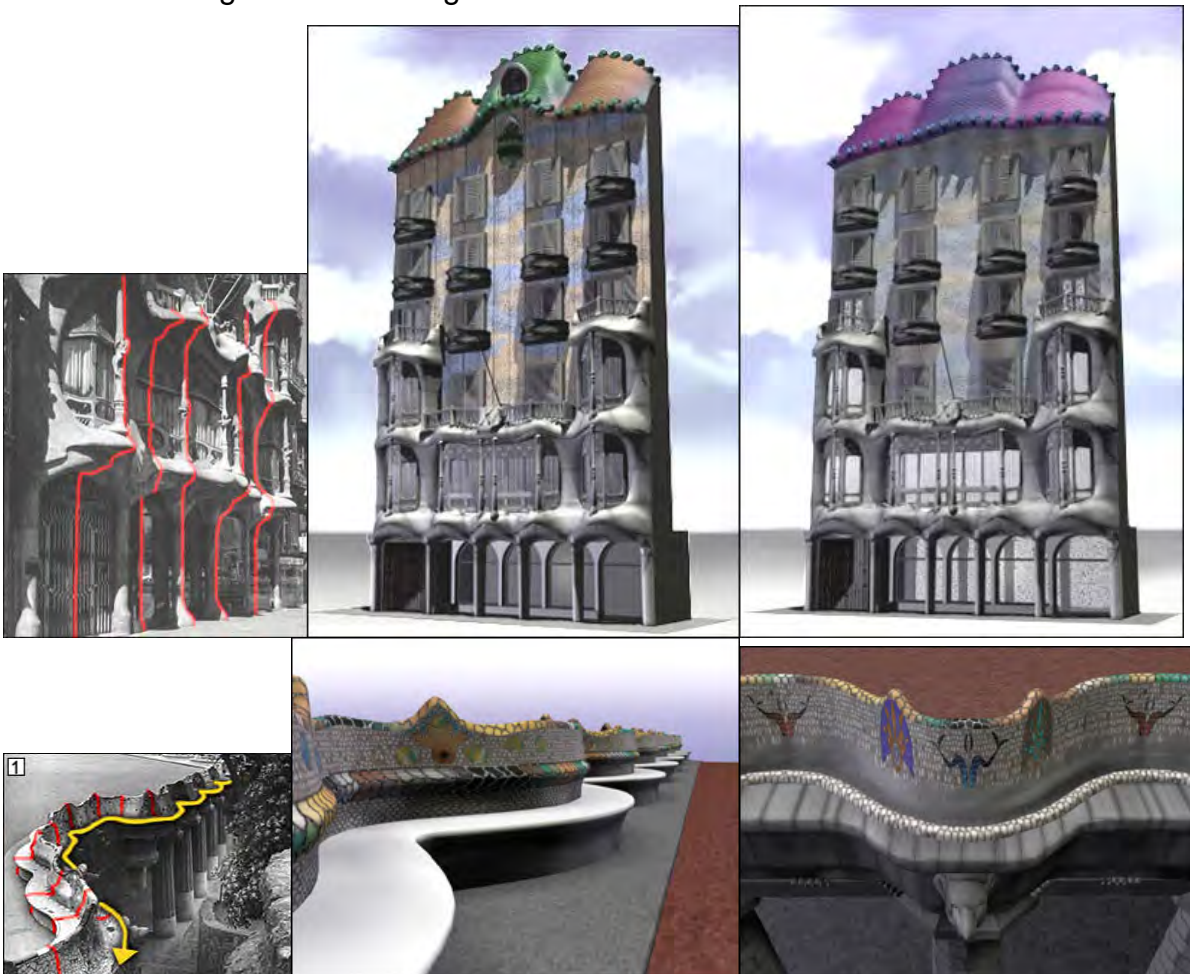


Transformation of 3D car models following identified codes. Luigi Martinetti 1997





Interpretation of sections and geometries and design of Gaudi' codes for generating endless "Gaudi'" buildings. Matteo Codignola 2000.



Construction of generative transformation rules of Manhattan identity. Four steps of evolution. Mariateresa Capodici, Marco Melino 1996



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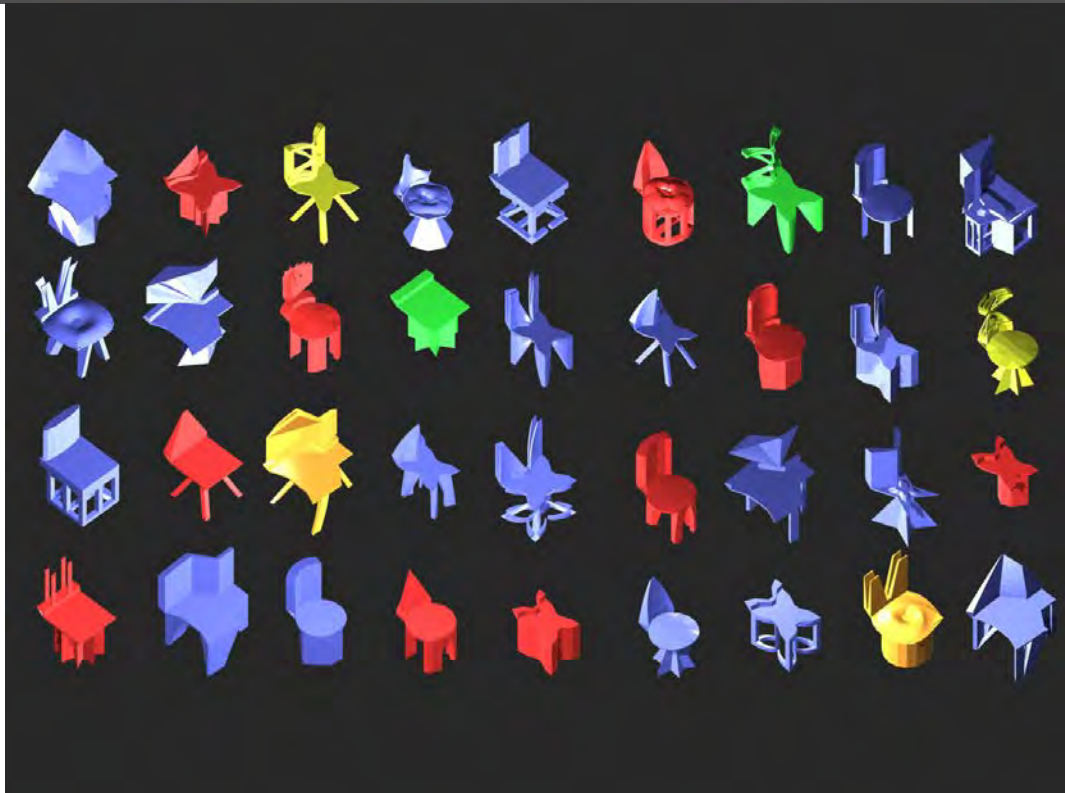
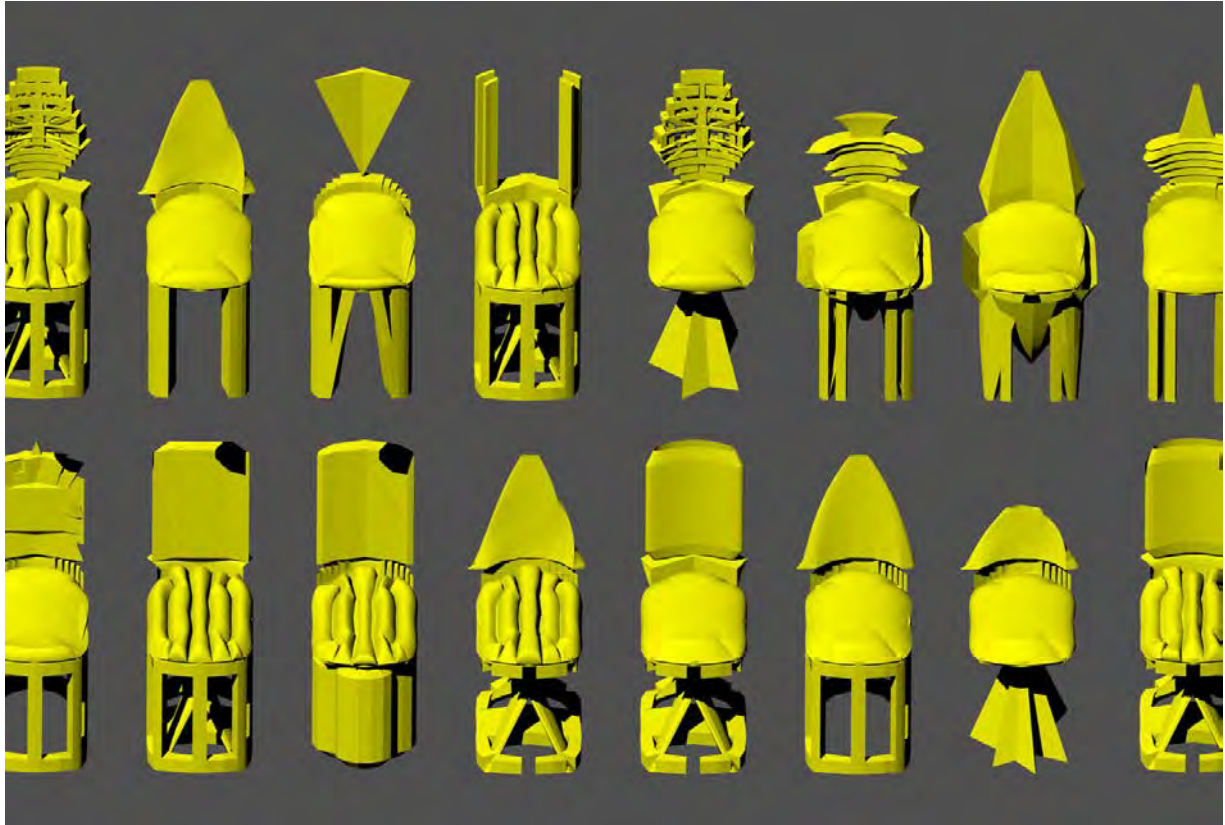
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C. Soddu, "*Generative Design / Visionary Variations - Morphogenetic processes for Complex Future Identities*" in the book *Organic Aesthetics and generative methods in Architectural design*" edited by P. Van Looke & Y. Joye in *Communication&Cognition*, Vol 36, Number 3/4, Ghent, Belgium 2004
C.Soddu, E.Colabella, "A Universal Mother Tongue", Leonardo Electronic Almanac Vol.13, Number 8, August 2005

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Generative projects in 2006:

New chairs generations



**Dehli Cultural Heritage.
Creating Identities.**



Endless interpretations, infinite in the mirror

GA 2007

Abstract

Inquire about problems of design in our time of globalization, mainly the losing of cities identities, of architects identities, differences, and cultural heritages.

Philosophy, methodology, and tools of Argenia, generative software able to produce complex architectural and urban scenarios connected with the cultural identity of each context.

Premise

Generative Design works defining how to transform the existing environment into scenarios more closed to a vision of future. The rules of these transformations are applied in concrete projects, from urban planning to architectural design, from product design to Art and Music.

Generative artworks are not only the result of these transformations but the operative concept. A structured Idea that is defined as a way to look at a possible future, how to build it transforming the existing environment.

Argenia is my generative software, as I have designed it in the last twenty years, operating from architecture to product design, from art to music. My first Argenia was, in 1987, a software able to generate endless 3D models of Italian Medieval Towns, a generative work inspired by Giotto frescos.

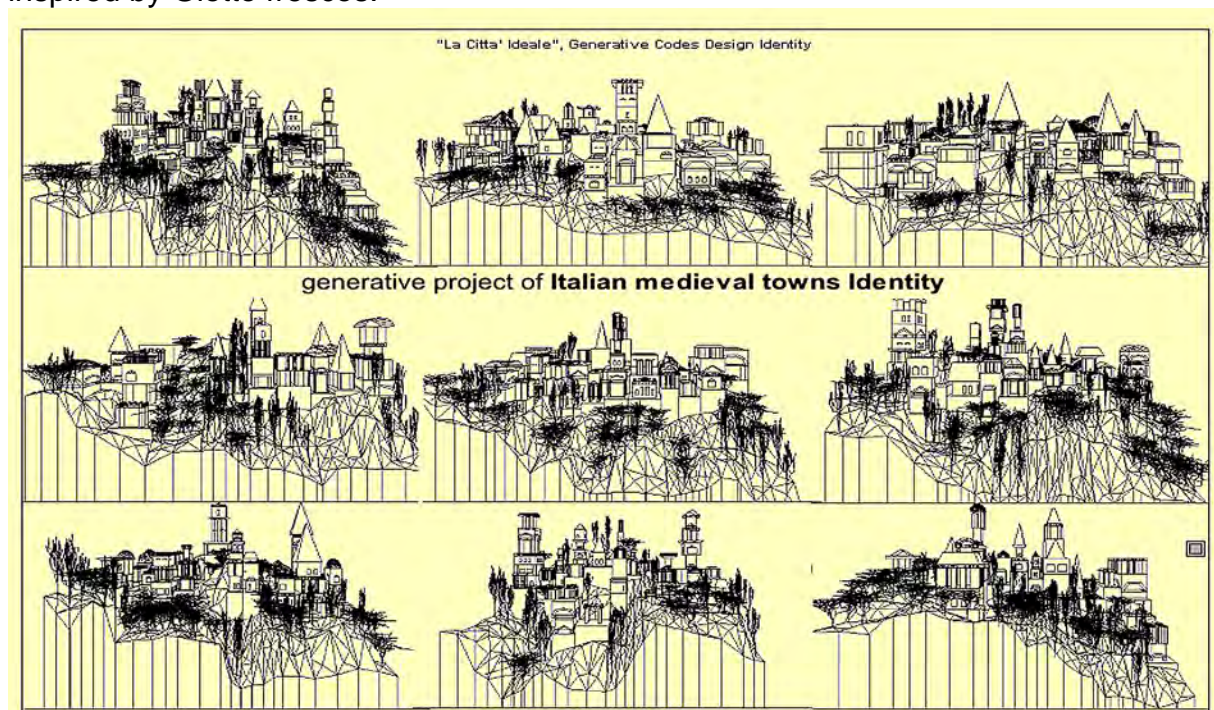


Fig.1. First Argenia. Generative design of Italian medieval towns. 1987. The main reference was Giotto's frescos.

Argenia is a generative system based on transformations. There are some points of interest that must be clarified and defined approaching architecture design.

1. The **starting point** of transformations. This is the main question involving also:
 - a. *if and how* to use random into generative processes.
 - b. the possibility to use forms as paradigm of relationships among 3D locations defined as parametric organization.
 - c. Does a starting point exist in a generative process? If it exists which could be it? How is this starting point considered in Argentina?
2. The **logical structure** of these transformations and their applicability to architectural and urban design.
3. How we can **define and check the objectives** to be reached in an architectural project, from functional to aesthetic needs? how can we reach and fit them through the dynamic generative process? This question involves **how to use references** in design processes for reaching predefined aims: copy versus interpretation.
4. **Context and project.**
 - a. Generating architectures in a city, how can we manage the relationships with the **environmental and cultural context**?
 - b. Which is the role of the subjective architectural idea, of **designer identity** in fitting an increasing identity of a city and its cultural heritage?
 - c. The question involves the respect of the cultural-environmental identity by using **interpretation and not repetition/cloning**. Interpretation is a subjective imitation of an existing process, mainly in nature, for getting comparable quality in fields identified as important.

1.The starting point

1st consideration.

Each project seems to start up from a blank sheet. But it is the development of two precedents: our architectural Idea and the existing environment. The existing environment is an external datum of the project. It conditions the project's development setting some needs and requests, also concerning the city environment identity.

It is like natural environment in which a seed of a tree is thrown: it strongly conditions the development of the tree but it doesn't act on its recognizability as the identity of species. It interferes with the oneness of the tree but not with its "hereditary" characters. We know that an individual's existence, in Nature, starts from a seed and progressively will get transformation following the rules are written in its DNA (contained in the seed) and managing the interactions with the external environment that will enrich its complexity because of the need to answer to subsequent unpredictable events, like winds and seasons. From the side of the environment, the insertion of the new individual will also increase (or decrease) the environmental identity. The increasing identity comes from the increasing number of variations belonging to the same species: a wood of pines owes its strong image to the presence of numerous pines, all variations of the "pine". These variations contribute to creating the identity of wood.

Also a city, Rome for instance, owes its identity to the progressive variations of its architectures, from the Imperial to Medieval era, from Renaissance to Baroque, creating a wide range of variations that we can consider as possible multiple interpretations of this city. These events were realized varying in the time, but also with jumps, those that René Thom would call catastrophes. The running of a project is really a non-linear system.

This stratified mix of architectures have set up the uniqueness and unrepeatability of Rome's Identity as also happened for other cities with a briefer history, from New York to Hong Kong,

from Chicago to Venice, but with the same fascinating strength to be in progress more and more unique and unrepeatable.

The starting point of a city and of an architectural project is similar. From what was New York born? Which was the starting point establishing Rome? The quality of the environment structure, obviously. Probably, as in the legend, a limit drawn around a person that traces the borderline between the inside and the outside. A limit that must be defended valiantly but that is destined to be shattered, but from the inside: as an egg or a seed. A limit, therefore, that cannot be a sphere, or a circle if we are working in 2 dimensions, but something that is "oriented" like an egg or a seed, or like a rectangle that marks the future boundaries of the city. Spheres don't have orientation but only spatial positions. And if we try a perspective view of a sphere from its inside, we are destined to failure. It is impossible. If we use the artifice to draw the meridians and the parallels, we have already oriented it: the axle north-south will exist, and the sphere will be different from all other with different axles.

Representing the space could mean, as the first action, to orient it, and this can be a starting point of a generative process.

Second consideration

How much is the starting point important in a creative process?

Argenia is a process structured as a sequence of transformations in which each transformation works in two different fields: first, it answers to an external solicitation, to a need, to a client's request; second, it's an occasion to express the designer's own idea following own dynamic interpretation of the existing environment.

In this perspective, which is the sense of the starting point? What role does it have and how we can structure it in a generative software?

My hypothesis is that the starting point is not anything else than a catalyst, an help to enter in the designing field, applying our first transformation rule. At the end of the design process, the starting point will be only a marginal event that was progressively canceled by the increasing of complexity owed to the following sequence of transformations. As happens in a fractal. If we get a shape and we apply to this shape some interactive transformations, or rather we repeat the same transformation (for instance scaling it and rotating it in a pre-defined measure) for many times overlapping the images as progressively they are produced, we will have, at the end, a complex result whose recognizability and character almost exclusively originate from the applied transformations.

The initial sketch has a marginal role in the final result, or it could have the role in differentiating each some possible results that appear as variations of the same idea. The idea, therefore, it is entirely contained in the rules of the variations, not in the initial input.

Even if we use a random/unpredictable event as initial input that could be, like in my Argenia, the 3d structure of virtual mountains in Italian Medieval towns project or the date and the time of the starting up of each generation in other Argenias, the characters and clarity of the idea inside the various results cannot be referred to such initial input. These inputs can operate in another field, i.e. becoming the generating input of oneness of every single variation.

2. Transformations

At the beginning of a generation, I perform a void as representation and a full as a concept. This void can be reported by a sphere represented by its inside. The full is its specificity that is not represented by results/forms but by attributes defining its possible characters, by

adjectives describing the aims to reach. Attributes and adjectives built as codes of transformation, algorithms able, all together, to define an artificial DNA.

The beginning of the generative process is the orientation of the system. The sphere, suddenly becomes visible, its representation seems to be born from nothing, but it is only the passage from an event without orientation to one oriented. This is the first generative action.

The further design developments are nothing else than progressive and multiple transformations making the system more and more visible and complex. Transforming it progressively into an habitable architecture, beautiful, leaned out on the environment, stately, technologically attractive, fantastic. A generative process imitating what happens in Nature.

The transformations, the generative algorithms that I write for representing and check them, were born from my interpretation of what surrounds us, of the environment as dynamic system tending to the beauty, to the functionality, to the correspondence to the manifold needs of the man. Geometry and Mathematics are the specific fields of this creative moment because interpretation is the main creative moment. Transformations are easily representable as algorithms, and this is the most immediate and controllable way to conceive transformations, also before knowing on what and when they will be applied.

Argenia, the generative project of my architecture/object/artwork concept is to conceive, to manage, to reciprocally contaminate, to calibrate these transformations into a set of rules.

Designing transformations, rules of the mutual contaminations, calibrating the system in its progressive evolution is to build something like the DNA in nature.

Argenia, Generative Design is Artificial DNA, it is Identity's Design.

Every transformation is identifiable from:

1. the field in which is applied
2. how it happens
3. which orientation
4. which character / objective / function each transformation will add to the system.

The fields of application are born from each subjective interpretation of Nature.

Generally, the fields of transformation that I consider when I am designing architectures are:

- a. How the architectural event wraps itself, how is oriented, how it becomes visible with its skin. As in Nature the flowers or fruits.
- b. How the architectural event folds up. From hills to the branches of the palm, from the Gothic arc to the curve of a dam.
- c. How the architectural event divides / articulates itself, from the articulations of the fingers to the flowers, from the petals to the structure of the branches, to the tessellation of the floors, to the construction of the façades of the buildings.
- d. How the architectural event extends itself. References could be from the bell towers to the fins, from the spiral dome of Borromini to the branches of a tree.
- e. How the architectural event ends. Referencing from the hair to the helmet, from the dome to the top of the mountains, from the point of the arrow to the fingernails, to the hat.
- f. How the architectural event starts up. Getting interpretations from the roots to the foundations, from the legs to the shoes, from the clogs of the horses at the base of a vase.
- g. And so on.

"How happens" defines the way of operating the transformation, It is the "know how" of each architect, and can be defined by algorithms, writing how it's possible to reach wanted results departing from a precedent that not necessarily is previously identified. An algorithm that traces the formalities of each transformation could be applied on what previously exists,

without knowing it in advance. If we apply to a sphere an algorithm able to extend toward outside the previous event by using points identified by a division in 4, 8, 12, n parts the previous event we would have, as possible results, from a tetrahedron to a cube to one of the solid traced by Luca Pacioli and Leonardo.

If the algorithm expresses formalities in a more articulated way, we could have spaces with more complex characteristics able to answer to precise architectural intents. The advantage of operating through progressive transformations / algorithms is also the possibility to reach a multiplicity of objectives in each single results. We can run a sequence of transformations, each one operating on the result of the previous one, and not choose among different pre-defined forms.

The transformation rules that I used in Argenia fit my architectural concept and cannot be used by other architects because they perform my identity as designer.

My last work is an Argenia able to be performed by each designer creating subjective rules of transformation, subjective paradigms for controlling the generative process, subjective starting forms defined and parametric systems of relationships among different locations. It can also use an adaptive Cellular Automata engine for increasing the complexity of paradigm's relationships.

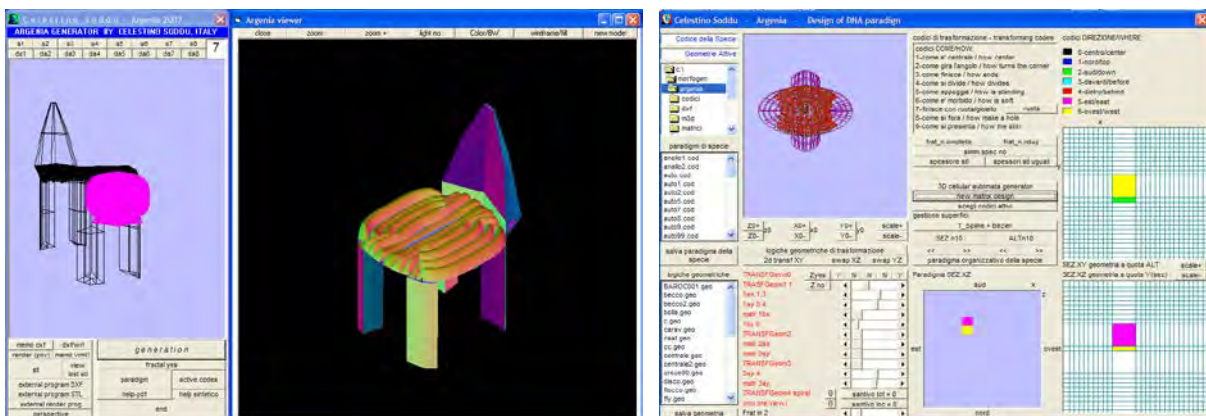


Fig.2 Screen dumps of last Argenia software. 1st version 1987, last version 2007.

3. Identification of aims and objectives

One of the activities more abused by designers is to copy from magazines. It is an activity that actually can arrive to dry up all creative subjective potentiality. Magazines follow fashion and the trend is to follow the fashion. This forces designers to conform themselves. Running constant progressive adjustments is a habit that risks creating dependence.

Alternative of copy is the subjective interpretation. In generative terms, it is the construction of a rule or a set of rules of transformation suggested by each reference. Operationally, if we appreciate something because it is beautiful, enthusiastically, light and technological, instead of copying it, we can create an algorithm of transformation - all the algorithms are logics of transformation - that operates transforming each input in an output that, keeping the previously reached qualities, should be more beautiful, enthusiastically, light, technological than before.

When Picasso repainted Velasquez he didn't copy but interpreted a way of construction of the picture defining a logic that didn't derive from a philological analytical approach to the composition structure of Velasquez. Picasso's interpretation derived from his subjective

creative moment stimulated by the appreciation of the painting of Velasquez. This interpretation supported him in constructing his own work, using his peculiar artist's identity. But he reached also another goal. The result, being an interpretation-variation of the original Velasquez painting, succeed also in widening the communicative strength and of the original. This is the reason why we call these works "homage to .."

Contrarily of the copy, the subjective interpretation and the representation of references as logics of transformation doesn't create a habit but help the growing of own cultural identity, of subjective creative ability and clarity.

Generative art runs this approach, exalting own creativeness by the interpretation of the existing events as dynamic systems, managing their evolution with own rules of transformation.



Fig.3 Woman Portraits from Picasso realized with rapid prototyping equipment using STL files directly generated by Argenia.

In my Argenias from Picasso I have run again this type of approach, that was of Picasso toward Velasquez, proposing my interpretation of the woman portraits of Picasso through the construction of a generative code able to build such interpretations as endless series of three-dimensional models. And building them physically with rapid prototyping tools.

In this case, for avoiding the copy, I managed the interpretation also by moving from two dimensions (the original portraits) to 3 dimensions (the possible outputs)

My main reference in architecture is Gaudì. I have interpreted his works by building a generative project of towers that I have called "homage to Gaudì". In this Argenia, I don't use forms, like the forms of Gaudì's architectures, but I define a logic of reaching complexity and geometric contaminations able to allude to the work of this great master. In the same moment, my aim was to follow my peculiar idea of architecture.

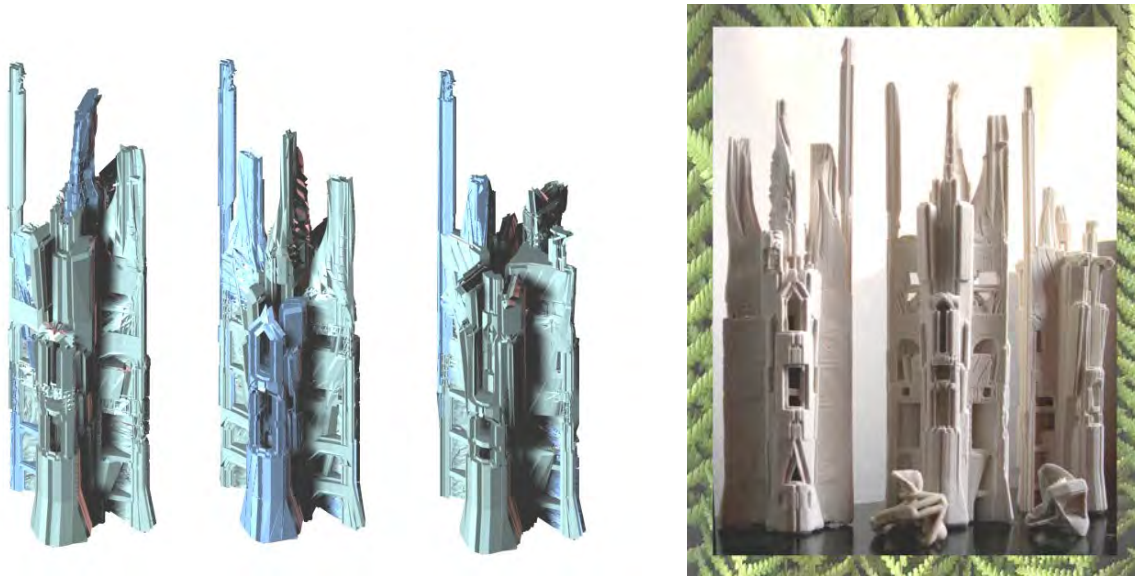


Fig.4 “Homage to Gaudì”, generated a variation of towers with codes fitting my interpretation of Gaudì. Realized with rapid prototyping equipment using the STL files generated by Argenia.

4.The impact with peculiar town environment and its local cultural Identity

Generative design is a design approach based on the imitation of Nature. Its results should be, like in Nature, strongly recognizable, functional and aesthetically fascinating. With a strong Identity of species, like in the best artist's artworks.

But such identity, if the generative approach is operated in architecture, is double: the identity of the architect's idea and the identity of the existing environment.

It's thinkable that the construction of an artificial DNA through the representation of own interpretations as rules of transformation brings to enhance the identity and recognizability of the architect, artist, or musician that designed the rules.

But in architectural design acts, the identity of the surrounding environment, the city, and its local cultural identity directly enters in the creative process. Every architectural project should preserve not only the cultural identity of the existing environment but should increase it. The identity, in fact, is a dynamic system. If it is not increased, it decreases and disappears. A new architecture that not increases the city's identity destroys it.

I like to think that the city identity, its specificity, and oneness, depends on the simultaneous presence of different architectures that we can consider as possible variations belonging to subjective interpretations of the city made by different architects.

Every architecture, if it is in tuning with the city identity, should contain an interpretative representation of the city's identity together with a strong representation of the architect's idea able to make the difference among all other interpretations.

One of the characters of generative design is that a single result doesn't exist. As in nature, every individual is one of the possible variations belonging to a species and every species is one of the possible variations of a base concept. A small variation in the natural DNA is enough, also only of 2%, for moving from human beings to monkeys.

In my experiences of the generative design of urban identities I have realized that, as in nature, the rules of transformation, the generative code, the artificial DNA of my architectural

idea is extremely sensitive. Small variations are enough, also only infinitesimal variations, for reaching different characterizations.

This gives a great potentiality to Generative Design. When built an artificial DNA or rather a code of transformations that correspond to my uniqueness as an architect, I can, with small variations, to direct my project in a way that it will be an interpretation of "how to make Hong Kong more Hong Kong than before" or Chicago more Chicago than before. I work for increasing the identity of a preexisting environment by varying just a little the algorithms of my generative software. I have experimented how much is enough for reaching, with my Argenia, the possibility to increase different cities identity and keeping unchanged, or better increasing, the identity of my architectural concept.



Fig.5 Cities Identities and Argenia. Generated architecture for Chicago and Los Angeles.

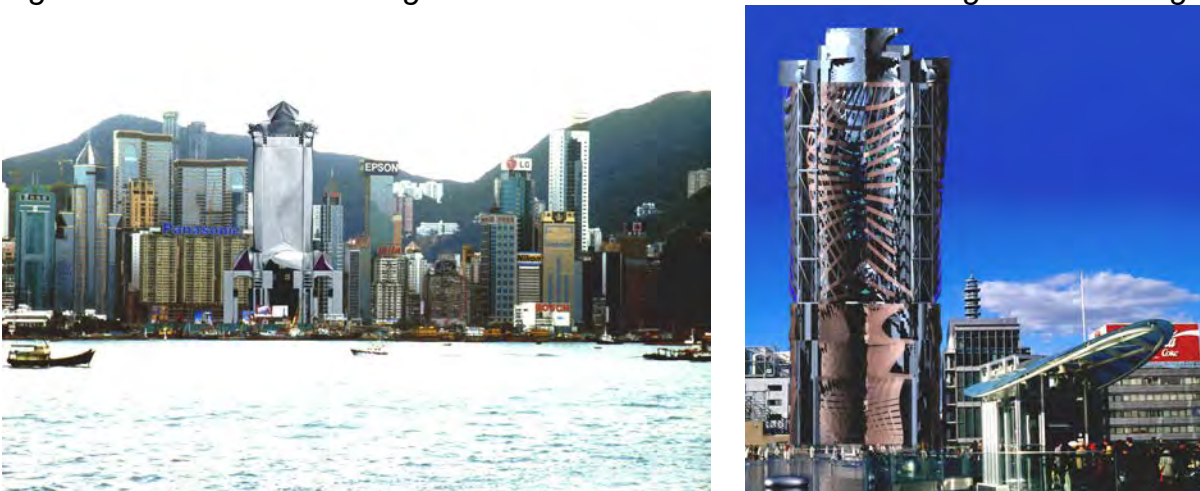


Fig.6 Cities Identities and Argenia. Generated architecture for Hong Kong and Nagoya, 2001,2002



Fig.7 Cities Identities and Argenia. Generated architecture for Cagliari, 2007, and Beijing, 2004.

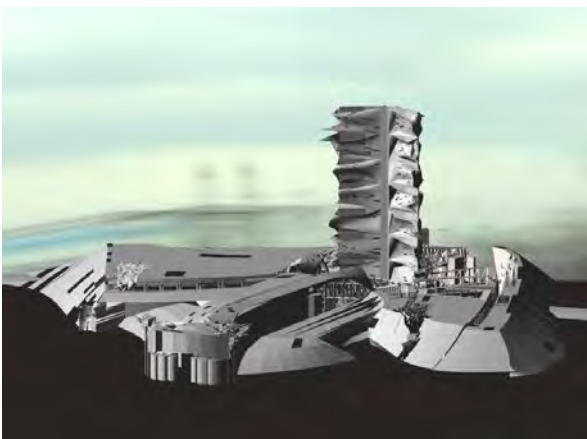


Fig.8 Cities Identities and Argenia. Generated architecture for Milan hinterland, 2001 and Tianjin, 2003.

Traveling through different and parallel cities identities over the world and structuring progressive variations able to answer to these cultural differences has been an enthusiastic and unrepeatable experience. Also, because unpredictable correspondences emerged among very distant cultures, where the concept of fluidity and wrapping of spaces is similar in China and in Sardinia. More, small differences in the degree of iteration of same transformations, that we could call fractal transformations of space and details, could define substantial cultural differences.

A clear example is that raising the fractal degree of transformations, it is possible to generate architectures answering to Indian cultural identity starting from paradigms and rules designed for Italian medieval castles.



Fig.9 Alpes Identity. A borgo on the lake referring to gothic cities environment, 2007.



Fig.10 Twin towers for increasing Shanghai identity, 2004 and the TV tower in Tel Aviv, 2005

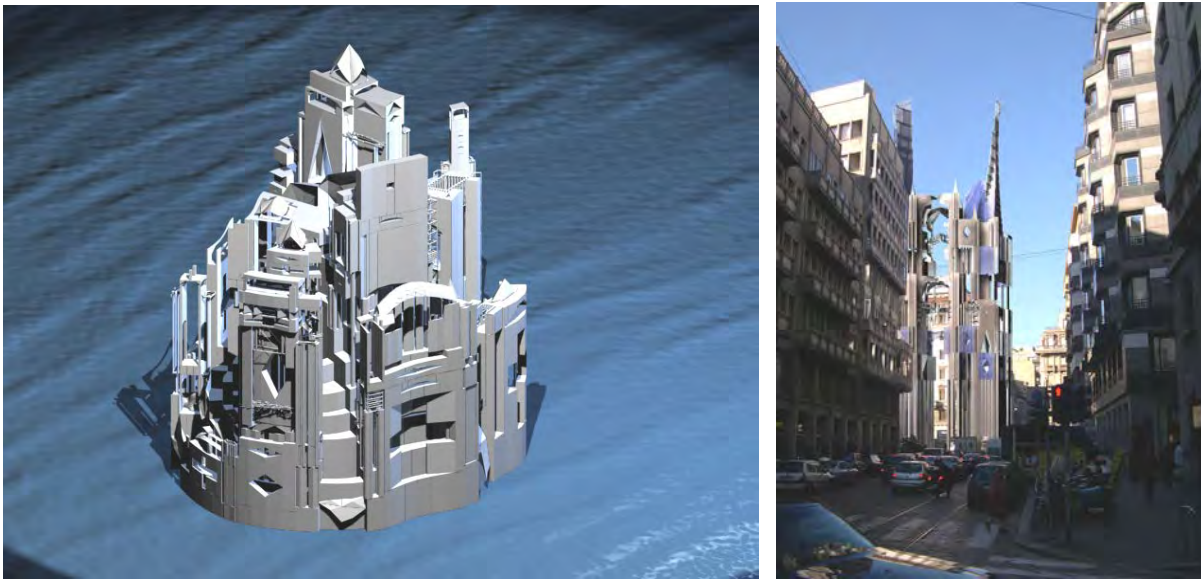


Fig.11 City on the water for Macau earth's recovery from the sea, 2004, and New Gallery in Milan, 2004.

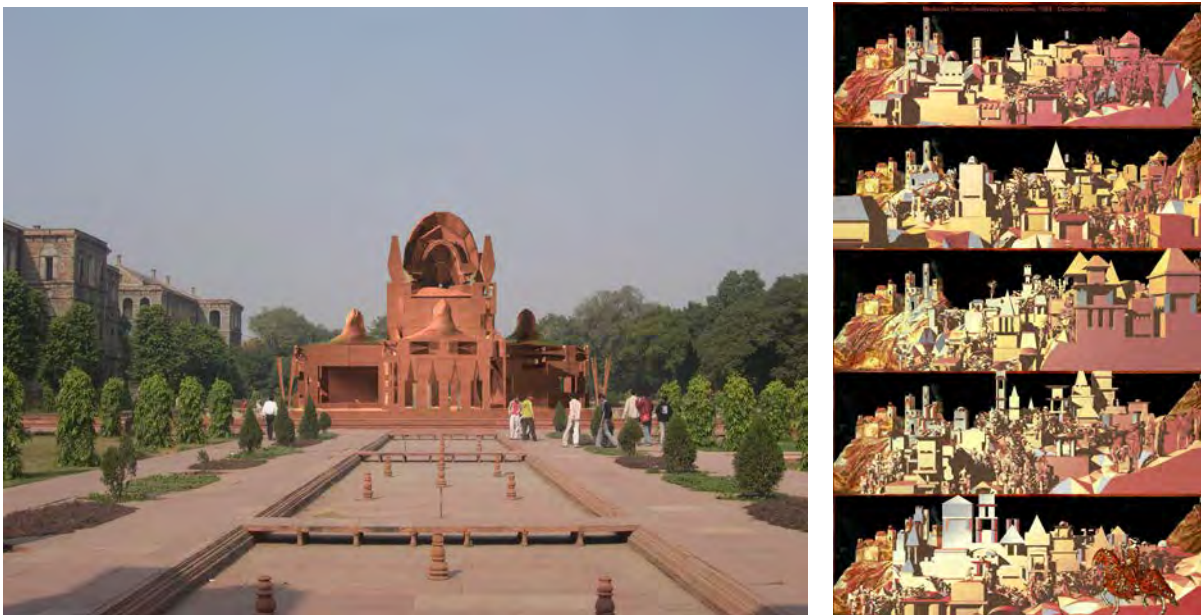


Fig.11 Indian Taj generated by Argenia, 2006, increasing the fractal iterative sequences of transformations for reaching “Delhi Identity” and Medieval towns, 1987.

More, each new generative project, through the plurality of algorithms set for every different occasion, can support us in increasing and consolidating own professional and cultural identity. As happened for me with Argenia.

But how much the identities and recognizability of architects are useful to the quality of the urban environment? More the architect is recognizable, more his work could be a meaningful variation of possible interpretations of the city. A city that has manifold interpretations is a city that has its own identity. It has a history.

The variations of Bach don't destroy the identity of its work, but they consolidate rendering clearer the concept. The multiplicity of possible cats, different in aspect and color, don't certainly reduce the identity of cat's species but consolidate it really through the variations. The cultural identities of the various European countries, in their difference, increase the

clarity of a European identity really because they can be recognized as meaningful variations of a same cultural approach.

Generative Design and Argenia, directly working on species of objects and producing not single results but variations of the idea is an essential tool against homologation and cultural leveling. It is against clones by supporting the plurality, against the repetition and the copy by supporting the variation of cultural interpretations and its aim is the generation of uniqueness.

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Other generative projects made in 2007:



Cagliari, Sardinia, a the waterfront via Roma.

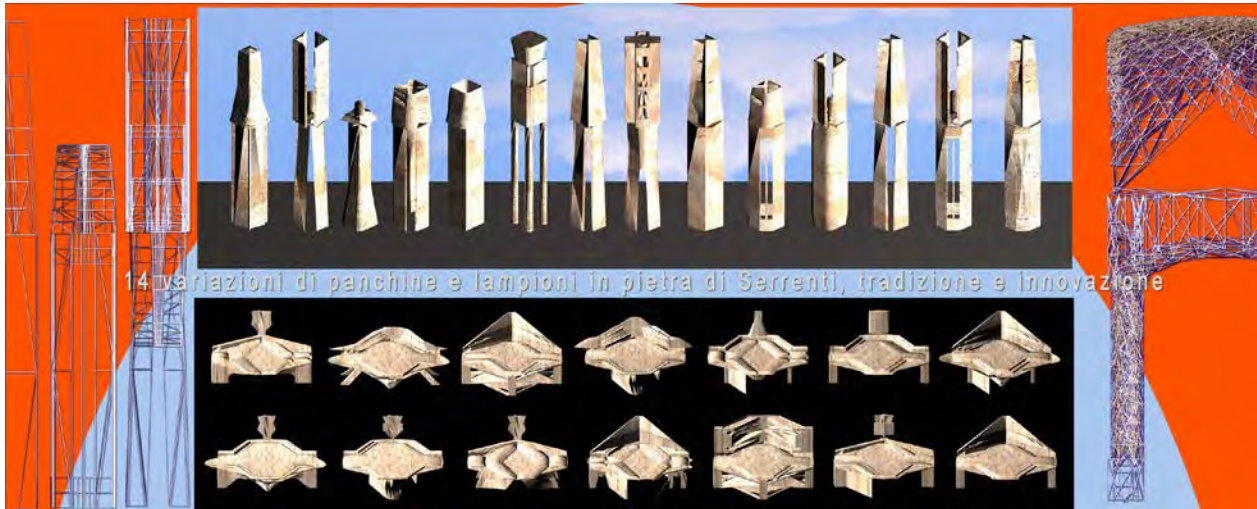








Outdoor generated furniture



A new Nuraghe in Serrenti, Sardinia.



Alive Codeness

GA2008

Abstract

A Vision identifies how to transform the existent, the past into the future. It can be born, like in Renaissance, only from a deep knowledge of human cultural heritage in Art and Science. This knowledge allows us in setting up the rules for shaping the future. Leonardo da Vinci teaches at the best this need to define a code before defining a result, a solution.

Generative Art refers to this cultural heritage. Generative Artworks with transformation rules and not with solutions, as forms.

Generative Art, as my Argenia soft, defines Alive Codeness. Following a Logical Interpretation of Nature and of great Masters of the Past, I designed a set of rules able of managing the transformations inside the creative process. The Alive Codeness, as "artificial DNA", defines a Vision identifiable as poetics. Poetics is the summa of Visions. The result is the generation of endless Variations.

Methodology: *the creative path is a non-linear sequence of moments of discovery.*

It is based on a starting moment, not very important for the final recognizability of the own poetic result but important for the individual identity among variations. The discovering path is the flow of subsequent answers to upcoming needs coming from the artist's Vision. Each answer is shaped with the use of transformation rules, strongly linked to the Vision, applied to the precedents.

The starting point of transformations *is the topological paradigm drawn as a catalyst, where the set of transformation rules, the artificial DNA, performing Alive Codeness, will operate.*

Complexity *is the main character of generative processes. It is the result of stratifications, contaminations, and iterations that happened during the discovering path. In Argenia the approach to complexity refers mainly to Nature: the complexity of an olive tree comes from its DNA that is able to manage transformations facing different unpredictable events like storms and rain and increasing, with these transforming acts, its uniqueness, and recognizability as individual and as species. In imitation of nature, I am referring to Baroc for transforming and fractal geometries, to Piranesi for stratification of meanings and perspective points of view and to Gaudi' for complex events like movies of dynamic transformations.*

Identity and recognizability *must be the main characters of generative artworks. There is a strong relationship between a well-identified Vision and the necessary generation of Variations. Identity is defined in the type of path to increase complexity, in the character of the synthesis and in the recognizability of each different variation.*

Recognizable Visions

Vision is the expression of how each artist manages his creative process. : Kandinski, Picasso, Van Gogh, Borromini, and Gaudì are recognizable artists and architects. If you look at one of the artworks of Kandinski, Picasso, Van Gogh, Borromini or Gaudì you will identify it as belonging to their own Vision, also if you never have seen the particular artwork that you are looking to.

When visiting cities and architectures and looking at objects and artworks, people appreciate and easily remember their impression, that is their interpretation of the artist's vision. People don't remember forms, but Ideas.

Many architects or artists made wonderful artworks and architectures. They reached the beauty but their works are not recognizable as belonging to a vision. Maybe that they refer only to a collective style or cultural moment or to a fashion moment. But this is not enough. Each person has subjective needs and he likes to identify, interpret and interact with recognizable subjective Visions. If not, it's boring.

Designing own vision with generative approach

My generative approach was ever focused on identifying how this recognizability, how each vision can be expressed in creative processes. Starting from my first generative work, *Basilica*. It was the software I designed in 1987 to generate endless 3D models of Medieval Italian towns, all different and unpredictable but all recognizable as belonging to this strong cultural identity. But also, they are an expression of my interpretation of Italian Cultural Heritage. It is not a case that I used, for setting up the transformation rules used in this software, the Giotto frescos and not only the existent medieval towns. Giotto Vision is strongly significant about the identity of these cities than reality. Subjective interpretations are more rich and complex than objective data. Starting from artworks it's possible to go ahead with the subsequent interpretation of artist's visions as Picasso made with Velasques, because the Past, the precedents, and their interpretations are necessary for reaching complexity.

The following versions of *Basilica* and *Argenia*, my subsequent generative software, were written increasing the complexity of their generative engines: each new design occasion was important for creating a new interpretation of my cultural heritage, new possible transformation rules linked to my Vision. Now, after 20 years of subsequent increasing complexity made with my subsequent interpretation of Nature and of our Cultural heritage made in different moments, with different moods and facing different needs, my generative *Soft* reached an unpredictable strength. It has, inside, the memory of how I interpreted each different architectural project. These codes help to face new projects because they have found, after the contingent use, further roles for increasing the complexity of my architectural Vision and of my architectures. When I work in different contexts of different Cities Identity, I can set up the software tuning the code to my interpretation of the context, performing new transformation rules if necessary and changing a bit the role of existing rules. The aim is to consider the Identities as the main quality of natural and artificial environment: Identities can be stratified through the design process without losing them. More, architectural variations coming from subjective interpretations of a peculiar city could increase the recognizability of its cultural identity.

I verified this possibility in all my generative architectures, from Los Angeles to Chicago, from Rome to Hong Kong, from Washington D.C. to Shanghai.

With my last software, I tried to enlarge this generative approach to other designers by creating the possibility to write and develop the own vision.

How a Vision can be transferred into a design rule

Vision is how to approach to the existing environment for creating incoming scenarios. The vision of upcoming events can exist only if we refer to the existing events, to our past with the knowledge of our cultural heritage.

Following our interpretation of human cultural heritage in the fields of Art and Science, we can design some rules able to be applied to shaping the future. Leonardo da Vinci teaches at the best this need to define a code before defining a result, a solution. Generative Art refers

to the cultural heritage of Italian Renaissance. It works with transformation rules, with codes, and not with the form of the result.

Doing that, Generative approach can define a Vision, it can identify a Poetics



*Renaissance approaches to Codeness.
In these pages, Leonardo da Vinci identifies a code
from multiple variations of how the water transforms its
own form when flowing.*

New, Beautiful, and poetics

When people design an object often people search for something "new", for an unusual shape, looking for a new form in fashion magazines or in unpredictable random events. This is not a generative approach. And this is neither a creative approach, it is only the typical approach of buyers.

The generative approach, interpreting at the best the creativity, defines a new approach on how to transform forms. Every form is good as starting point for subsequent transformations but it cannot enter into the final result(s). I identify this starting form as "catalyst": it helps to run properly the transforming path, by using subjective transforming rules, but it cannot enter into the final result, as the catalyst in chemistry. The catalyst can be the copy of something that exists; the copy, the false in front of the truth, but after the generative transformation process, the result forgot the used forms: if the creative process will be successful, *it will be the truth.*

If we use forms without transforming them with our logics and our Poetics, we can reach to something "new" and "beautiful" as happens when we look for the emerging forms in random processes, but these forms will be not recognizable as belonging to an artist. With this approach, we forgive our identity. No one will identify a Vision in these "random" results. They will be "mechanical". Only stuff.

We cannot identify the Generative Art as the Art of Buyers, waiting for the random emergence of unexpected and beautiful forms. We can reach only approximately to what is not enough for Art.

Argenia, from Forms to Transforming Rules

Argenia, my generative software, utilizes forms only as a starting point. At first each generative project, architecture, object or artwork, is defined as a paradigm of the organization of incoming possible events: as an organic system of relationships, not as a form/solution.

This paradigm defines a dynamic topology. The form of the starting events is not important. It's important the identification of their character and of their mutual relationships. In my last Argenia, it's possible to identify and define the catalysts (the starting forms for each event), the functional / symbolic / aesthetic character of each event and the rules to be used in transformation processes.

Results will appear after subsequent transformations that happen several times in each event and in the whole system. The rules used for developing the system are a set of logics

strongly representing the subjective vision, the identity of the designer.

At the end, we can easily identify that the starting forms are not so important to construct the design character like the transforming rules. As normally happens with fractal subsequent processes. So I can say that the set of subjective transforming rules are the operative representation of the artificial DNA of each designer. This is my Alive Codeness.

(With my last generative software Argenia, opened to different designers, each designer can create his peculiar artificial DNA. I have not yet published a commercial version of Argenia. My aim is to use this software in "Domus Argenia" the international research center about Generative Art that we are establishing in Sardinia whose activity is starting from next summer)

Generative Art is a Philosophy

If Generative Art is to design a creative process, to define its peculiarity, identity, and recognizability, to set up the generative rules for getting (from 2D-3D-physical and more) scenarios belonging to desired characters and to construct a software as a dynamic non-linear system able to generate unpredictable but recognizable endless results. If so, Generative Art is, in other words, to discover and design the own poetics: as a philosophy of a creative process.

As a philosophy, Generative Art can define a very useful way to teach design because *it* can identify some logics of a creative approach. Therefore, I discovered that starting from the creation of my first generative software, my teaching activities on the topic of Architectural Design and Industrial Design improved clarity and ability to involve my students. This because the aim was to help students to identify and create in progress their own vision by running on generative creative paths.

I learned that it's possible to teach "how" to interpret their own cultural identity, the surrounding environment and Nature for tracing a vision and generating incoming future scenarios. My last teaching experience was with Enrica Colabella, last August, a travel workshop around China for teaching to the students of Hong Kong Polytechnic University how to use their Chinese Cultural Heritage for designing the objects of the future. Following our generative art process.

Architectural and Industrial Design teaching, using Generative approach, could be full of significance for upcoming architects and designers than the teaching of functional analytical approach.

Complexity and Quality

Complexity is the main character of generative processes. Generative Art shows its power only through complexity because Generative Artworks are processes of self and resonance iteration of logics and complexity is the result of a "long" and repeated non-linear process.

Although beauty can be reached soon, poetics needs an increasing complexity path, using subsequent transforming logics. Only when we define "how" to apply, for example, the golden rectangle relationship we can define our poetics.

We can reach beauty in two ways. Soon with an existing form or with a minimalist approach: also, a natural stone could be used as a paperweight. But, in this case, the identification of a vision will be impossible. This quality can be reached only by an increasing complexity process. We need a very long path for arriving at a result, also a "simple" result, where forms are not simplified but distilled into a full-of-sense event. Simplified results, like common results of our era, are not more acceptable.

Full-of-sense results are complex results where we can identify a poetics. And where we can find and identify our possible interpretation of future. Complexity, as endless meanings, defines the best quality that we can reach in the contemporary: the possibility to give focused

answers to different unpredictable requests of each different unpredictable customers.

Simplified architectures had got their time in the last century. They destroyed the cities identity, especially in the surroundings, where equal repeated simplified architectures have constructed new towns and new districts.

We need Baroc approach in our time. We need complexity. We cannot ever more accept minimalism if this is associated with simplification, with no-project, with repetition of all equal, with the obsolete legend of optimization. But we cannot appreciate complexity if it is created with the random approach. It's boring. At the best it can be only a decoration.

Generative approach and Cities Identity.

With Generative approach, we could support the increasing identity and uniqueness of each city, discovering its poetics, its peculiar vision that we can call its "ideal city". When we have identified this "ideal city", or, better, one of a possible interpretation of it by defining a code, an artificial DNA, as its unique way to look at future, we could use this code for the incoming transformations and for managing its increasing complexity.

Architects, by designing many different architectures identified by different recognizable visions of the same "ideal city", can give to each citizen the possibility to mirror themselves in the increasing complexity of their environment, in the multiplicity of possible interpretations of their city, of their cultural heritage represented by the city variations.

My research work is in this direction. I discovered that the transformation rules could be contaminated, increasing their strength, with the identity of each city. Sometimes only little contaminations a minimal variation of parameters could represent an own interpretation of the identity of a particular city. The identity of architect and identity of the environment are not one versus the other. The best way to get complexity, and to get quality answering to different unpredictable requests of customers, is working by stratifying different identities, even their contamination.

Particularly the complexity is the common table to put together new and ancient. The time patina of ancient architecture came from having lived through different cultural moments and from being contaminated like happened in Italy. This gave to these ancient architectures the power to have a beauty without time but in harmony with the flow from past to future. The Piranesi's engravings, representing ruins of classic Roman architectures and their subsequent transformations during the time give us the knowledge of how the time patina is strongly linked to complexity, beauty, and recognizable identity.

In my Argenia software, I tried to run an increasing complexity path similar to the natural time path of ancient environments. This using stratification of meanings and characters, contaminations of different creative moments, subsequent transformations following subsequent aims, multiple references, also contradictory reference in paradigms and transforming rules. Like Baroc. Or, that's similar, like Nature.

Vision generates Variations

The recognizable Identity of each possible result is the identity of a species of results. There is a strong relationship between a well-identified vision and the necessary generation of multiple variations. A set of variations identifies better a vision than only single results. Variations, like in the history of music, from Bach to Jazz, are strictly linked to a recognizable creativity.

The generative software is like a DNA of a species of possible results. In my Argenia, the variations spring from unpredictable contamination among different transformation engines working together. Contaminations define the identity of each unique result; Logical

Transformation Rules define the Vision.

Technically, in my generative software, individuals are defined by the time when the software begins to run. This clock, ever different, defines different speeds of parallel transformation sequences, it creates unpredictable contaminations.

Questions regarding the structure of Argenia, my generative software.

Argenia is my representation of the design logics as the path of discovery: a complex non-linear system where many different codes work together. The transformations are controlled by a paradigm that is a topologic system of relationships.

A. Methodology

A.1. *My approach to design.* I consider the design path as a non-linear sequence of subsequent discovering moments. It is based on a starting moment, not very important for the final quality and for the identity of species, but important for the uniqueness of each result among multiple variations. The path of discovery is developed through the utilization of subsequent transformations strongly linked to the subsequent requests of the client and of my vision, but which results are unpredictable because of unpredictable reciprocal contaminations. The possibility to have many different alternatives during this process is important because quality springs from creative freedom that is to be free from "only one possibility" when the development process is going ahead.

B. Topology and Character

B.1. *The use of a paradigm.* In each generative project the definition of the topologic system and of the characterization system is normally not "generative" but is one of the inputs for "generating" variations. Argenia can also generate paradigms using Cellular Automata, but this possibility cannot easily be used if we need to fit exactly the needs of the customer.

B.2. The paradigm doesn't define the results but is the creative representation of the system of customer's requests, of their mutual relationships and of functional, aesthetical and symbolic aims. With the paradigms, the aims are transformed into an open system of constraints. Constraints don't limit the generation possibilities; they don't fix only one character by destroying the alternatives. Better, constraints increase the number of variations. If the constraints are a lot, the generative system has more matter to explicate and represent its peculiar character and uniqueness. Constraints are requested and each request asks to the generative path to work for answering, by increasing the complexity of results and, together, increasing the possibility to follow and recognize a Vision.

B.3. In Argenia, there are two sectors of an open system of constraints: the topological, that is the orientation of events and the definition of point of congruence among events, and the field of "open" functions, that is the definition of the role of each event in the global system of the project. Each "open" function defines that an event must have, for example, the role of an "end", like the dome in space, or the role of "connection able to manage a corner", or the role of "organizing the division", and so on. This constraint asks to the design generation process to use, one after the other, different sets of codes of transformation that are written for managing "how" the event ends, fold itself, is divided, and so on.

C. Identity

C.1. *The management of the identity of my Vision in the **complexity of details*** is the design of the codes of transformation to be used in all the generative projects because they interpret, in a subjective recognizable way, how each event can manage the design needs. That is, for example, how an event folds itself, how the end of the object could be created, how an event divide itself for creating a sequence of events like windows or columns, how an event could manage the relationship with the ground, and so on. The approach is similar also in a simple generative work for drawing 2D scribbles: how the drawing line folds itself

facing the surrounding events ...

C.2. *The management of the identity of my Vision in the **synthesis of the total image** of possible different results* is the design of the codes of transformation to be used for transforming the global system or a significant part of it. These rules define the character of the geometrical system keeping active the topological geometry of each part and their relationships.

C.3. *The management of the **identity of each variation*** works as in Nature, where individual identity doesn't overcome the species identity but, where the difference among individuals increases the identity of species.

C.4. *The management of the **identity of the context** (city for architectures or/and brand for product design)* is the definition of "new" transforming rules focused on each peculiar project by considering the identity of different cities, of different brands, if the project is focused on an industrial design production, or other identities belonging to the market. This management works with little changes of some parameters in the algorithms representing structural transforming rules. Little variations of parameters inside the transforming rules work as "fly effect" in complex dynamic systems. This can change, or better increase, the identity of the results by arriving to represent, in each possible variation, my subjective interpretation of different city identities. I have done that in the exhibitions of my generative architectures where I verified this result by asking each visitor in which visionary image of architectures he has found the increasing Identity. I.e. regarding architectural future scenarios of Hong Kong, by asking in which one HK seems more HK than before.

D. Complexity

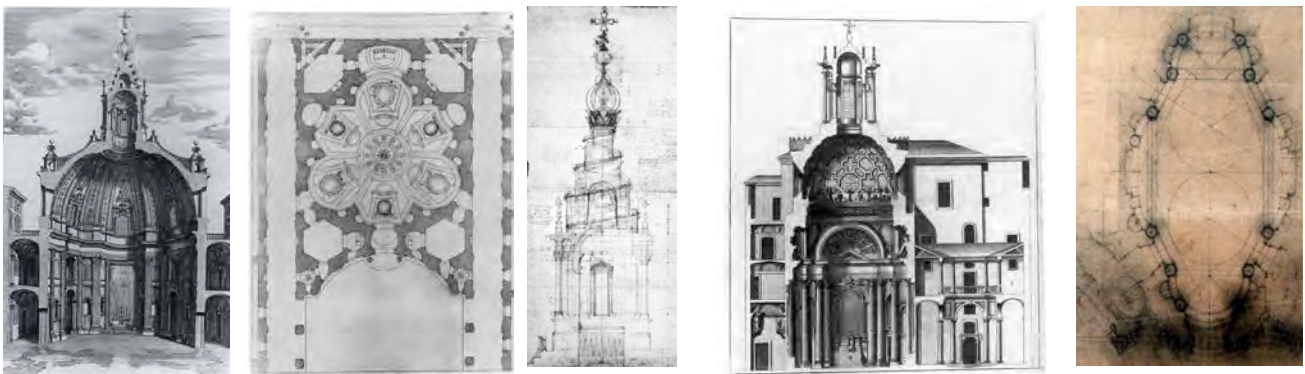
The philosophy of Generative Art identifies how to design complex systems. In Argenia, this aim is reached with three approaches, everyone belonging to Nature. The first one refers to Baroc, mainly to Borromini; the second refers to Piranesi, the third to Gaudì architectures. Piranesi, Borromini, and Gaudì are my masters, my main references for Generative Art.

D.1. *Baroc complexity*. Referring to Baroc and, first, to Borromini we can interpret these architectures like the result of a generative process. The paradigm was based on the use of "new" geometries, as a rectangle, a double square, in Saint Carlino and the equilateral triangle in Sant'Ivo, that no one used before in the same way. The system of increasing complexity refer to the knowledge and use of classical architecture heritage but, using these unusual geometric paradigms, results are unpredictable and, in the meantime, unique and strongly recognizable. More, the Baroc approach to complexity uses fractal sequences. The homothetic symmetries support the increasing complexity path through detail not by enlarging to the subjective multiplicity of different stonemasons as in Gothic but by using the scaled similarity as in fractal images. In Argenia, I used all these possibilities and I like to consider my architecture as Baroc new generative architecture.

D.2. *Piranesi complexity*. When Piranesi has done his more famous engravings, the "carceri d'invenzione" he used the possibility to stratify, one after the other, different moment of interpretation of these visionary environments by drawing again in the same engraved plate. These different-in-time stratifications were realized not only with increasing details and events one over the previous one but, and this is really interesting, also changing the point of view of the perspective system of representation. In Argenia, I used this increasing complexity path. Transformation events can be easily stratified, by using the codes of transformation one after the other. This process is impossible if we use forms because we cannot stratify forms. But in generative approach, using transformations, we can stratify all the process by keeping alive the character of each transformation. This is the most interesting process of increasing complexity because it belongs exactly to a generative

process and cannot be done if the process is different. Following this important reference I tried to go ahead with this process inside some Piranesi's engravings. (See images)

D.3. *Gaudi complexity*. It was the more complex way to gain complexity, also because this complexity comes directly from a strong creative activity. The complex geometries of Gaudi are the result of contaminations among "structural" geometries like the chain geometry ("catenary") and dynamic transformations of subsequent sections where each point can run its particular transforming path. In my generative approach singular algorithms managing different entities of the same system easily represented this increasing complexity system. In Argenia, these contaminations, that are the main engine of my interpretation of Gaudi's reference, were managed in an unpredictable way by running the different parallel codes of geometrical transformation all together. Results are unpredictable but not random. And I like to think that results belong to my recognizable Vision.



Borromini, Original Borromini drawings of Sant'Ivo with the triangle geometry of space and its helical lantern; Saint Carlino, with the double square geometry transformed in an ellipse.

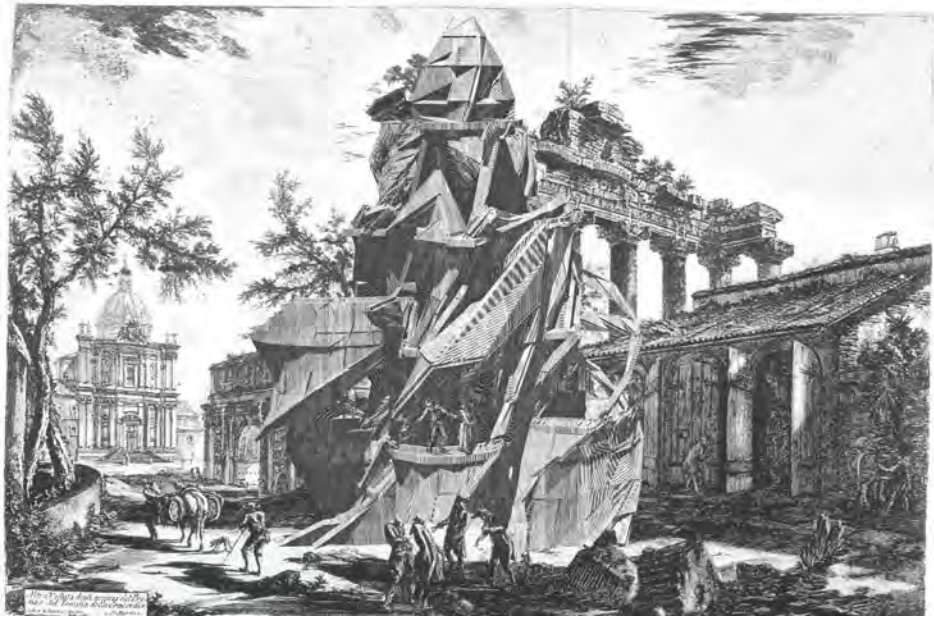


G.B. Piranesi, the "carceri d'invenzione" engravings. The first artwork and his subsequent increasing complexity in two of his more famous engravings.



The original engravings of Piranesi.

The “Babel Tower”, generated architecture using helical codes from Borromini and The Piranesi increasing complexity. C.Soddu, 2008



The original engravings of Piranesi.

Inserting a generated architecture using codes from Gaudi’ with the reference to Mila’ house and The Piranesi increasing complexity. C.Soddu, 2008



The original engraving of Piranesi representing the “portico d’Ottavia”.

Inserting a generated architecture using codes from Borromini’ and The Piranesi increasing complexity. C.Soddu, 2008

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20 years ARGENIA evolution

GA2009

Abstract

Starting from 1986, I developed my generative approach by identifying, from Basilica generative software to the last Argenia "open" version, the challenges linked to my own creative Vision:

1. he cultural references to Italian Heritage, from Renaissance to Futurism, particularly Leonardo, Borromini, Palladio, Piranesi and Depero, and the reference to Gaudi' and Kandinskij, following my subjective approach to complexity.

2. ubjectivity as the main way to reach the complexity

3. oving through multiple dimensions as the main engine for generating identifiable series of events,

4. ariations as the main expression of a Vision, following Bach approach.

5. ecognizability of each possibly unpredictable result as confirmation of the quality of a generative process.

6. identity, architectural, environmental identity, following own cultural and creative Identity as the main topic to manage with Generative approach.

Moving from subjectivity to multi-subjectivity, the new challenge is the possibility to extend Argenia to different users with the possibility to involve each user in constructing, in a while, the artificial DNA of his own creativity. This new software will be used, together I hope with other tools made by the friends of Generative Art, for starting new research and teaching activities also inside Domus Argenia, the international center on Identities and Generative Art just now established in Sardinia.

1.Premise

When, in 1986, I designed Basilica, my first generative software in the field of Architecture, I had the experience of seven years of experimental software. Starting from 1979 I had designed software in the field of perspective representation of architecture, of reverse perspective for generating 3D models from 2D images, of the total 360-degree perspective and about the use of fractal geometry for generating natural environments. This first software were made together with experimental representations of complex non-linear systems with the aim to manage in a morphogenetical way multiple bifurcations and variations. My first reference, but also the friend for discussing these advanced approaches to Art and Science was C.L.Ragghianti, which published several times my researches in his magazine "Critica d'Arte".

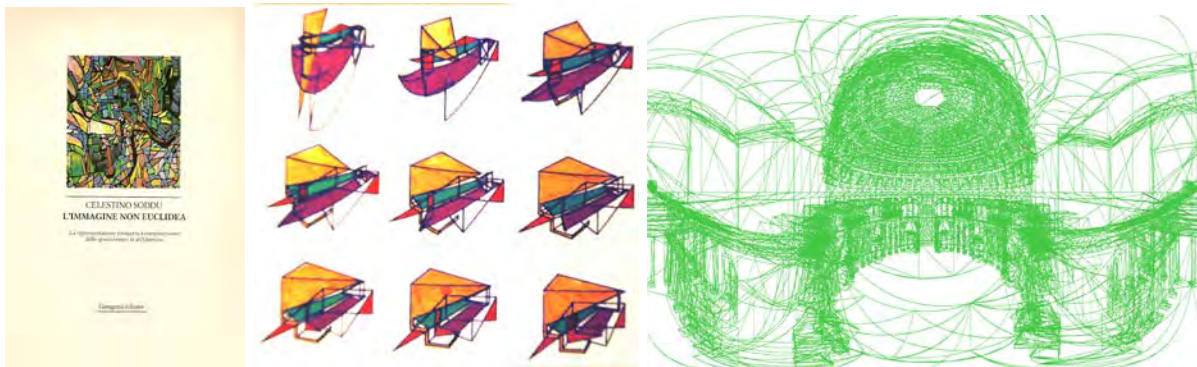


Fig. 1, Cover of “The not-Euclidean Image” C.Soddu, 1986

Fig. 2, From the article on “Critica d’Arte”, the magazine of C.L.Ragghianti, n. 18, 1988, about dynamic multi-dimensional and not-Euclidean interpretation of “futuristic” Balla.

Fig. 3. Use of Total Perspective for representing the Pantheon. Made with the “Total Perspective” software designed by C. Soddu in 1985. The software was explained in “Not-Euclidean image” book, 1986.

The aim of designing generative software was born from my passion for the architectural composition and design and from a consideration: in architectural design processes, each following step toward the final result forces us to choose among different possibilities/bifurcations. We need to choose what seems acceptable and what seems to fit our aims. But we are not able to evaluate, also *a posteriori*, if the choice has been happy. Certainly, the custom in designing and the acquired experience allows us to knowingly make such choices, as when we make a movement to chess and we preview the possible future scenarios. But always the doubt that the lost road would have been able of fitting unpredictable qualities remains. We know very well that alternatives that seem to be not practicable are only hypothesis not yet arrived at an acceptable maturation. But alternatives are innumerable and each one multiplies the possible incoming scenarios until infinite.

The matter is that we are aware that architectural idea/vision can be only represented with the endless possible choices that we evaluated as fine. All they are part of our Vision, not only those that we have made for finishing a project. The idea is a Poetic of the world of possible. Poetics cannot find its full expression through only one final result.

Is it possible to write this Idea as a chaotic dynamic non-linear system? Where each bifurcation/alternative could be represented and variations can be generated by changing the starting point?

This consideration is at the base of my generative approach. The idea is not only the result but the logics able to develop the design processes. The idea as genetic code in imitation of Nature. The idea is the system of transformation-logics to move from a scribble (or other unpredictable starting points, not necessary fitting the idea) to an architectural project. And the idea belongs to subjective poetic. (C.Soddu, “Alive Codeness”, GA2008 proceedings, DomusArgenia Publisher). This is the engine of Basilica, my generative software able to represent my Generative Vision in Architecture.

2. My first experimentations: generative engines from moving through different dimensions

Therefore, using my acquired experience in realizing software based on mathematical / geometrical approach, I decided to design generative software with the aim to write something like progressive Logics of Transformation from an existing environment to a possible one that had to be, more than only a tool, the expression of an Architectural Vision.

I have immediately realized that this approach would have sense only by stratifying a lot of possible "choices", therefore, this approach would have asked a lot of time for reaching the necessary complexity. My idea was, and it remains, to stratify, to put into the interconnected system and recording them as operative logics, as algorithms, the "thoughts of design transformation" able to reflect particular design moments and different environmental situations. Design processes are not only dialectical games. They need creative vision and experience. Algorithms come accordingly

I had learned from my previous professional design activities that, very often, the only possibility to overcome a moment of stalemate in the development of a project, that is the moment in which we don't succeed in identifying possible alternatives and the design evolution seems linear, axiomatic and boring, is waiting for a change of humor or, if we are in a hurry, is artificially changing the point of view. We can do that, for instance, by turning upside-down the sketch that we are working to, or tracing a new perspective view from another point of observation. The new point of view is able to be a catalyst for seeing in a different way the relationships among the existing structures so that it helps us to identify, immediately, a set of alternatives among which to choose.

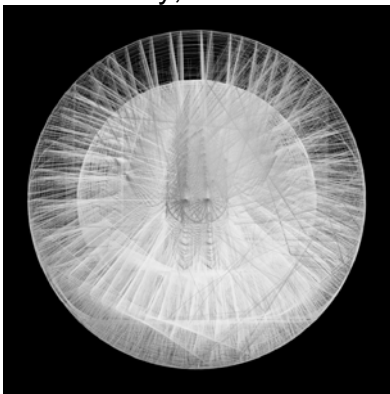
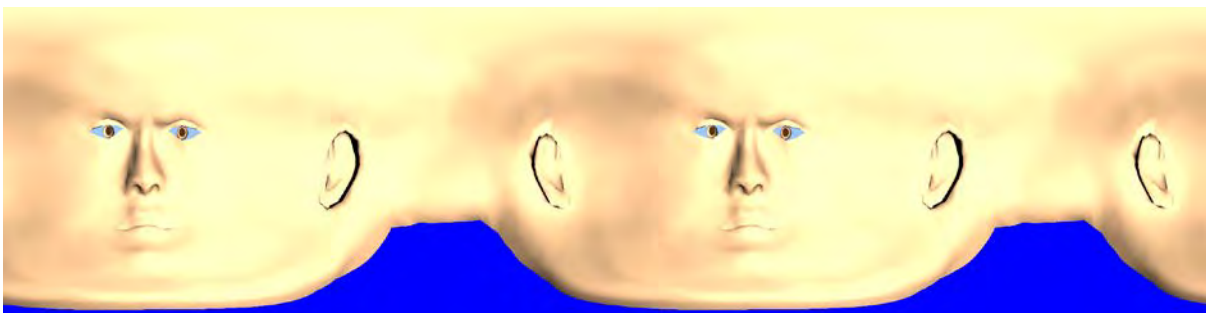


Fig. 4 Studies on multiple dimensions: a 9 dimension sphere. C.Soddu 2004

Fig. 5 Using reverse perspective of Florenskij in the 360-degree view of a face seen by inside the same face. (C.Soddu, "Perspective, a visionary process, the main generative road for crossing dimensions", NNJ journal, incoming publishing.



Therefore, the progressive creation of "logics of transformation" was immediately based on the manifold passages through different points of view, in practice on the passage from two to three dimensions, and vice versa using perspective representations and reconstructions 2D-

3D and on different passages from a dimension to another not limited to 3 dimensions. (C.Soddu, "Endless interpretations, infinite in the mirror" GA2007).

Also my studies on the representations of medieval cities by Giotto and Simone Martini, developed in my book "Not Euclidean Image" (C.Soddu, L'immagine non-euclidea, Gangemi Publ. 1986) identified, in the medieval images of cities and architectures, the dynamic progression of the "perspective" point as able to define a multiplicity of "reasonable" spatial orders that, all together, can better represent the idea of "medieval city". This particular "ideal city" is in the mind of these medieval artists and architects but, as happens also today, they cannot succeed in representing their Vision with only a static image but with dynamic images based on sliding points of view. These medieval city images seem to be not in "correct" perspective but they are only constructed stratifying different views with different points of view.

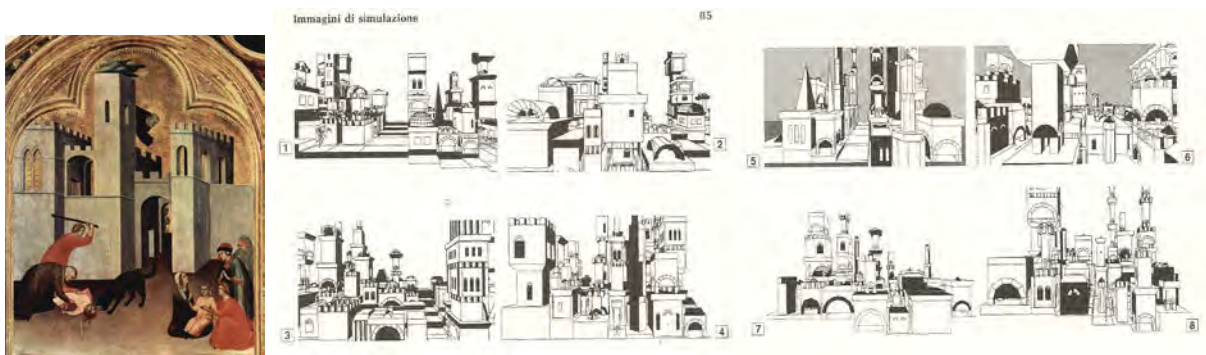


Fig. 6, 7 Starting from the studies on Simone Martini dynamic representation of medieval cities ("Not-Euclidean Image" book 1986) to the medieval town generated 3d models (from "Aleatory Cities" book by C.Soddu, 1989)

I have begun my generative experimentations by writing the first version of Basilica on Apple II with pen plotter. All was focused on generating events belonging to an urban "medieval" environment, or better an urban environment whose characters were my interpretation of Giotto and Simone Martini. The dynamic sliding of the point of view into only one image, peculiar character of the historical representations of medieval cities, but also used later by Piranesi (C.Soddu GA2008), became, in my generative program, the engine of possible transformations and multiple variations, operating "subjective" transformations among two and three dimensions. The main difficulty of these first experimentations of the middle of The eighties was the time due to verify the system. Because the screens with green or yellow phosphoruses were at low resolution, the only possibility was to directly trace a representation through the pen plotter. I launched in the evenings the program and the subsequent mornings I got up from seeing the result. Updated the program I had to wait a lot for verifying it again.

Soon, however, an aspect became more and more clear: Approaching the project through repeated progressions of transformations had two important results: the complexity and the strong identity; every result, although unpredictable, gained the possibility of being recognizable as belonging to a Medieval Vision.



Fig. 8 Cover and 3 pages of “Aleatory Cities”, Masson Publ. 1989. The first book of Celestino Soddu explaining his Generative approach to Architecture and urban design and his software Basilica. In the images, the generation of “Medieval Cities” as an interpretation of Giotto and Simone Martini artworks.

First Basilica, toward the complexity.

The primitive structure of my generative software Basilica was therefore very simple: 1) Identifying organizational paradigms of architecture able to define events, relationships, and interferences, 2) Tracing initial events that define, in first approximation, the dimensions and the orientation. 3) Managing ranges of geometric transformations, each one able to increase one of the functional / aesthetical / symbolic aspects and to push the events toward my architectural Vision. Each aspect answers to one of the functional, static and constructive architectural requests and, parallelly, to one of the characters identifying my Vision of architecture. I.E. “how I can apply a character of my Vision for transforming my beam in a way that it can reach the static needs?”.

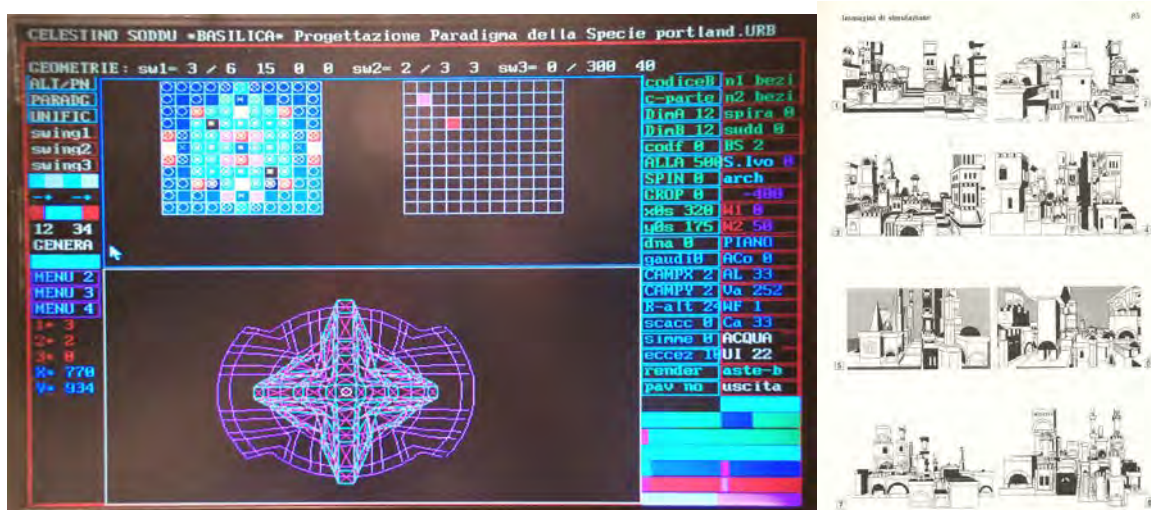


Fig.9, 10 Basilica Generative software (1987, it works only on Dos, also the last version 2009), Screenshot of the paradigm and global geometrical transformations design

interface. On the right a page from the book “Aleatory Cities” (1989) with 8 screen dumps of medieval town generation using Basilica.

The transformations run in parallel and also in series, belonging to single events and to the whole system; therefore, transformations are repeated several times by using manifold "logics of transformation. If a series of transformations refers to the same logic in a way that we could define "fractal", the related functional / aesthetics / symbolic character is strengthened.

I designed these logics of transformation, these algorithms, in different moments and in different situations. Actually, they reached a critical mass whose potentiality is to represent, even if still partially, my architectural idea in its evolutions and mutations. Reaching a critical mass of algorithms is fundamental for overcoming the simplification and for working on complexity. Today my generative software Basilica, in its last version, generates complex architectural scenarios because stratifying from more than twenty years, I used every occasion for increasing the number of possible points of view and possible logics of transformation. It is evident that my generative approach funds on Poetic, therefore on the subjectivity, the possibility to reach the complexity and the production of variations. But does exists an "objective" way of reaching generative complexity?

In Basilica, the choice of *when* and *how* these logics of transformation are activated, of what algorithm the program have to choose in each particular situation, is done by managing the progressive evolution of the system. All possible "transformations" that are able to fit the Vision could happen; but some were more probable than the others because they reflected a specific way to compare the transforming event to the already existing events. Like a Cellular Automata program mixed with something like Fuzzy Logic. This "management of the tones" also answered to the peculiarity of architectural characters able of reflecting the peculiarity of each single design occasion, the environment and urban identity in which the incoming architecture will live, in other words, the live-complexity of cities.

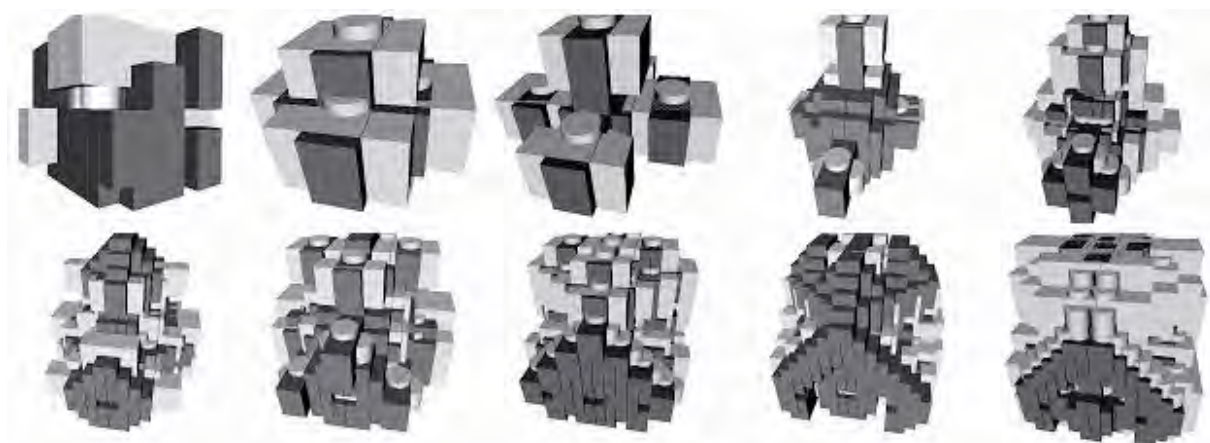


Fig. 11, 3d Cellular Automata software designed by C.Soddu for Generating 3D topologic paradigms, and now integrated into Argenia software.

The different starting point and the numerical not precision of parameters used in these logics of transformation guaranteed the unpredictability and uniqueness of each result

together with the recognizability of outputs as belonging to the same idea. (Marie-Pascale Corcuff, Chance, and Generativity, in GA2008 proceedings)

The characteristic of the generative approach is generating unpredictable results belonging to the same idea, as happens in all non-linear complex systems. In my approach, each result is also recognizable as "figure" (Enrica Colabella, figura, aura uniqueness, in GA2006 proceedings). This is the realization of a feasible architecture and not only the realization of an abstract three-dimensional image. In other terms my approach can be called "figurative", as for instance the approach of H.Cohen and of H.Dehlinger (GA1998 and subsequent) in the generative visual art, the experiments of P. van Looke in Mathematics that have the aim to reach the figuration (Philip Van Looke, Symbolic organic design, GA2006 proceedings), and the generative architectures of Renato Saleri Lunazzi ("GRUE: Génération régulée pour un urbanism environmental", GA2008 proceedings). The figure is defined as a dynamic event in which abstract is hidden inside. Similar to figurative is the representation of Nature

The "figurative" approach needs the use of a "control paradigm". It addresses the generative progression toward the "figuration", a functionally and constructively correct architecture, a recognizable event as a possible variation of a known species, a human figure, a tree, a house, a city.

Another question is the difference between subjective and objective approaches. The aim of constructing a tool for everybody, an aid for generative design that, as the experiences of John Frazer J.Frazer, An evolutionary Architecture, Architectural Association Publications, 1995), Aant van der Zee and Bauke de Vries (Aant van der Zee, Bauke de Vries, Design by computation, GA2008 proceedings) try to refer mainly to "objective" functional aspects is different from my "subjective" approach that tries to increase and communicate an Idea by tracing a software as artificial DNA able to generate events belonging to a subjective Vision.

Results based on "objectivity" are very interesting. They identify a set of alternatives but they don't easily succeed in reaching complexity; and when it happens it is by introducing "subjective" choices as "objective" choices. For instance each house is different; each bridge is different even if it was built following the same scientifically correct choices based on the objectivity of statics. These "subjective" differences are really important in architecture and design. The difference between objective and subjective approaches could be identified, for instance, as the difference among axonometric and perspective views. The axonometric view, objective, cannot reach the representation of Infinite despite its strong communication and measurability. The perspective view, instead, can reach the representation of Infinite because it was born from the subjectivity of a point of view.

Based on subjectivity, for the reason that poetics is subjective and can be, obviously, not shared by everyone but only sometimes appreciable as subjective representation of the complexity of our life, this approach is more difficult to use as conceptual and operational reference in front of the "objective" approaches that can reflect in each result the direct relationship between algorithm and formal / functional needs. Knowing and exchanging "basic" algorithms is useful for basic needs, creating own algorithms is essential in performing creative results. Quoting Focillon, each visionary people must create his own tools.

The question that many people often asked me: "which algorithm do you use for Basilica?" hides the question: which category do you belong to? This question is misleading because my approach is based on the multiplicity and on the progressive increasing of algorithms

able to fit my own Vision. This increasing number of logics is the attempt to produce "variations" as progressive increase of recognizability of the idea. (C.Soddu, "Recognizability of the idea: the evolutionary process of Argentinia", in "Creative Evolutionary Systems" edited by P.Bentley & D. Corne, Morgan Kaufmann Publisher, San Francisco US, 2001)

In Basilica I used specific geometric parametric algorithms, algorithms managing the transformation of event's figure by moving from a dimension to another, Cellular Automata and parallel progressions of transformations of single events that dynamically interact with others, as flocking of birds, and structures of repetition of the same algorithm applied to the same event, as fractal approach. But none of these methods is primary. The peculiarity of my approach is "how" I use them all together. It is the expression of how it's possible to effort single, unexpected and unpredictable requests with the aim to fit my Vision of Architecture. The main question is not only the tools but the right aim. I teach that to my students too, bringing them to consider their Vision overcoming the tools. (See the interactive website www.generativism.com with the teaching experience on Generative Art and Generative Architectural Design by Enrica Colabella and me)

Putting aside the difference based on categories of tools, we can identify two topics that make the difference among generative approaches and that can be reported to all involved fields, from Music to Visual art, from Architecture to Mathematics: **Figurative** versus **Abstract** and **Subjective** versus **Objective**.

3.Progressive paradigmatic development

I had to wait until 1988, this time with a PC 086, to find the time for subsequently developing the idea of generative software Basilica. And the possibility to use screen dumps for recording the sequence of results and to publish them together with the description of my software in the book C.Soddu, Città Aleatorie, "Aleatory City", Masson Publ. 1989.

Setting up a more rich paradigmatic structure of architecture was the following step. It allowed me to better direct and characterize single events and to generate more believable architectures. Moving from the previous simplified paradigm, now the architectural events were controlled by a paradigm constructed around a void space surrounded by 26 events: In total 27 events, the number also identified by Borromini as the main reference for architectural systems. Figuratively: an empty space, four pillars, four vertical frames, two horizontal frames, eight knots / interfaces / capitals, eight beams. Obviously, every space had in common with the nearby space, or with external space, 9 events that could be generated following this double influence in the progressive process of transformation. Possible evolutions could be managed, based on such relationships, through 3D Cellular Automata.

At superficial approach, this paradigmatic structure could be evaluated as too much axiomatic because it is easily representable as a cube. Instead, the paradigm was shaped in a way that the geometric transformations could easily modify the architecture varying from a triangular based prism to pentagonal or octagonal based prism or to the cylinder.

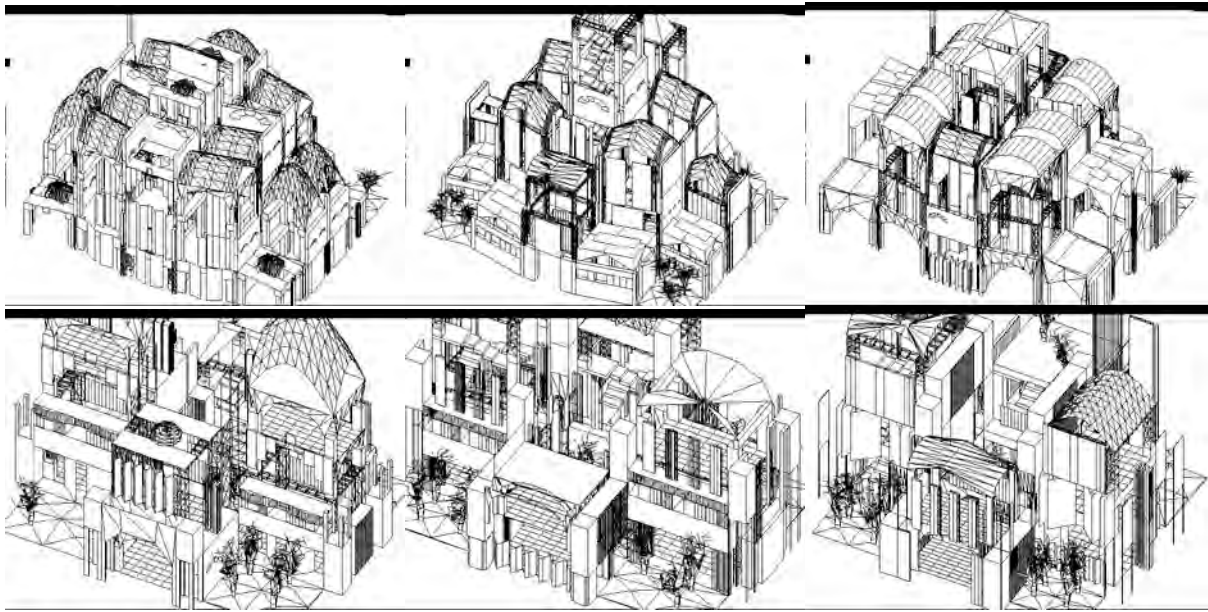


Fig. 12 screen dumps of Basilica using the new paradigm. 1990

Transformations can also involve the verticality of the architectural order, moving from inverted to truncated pyramid and managing, with an explicit reference to Borromini, the possible helical torsion of architectural structures. These transforming codes were in Basilica starting from 1992, soon after the publishing of the book “the environment design of morphogenesis”.

In any case, Basilica keeps, as main aim, the feasibility of the architectural system because beams and pillars varied, melting, or dividing themselves, becoming thicker or more thin, folding up themselves or fragmenting themselves but always doing that in relationship to the static and constructive congruences requested by the feasibility. The “new” concept of material could be a false problem. I.e. every architect has his proper way for transforming a “beam”: He do that by following the variation of the length. From a wood beam of few meters, moving toward a steel beam until a long suspended bridge, each possible transformation follows both the constructive needs and architectural character. Every designer has his own subjective way to manage these transformations also if each different result maintains, in the progression of transformations, its static, constructive and functional credibility, and clarity.

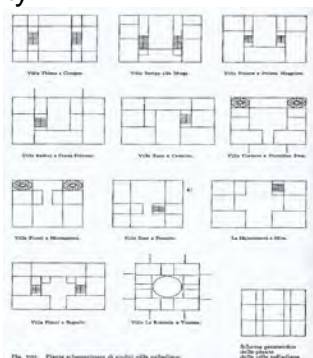


Fig. 13. the book by C.Soddu and E.Colabella “The environmental design of Morphogenesis”, Progetto Leonardo Publ., 1992

Fig. 14. All Palladio villas have a different geometrical organization but all belong to the same paradigm, as Wittkower shown in this drawing in “Architectural Principles in the Age of Humanism”. (The paradigm is down on the right).

The reached results made by using this “architectural paradigm” drawn by Borromini were immediately enthusiastic: this further complexity of the paradigm produced fields of further recognizability of the idea.

In the meantime, I have identified in the history of architecture, the organizational paradigm used by Palladio and drawn by Wittkover. This is able, through specific logics of geometric transformation, to splendidly suit manifold organizational possibilities strongly maintaining the architectural harmony in "innovative" geometrical orders. Approaching the transforming logics for creating "innovative" architectural systems, my first reference was Borromini: he made his wonderful architectural orders by using geometrical transformations on classical paradigms.

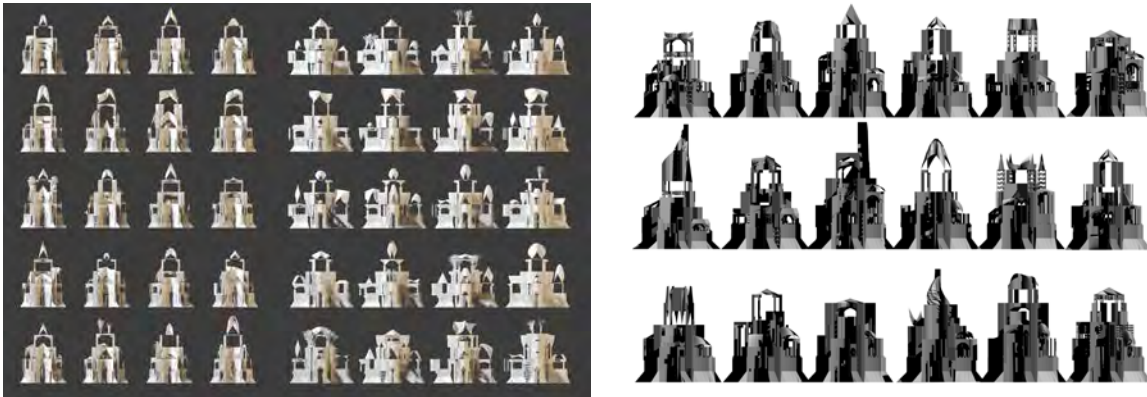


Fig. 15. Castles using the paradigm belonging to "La Rotonda" by Palladio. These two different variations of Castles were made in two different moments (with different codes). 1995, 2004

4. Variations, Design and Generative Art

Following Italian experience of Gio Ponti: not only architecture. At the beginning of The nineties, I was wondering if this generative approach could also be used in other fields like Design, Art, and Music. In the book "The environmental project of morphogenesis, DNA of the artificial ware" (C.Soddu, E.Colabella, Il progetto ambientale di morfogenesi. Codici genetici dell'artificiale, Progetto Leonardo Publisher, 1992) I shown the first results made by approaching what has been for a long time the theme at the center of the design discussions: the chair. I used a paradigm really simple: the support to earth, the support seat interface, the seat, the back, the interface seat-back. Looking at the results I identified a very interesting possibility in Design, industrial production, and market: the industrial production of unique and not repeatable objects. And we, Enrica Colabella and me, named this approach and the related software with the neologism Argenia. In the subsequent years, following this possibility, I designed Argenia for Jewels, Coffee pots, Lamps, and other objects.



Fig. 16. Generation of coffee pots, 1995

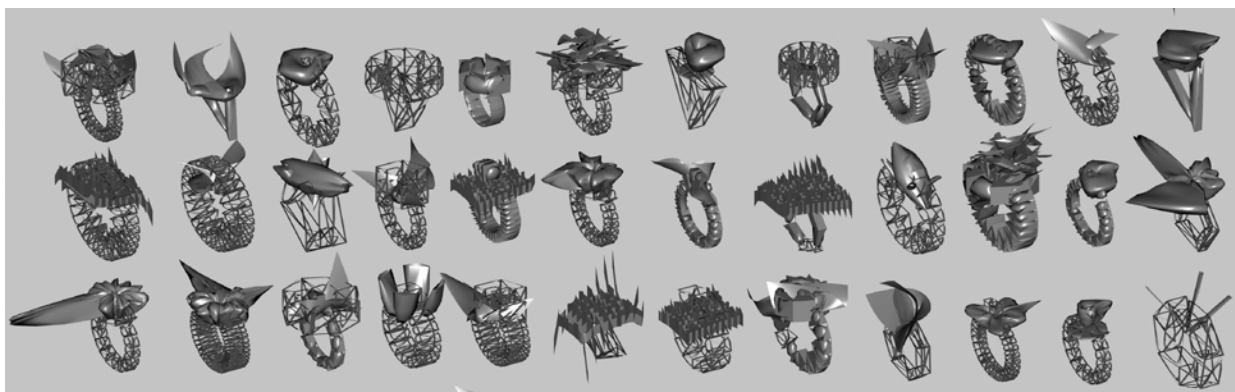


Fig. 17. Generation of “warrior’s” rings, 2002

From these experiments a new generative field of interest was born too: to work on Visual Art by following the Renaissance tradition to look at the Past for tracing the innovation. As Picasso re-painted Velasquez and the African art, naturally by stratifying over the identity of the references his own identity of the artist, his own poetic, so I tried to re-paint Picasso by designing a dedicated generative software. A generative artwork was born: "d'apres Picasso", an Argenia program able to generate a multiplicity of 3D models of women that, all together, can represent my interpretation of the women of Picasso, and printing them (in 2D but also, starting from 2001 with 3D printers) in real time, one after the other, until infinite.

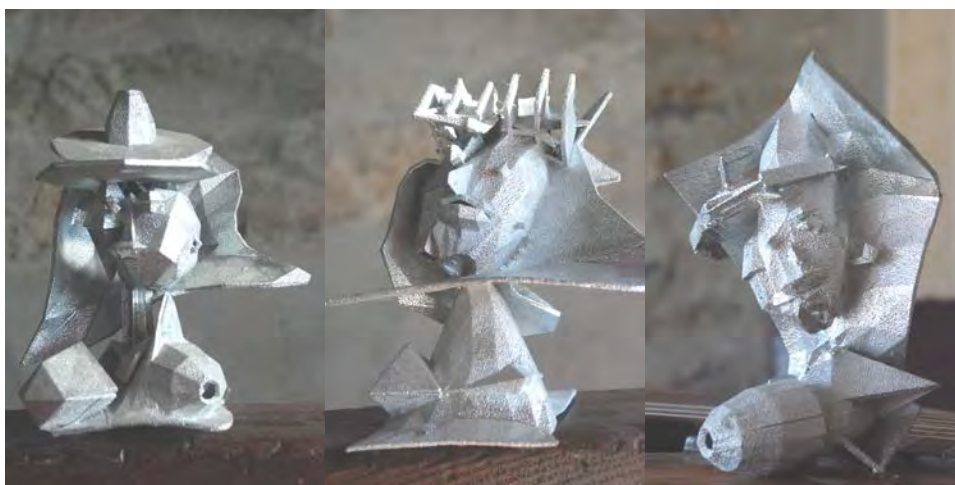


Fig.18, 19. “D’apres Picasso”, endless generation of woman’s portrait (1997) and the physical rapid prototyping results directly constructed by “d’apres Picasso Argenia software”, 2002

With Enrica Colabella, we have, in 1995, founded the Generative Design Lab of Politecnico di Milano University and the relative website. We have named this creative field Generative Art. The first personal exhibition of this kind of new "figurative/abstract" generative art was "d'apres Picasso" in a gallery in Milan in 1996. This personal exhibition has been the occasion to meet J.Frazer that, in 1998, participated in the first Generative Art Conference and invited me to the HKPolyU for make experiment related to my research. The first international conference GA'98, organized by my Generative Design Lab, has been the true first great experience of exchanging advanced approaches to creativeness and design. The presence of J.Frazer for architecture and design, of Hans Dehlinger for visual art, of Mauro Annunziato for artificial life, of Philip van Looke for generative mathematics and of other enthusiastic researchers, has been the occasion to define Generative Art as a multi-disciplinary field where the more advanced experiences in dynamically managing creative fields could usefully be discussed, exchanged and developed. Enrica Colabella and I named "Generative Art" this conference because we didn't intend to propose a limited conference to specific categories (cellular automata, worms, artificial life, shape grammar etc.) or to single disciplines (Architecture, Music, Design, Visual Art, etc.) but to look at a wide context linked to Science / Art. I have to say that this denomination, Generative Art, has been successful. Already from the following year, with the presence of GA'99 of P.S.Coates, J. J. Romero Cardalda, Adrian Ward and Gabriel Maldonado this multi-disciplinary approach was definitely established. (GA1998, 1st Generative Art conference proceedings, 2nd e-book edition in English and Italian, Domus Argenia Publ. 2009, in the attached DVD)

During my staying at Hong Kong Polytechnic University in 2001, I developed and experimented the feasibility of a direct interaction between my generative software Argenia and rapid prototyping devices, and therefore with industrial devices at numerical control. I successfully managed the possibility to directly produce unique objects by using these devices. Argenia opens this possibility by generating in real time unique STL files usable for producing a sequence of unique objects. The possibility of industrial production of unique objects belonging to a recognizable species, as in Nature, through generative software Argenia and existing industrial devices, was confirmed.



Fig. 20. Chairs generated by Argenia, starting from 1990. On the right chairs generated by using Argenia and directly produced with rapid prototyping device

Unfortunately, the unique object didn't fit the market of those years, completely dominated by the repetition of all equal "fashion" objects. The market didn't accept the concept that idea comes before the object. The idea as Product was, and is, our flag. The subjective Vision

able to generate, as in Nature, multiple different unique objects that people can choose because the Idea is recognizable was, and still now is, not accepted by the market.

5. Artificial DNA. Recognizable City Identity.

Beginning from 2001 I have developed a research field on Generative Architecture and Town Design fitting an essential need of contemporary environment: how managing in progress the urban and environmental identities and their clarity and recognizability.

I have discovered that, with minimal variations inside single algorithms managing the "logics of transformation" and their hierarchy, it was possible to reach aesthetical and symbolic tuning with the environmental characters of different urban identities.



Fig. 21, 22, 23. *Ideal Cities, from the Cultural Heritage (Renaissance, Piero della Francesca 1480) to incoming City Identities.*

I worked on generative projects focused on specific urban identities. The first experience has been Hong Kong, with the occasion of my personal exhibition at the HK Visual Art Museum in 2002. The aim has been to exhibit visionary scenarios of HK generated with Basilica and Argenia, unpredictable scenarios but where an increasing HK identity could be found. And I tried to ask to the visitors: "in which scenario do you see HK-City more HK then before? Clearly referring to an HK-Ideal-City that is in the mind of each inhabitant. Answers gave me the possibility to select the "logics of transformation" used for generating the "approved"

scenarios and to reconstruct an artificial DNA of HK, its genetic code able to represent the HK-Ideal-City.



Fig. 24. Hong Kong City Identity in progress. Generative projects are shown in the personal exhibition of C.Soddu at Visual Art Museum, 2002

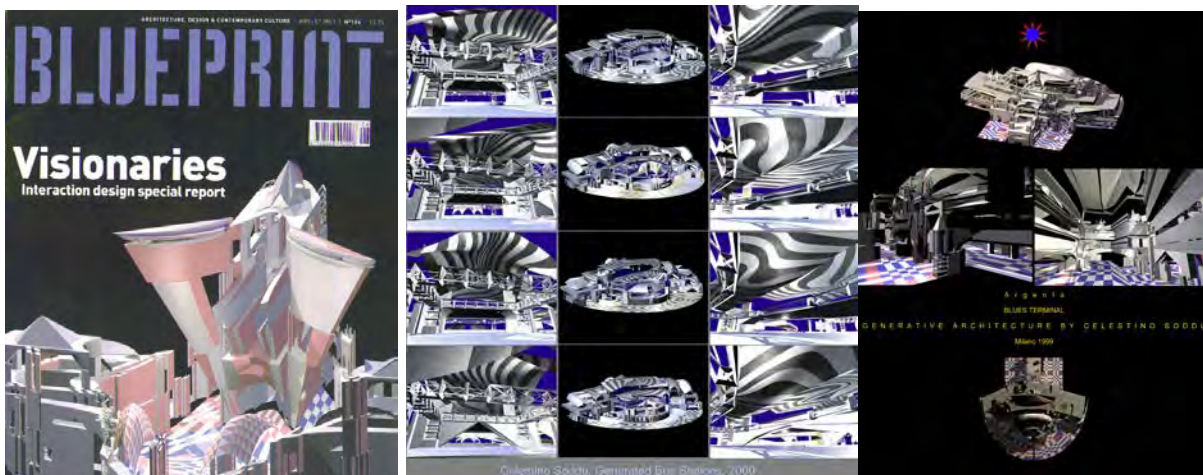


Fig. 25, 26, 27. Generative Visionary Architecture, The cover of Blueprint magazine 2001 with generative visionary architectures by C.Soddu, and other projects of C.Soddu published in the same magazine.

The following years, with my personal exhibitions in Los Angeles (Pacific Design Centre, 2002), in Washington D.C. (IDB Cultural Center, 2003), another in HK (International Financial Center, 2004) and in Milan (Palace of Giureconsulti, 2005) I have developed the creation of artificial DNA of these urban Identities and of others as NYCity, Chicago, Shanghai, Beijing, Macau, Dehli.

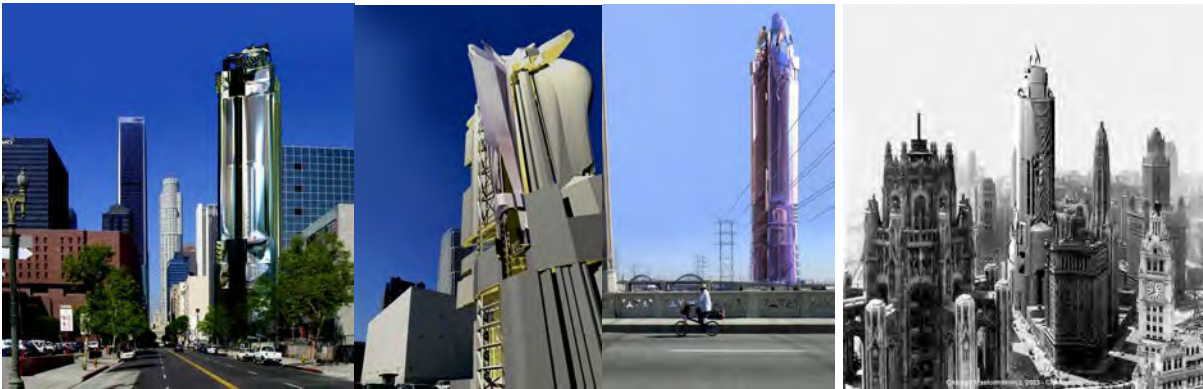


Fig. 28. Los Angeles: an office building, the broadcasting tower, and IRTAL, shown at the personal exhibition of C.Soddu at Pacific Design Centre, L.A., and a new tower in “old” Chicago, 2002



Fig. 29. Variations of the new Cultural center of World Bank in Washington D.C. presented in the personal exhibition at IDB Center, Washington D.C. 2003.

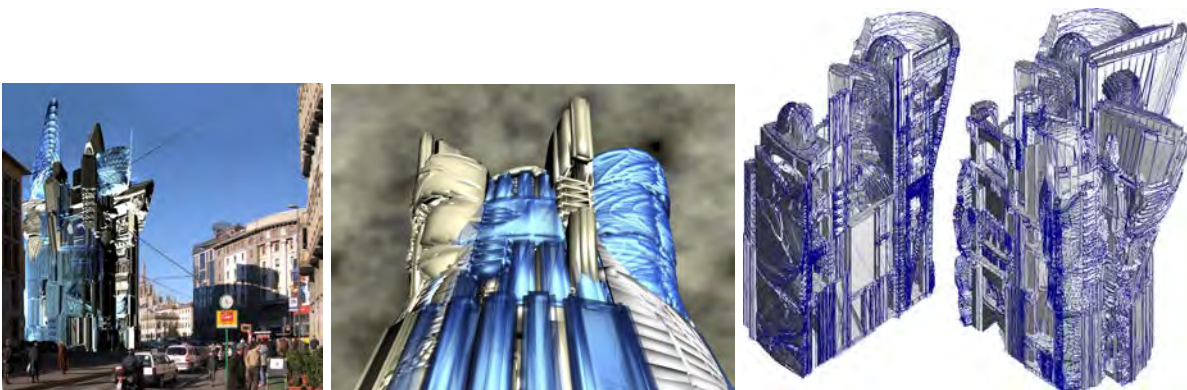


Fig. 30. C.Soddu Personal Exhibition in HK International Financial Center, Futurism Museum in Milan, 2004

In the same years, developing in my GenLab a research/exchange Asia-link program founded by European Commission, a program of which I was a coordinator, I succeed in establishing a Generative Design Labs network involving T.U.Eindhoven with Bauke de Vries and Aant van der Zee, Kassel University with Hans Dehlinger, China with Tongji University in Shanghai and Tianjin University, and enlarging the network to other Universities. This

program, implemented with meetings, workshops, seminars, and exhibitions was great and very useful for disseminating the Generative approach in several countries.

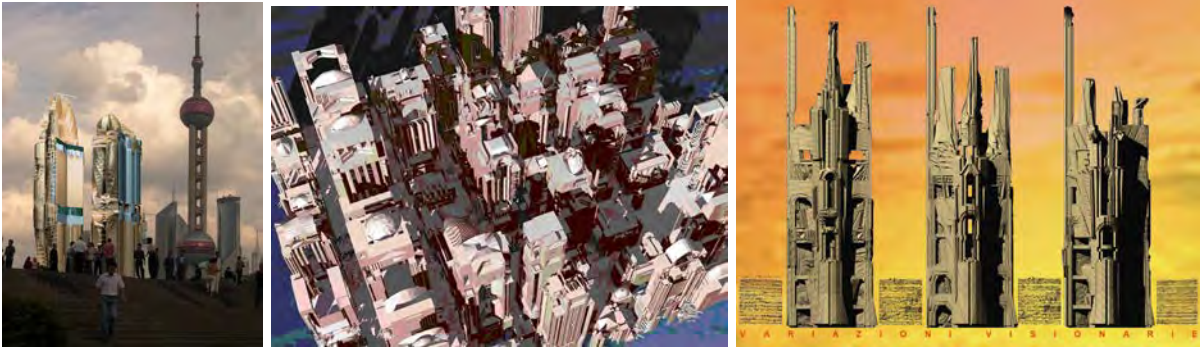


Fig. 31. Shanghai Generative projects, a generated town environment belonging to the reconstruction of New York City artificial DNA and 3 towers “homage to Gaudi”, using Basilica 2003



Fig. 32. Milano, Variations of Futuristic imprinting on Piazza Cordusio, The starting point of Milan Identity in 1915. (2005)



Fig.33. Dehli, finding city identity, 2006



Fig. 34, 35. Generating over the drawings of my main masters, Leonardo, and Piranesi, and learning from them (2008,2009)



Fig. 36. Generative scenarios of Lecco presented during the Futuristic Visionary Evening, 21 June 2009, at Lecco. Architectures generated using Basilica.



Fig. 37. Generated (with Basilica) scenarios at Serramanna, Barumini, and Poetto for the last personal exhibition at the gallery of Domus Argenia Center regarding ancient Sardinian Identity following Nature (Sardinia 2009)

6. How to gain multi-subjectivity from singular subjectivity?

How to overcome the problem of disseminating a subjective generative approach that works very well in creative design, as I verified with my student of Politecnico di Milano? How to design generative software usable by different people for increasing and managing their own design Identity?

I decided, until now, not to sell Argenia because it was not usable by other people: it directly reflects too much my subjective Vision. This new hypothesis for which I have worked is a generative software able "to learn" from the architects, artists, and designers. The aim is that the software becomes, after the first experiences, a rich and vivacious expression of each

own creative and professional identity. In practice generative software that builds, step-by-step, the creative subjective artificial “DNA” of whom uses it.

Argenia, in the last beta-version, performs a “DNA” that can be managed for representing different subjective creative identities through integrations and stratifications that each artist / designer can operate. This happens because Argenia is open to change by following new logics of transformation and new paradigms. It has the possibility to work defining paradigms, transforming logics, codes, cellular Automata rules and fractal repetitions. In the core of Argenia there are:

1. a series of logics based on geometric transformations. Each geometric transformation is structured by using modifiable parameters able to manage the character and "how" the algorithm will run.
2. The functional character defining the incoming event in relation to the nearby events is defined by the user choosing among different logics of transformation belonging to "how the event will end", "how is folded", "how is divided", and so on.
3. Each one of these characters is defined with an increasable set of "logics of transformation" that operate this "How". The user can make new hierarchies among these logics, can modify, can upgrade, can develop new ones and can select which will run in the generation process.
4. The organizational system of three-dimensional events doesn't work only in one "structural direction", as Basilica that was constructed with the distinction among vertical and horizontal structures in the base to the architectural feasibility but works through "directions" that the user can point out as the character of every incoming event.
5. The user can build the organizational paradigm of each 3D event by modifying or generating a new one. It's possible to use 3D Cellular Automata and choosing the association of each character and each transforming rule to the structure of Cellular Automata. Cellular Automata logics are, in Argenia, different and selectable by the user.
7. The generation of events can be performed also by choosing or mixing diversified tools of construction of surfaces (Bezier, T-Spline, and so on.) able to reach different character of 3D results.
8. The progressive increase of complexity can also be reached by using parallel fractal transformations and by managing the relative parameters.

Besides, there are optional outputs for generated 3Dmodels directly usable with rapid prototyping devices, render, and common commercial 3D tools.

Argenia is now opened to all artists, architects, and designers because Argenia will be used in the activities of the new center "Domus Argenia", just now established in Sardinia. The opening was made with an exhibition about the Sardinian DNA done by interpreting the megalithic cultural references of this wonderful country. Domus Argenia has the aim to develop exchange among different creativeness and different disciplines in a cultural approach focusing on Identities, the subjective creativeness, and different cultural heritages. And will be open also to not-lucky young people of the entire world for increasing their own possibility to creatively work with their own cultural reference.

This is my generative challenge of next years. .

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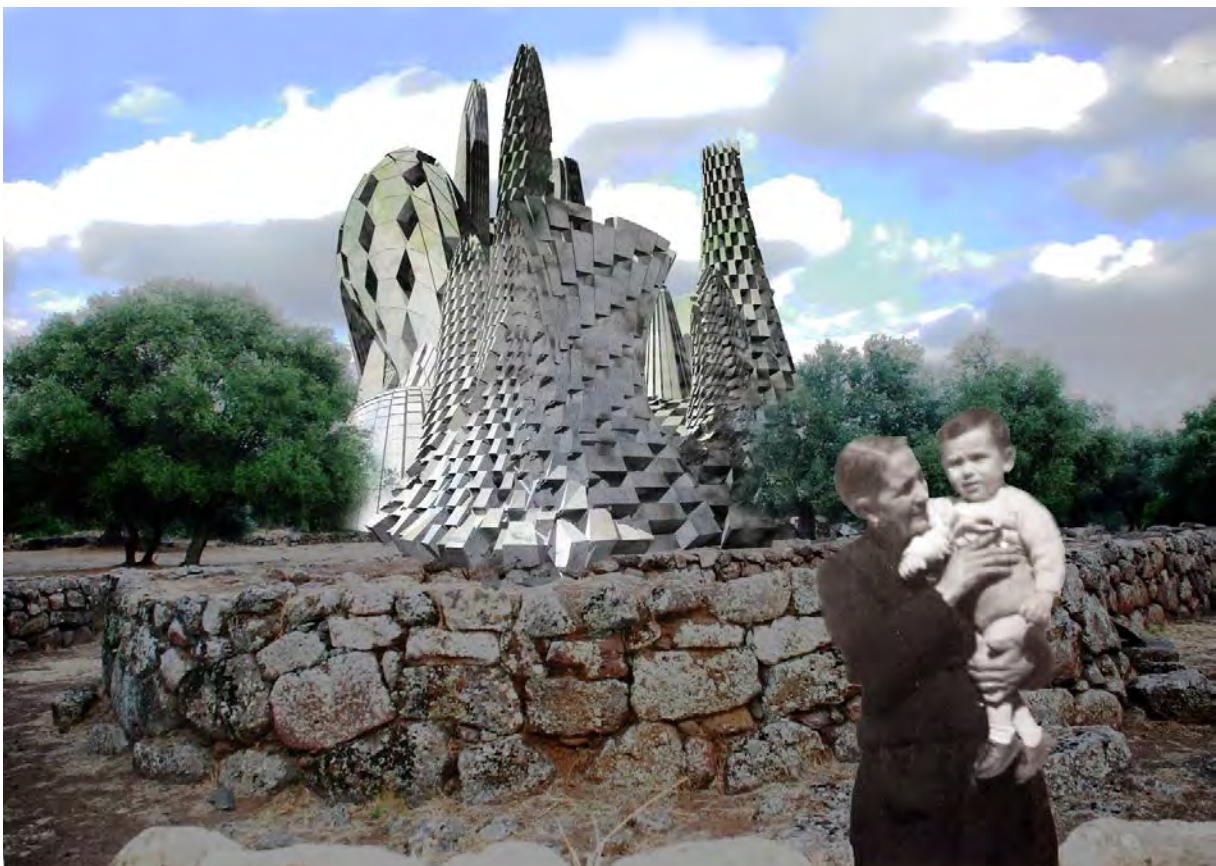
Hong Kong waterfront.



Hong Kong new generated tower



Sardinia. The main square of Serramanna and other generated architectures







Castle in Campidano





Virtual promenade at Poetto



The Domus Argenia center in Serramanna



Generative projects for Lecco.



Babel castle on the lake



Hydroplane harbour



teletransport station



Research centre



Investigation Point

Curved spacetime perspective as generative engine. Intersubjectivity & Contrapunctus

GA2010



Premise

The generative approach extends software from objectivity of a tool to subjectivity of a poetic.

It's possible to go ahead, moving from subjectivity to intersubjectivity. *The aim is to interact with different subjectivities inside their own complexity.* The field of the relationship between different subjectivities is the channel of knowledge, of increasing complexity, of possible answers to relevant needs.

This approach is based on the understanding that *identities are strengthened in comparison with other identities.* This interaction opens channels of growth and supports going in deep in the own cultural references, in the own history and tradition in the own creative potential.

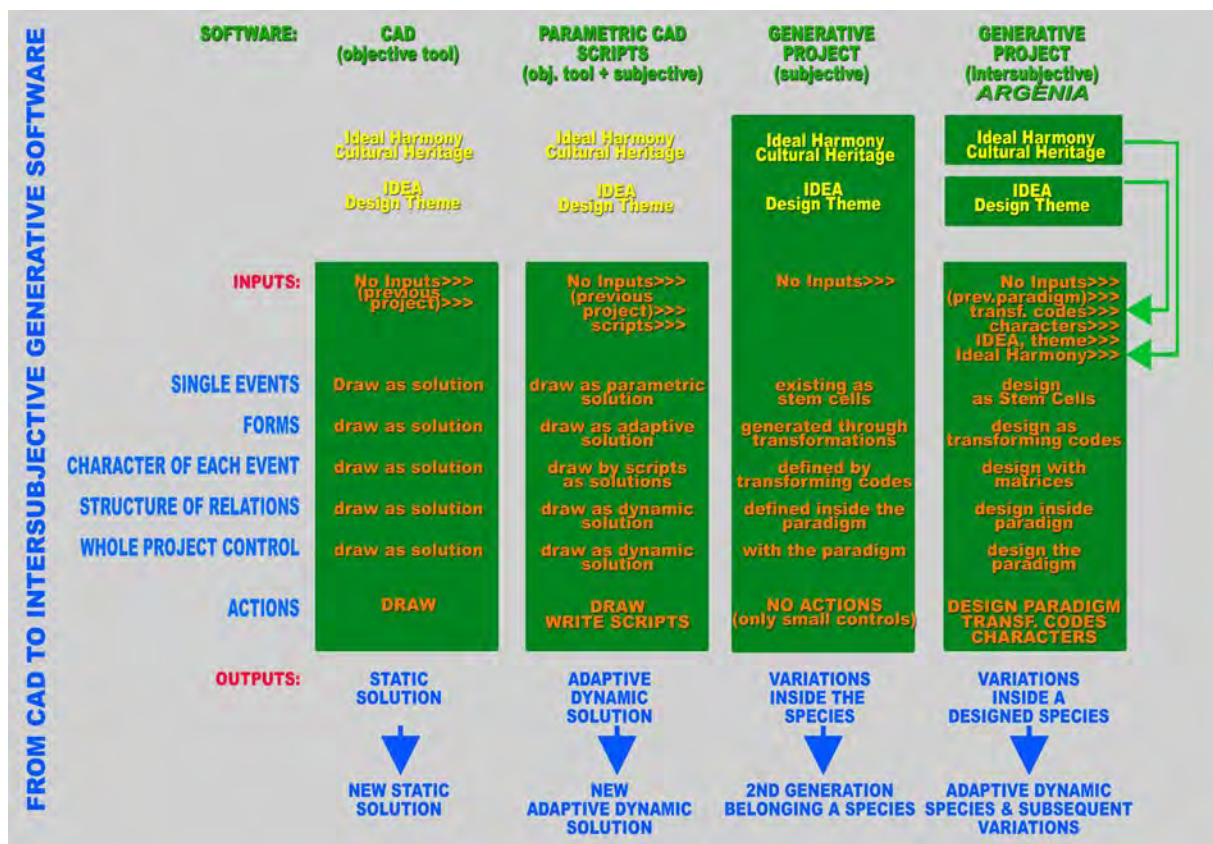
Creativity and innovation exist only starting from the own interpretation of what surrounds us, of existing environment, of our cultural traditions. Because this is the only way to gain complexity. A software built on our subjectivity, or that is structured as an interface between the surrounding world and our uniqueness, which is based on our ability to interpret existing environment and our own history, lets us look forward and it is, without doubt, the unique tool that can be used directly in the creation and innovation. In *Art and Science*.

Abstract

A strong relationship exists between approaches able of generating visions of future and the **creation of subjective instruments**: the visionary people builds its own tools. (note 1) Visionary people move from instruments as "objective functional tools" to subjective instruments, based on own interpretation of the world and its future possible incoming transformation. In other terms, based on own poetic.

The aim of the generative software is gradually leaving the "safe" field of software considered as an objective tool, whose processes reflect a system of objective data and of their controlled processing, to achieve software based on subjective Poetics. Moving to this software was a difficult path because they cannot be necessarily shared with everyone in the field of used approach neither of gained results. The advantage is that it *can enhance the action to get in deep*, finally, within the creative processes, design and more.

Everyone has his own perspective of the world, and everyone uses own conceptual scheme, created through the interpretation of own experiences gained starting from childhood, to identify the own poetics and to propose possible events-forms as explicit communication of own identity and uniqueness. The advanced aim is to use this conceptual scheme for finding out a **common field** to interact with other subjectivities, an intersubjective field.



Because even those who only acquires the events proposed by others has its own perspective, conceptual scheme. This subjective approach allows accepting, to reject, be

enthusiastic, not only on the basis of objective data but also following the own logical thread of interpretation that is supported by own uniqueness and identity, by own peculiar way of seeing and living the evolutionary dynamics of the environment.

The foremost objective is to arrive at a common place where two or more perspectives meet, where two or more different interpretations of the world find a common space for interpretation when the designers perspective and the user's perspective will finally meet.

Intersubjectivity: This field has always been the specific field that defines the quality of a project, of a proposal, of an artwork. (note 2)

In the generative approaches, this common intersubjective vision is not the result of progressive reductions of characters (note 3) but it is a **harmonious blend of multiple and different visions**. These visions can come from different moods of the same author, from different people of the same design team. More, these multiple viewpoints could be discovered, later, by different and unpredictable users.

spatiotemporal world. Transcendental phenomenology attempts to reconstruct the rational structures underlying — and making possible — these constitutive achievements. (<http://plato.stanford.edu/entries/husserl/>). Thomas J. Sheff defines intersubjectivity as “the sharing of subjective states by two or more individuals.” [Scheff, Thomas et al. (2006). Goffman Unbound!: A New Paradigm for Social Science (The Sociological Imagination), Paradigm Publishers).

Note
Note

Note

Software as optimized tool versus intersubjective software

Building software by leaving the easy field of tools, and also the fascinating field of only own subjectivity, to move around, looking at the field of intersubjectivity, is a hard road, a road that has not yet been really explored. But it is the road shown by generative artworks, by producing variations, by leaving the door open to the subjectivity of those who can appreciate, as a final user, the artwork itself, may be directly interacting with the artwork itself for creating variations.

Since the first research on generative design (C. Soddu, Città Aleatorie, Masson Pub. 1989) I tried to explore and theoretically and experimentally develop this hypothesis and I tried to trace possible approaches to generative creativity, first of all defining an approach that arises from the simultaneity of parallel and different paths.

The existence and awareness of multiple lines that come together in creative work are an essential part of our European cultural heritage and continue to be the logical framework of each harmonic "intersubjective" system.

In music, this creative approach has a name: **counterpoint**.

Each tune that blends with the other in counterpoint, maintaining its recognition, can be interpreted as one dimension of intersubjectivity. Therefore, the approach to counterpoint can be conceptually defined as a *multidimensional* approach.

Experimentally I identified two possible paths and, lately, I started to develop them systematically in the new version of my software Argenia which tends to go over my own subjectivity to perform an intersubjective software:

First path:

Stimulate multiple subjective views through perspective visions, not only as representation tool but as a code alluding to possible multiple interpretations that directly **work through three-dimensional space-time transformations of events made during their generation.**

The concept:

1. Each perspective is, in itself, a subjective code of interpretation of an objective event. And we can enlarge this subjective interpretation to multiple interpretations involving multiple space-time dimensions. Each different one could be made using different “perspective tools” and geometries. (note 1)
2. Each subjective vision amplifies an aspect of the event, making the related interpretation recognizable and unique.
3. Each subjective vision, following own cultural reference, amplifies own uniqueness when interacts with other visions.
4. Multiple interpretations / variations / perspectives, together, could create an intersubjective communication of the event and of its complexity. This happens when it's possible to find out a “common” field.
5. Using and stratifying variations as multiple interpretations we pursue a dynamic communication open to further interpretations and meanings.
6. Moving from one dimension to another, and going back by using different “interpretative tools”, and fixing their appearance as stereometry we can spatially transform events increasing their complexity and multiple meanings

An explicit example of this approach are the tables and the frescoes by Giotto and Simone Martini. In these representations of medieval cities, each architectural event is represented by a different “perspective”, constructed with a subjective, ever-changing, virtual viewpoint that **dynamically** relates to one of the multiple subjective paths for exploring the city. It seems that each architectural object follows one of possible subjective viewpoint able to underline a particular location in the urban image, or a point inside a discovering path in the represented environment. (C. Soddu, the not Euclidean image “L'Immagine nonEuclidea”, Gangemi Pub. 1986).

Looking at the urban images in these medieval artworks, and mentally reconstructing their whole urban geometry, each architecture appears as curved, physically transformed from “normal” orthogonal order by their own subjective perspective.



Giotto, “La cacciata dei demoni”, Simone Martini, “Beato Agostino Novello e il bambino azzannato dal lupo”

This approach, in other words, tends to a **progressive curvature of the temporal dynamics of viewpoints that can be reflected in the spatial construction of events**. The result is a fantastic example of the interrelations among multiple interpretations as the mutual transformation of space-time dimensions of the event. This happens through the counterpoint made by different subjectivities - viewpoints.

By using this “medieval reference” in managing the generative engine I had interesting results also if it's clear that, for applying these transformations to a whole architecture, we need, as done in Giotto's and Simone's images, to apply transformations only to X and Y coordinate because of the curvature of buildings stereometry. So these transformations don't lose the horizontal surfaces of architecture and don't introduce obvious functional problems. In the generation of objects, or parts of architecture, where all surfaces can be folded without functional problems., we can use the full transforming rules involving all dimensions.

Second path:

This second step is parallel to the previous one but it is different for the used instruments. The use of different viewpoints is not limited to perspective representation but it is extended to **multiple moving acts from one dimension to another** (i.e. cube-hypercube and vice-versa) and to multiple possible subjective interpretations linked to peculiar transforming logics.

Following this approach, we can manage the space, especially architectural and urban space, through progressive layers of transforming events that do not respond to one but to a variety of dynamic keys of interpretation.

Operationally we can manage the project, during the design progressive path, through multiple generative algorithms, multiple logical processors, belonging to different “instant-mood”. These logics are activated “in parallel” by generating events that are shaped in their complexity through progressive multiple transformations, each reported to a different but “congruous” interpretation of the event.

In the same way, when the project is made by a team of people belonging to different disciplines, each designer can interact with the others with own transforming codes. In this

way, each participant to the team don't enter into conflict with other but can give his own contribute to the increasing complexity, quality, and intersubjectivity. We easily can discover that more each "interpretation" is different, more each contribution is appreciated.

In other words, the attempt is to gain intersubjectivity by structuring parallel "time paths" that, while offering a wide range of possible meanings/functions, could be subjectively appreciated by those who will discover them when following their needs.

Results were really good in terms of increasing complexity and of reaching the possibility to be appreciated by a more large number of users.

Is it intersubjectivity? Not yet, but the way is open to moving this reached complexity to an intersubjective vision.

These experimentations are based on **the concept of creative multi-transforming acts, mirrored from the concept of musical polyphony**. The concept of **counterpoint is the central paradigmatic element** and it is, beyond any doubt, the main reference of generative creative approach related to our own tradition, the common European cultural root.

Note

Harmony and Intersubjective Vision

How to define the structure of a possible intersubjective target in a generative project? Or, staying in the first subjective step but looking at an intersubjective possibility, how to fit our different moods, fascinations, multiple interpretations, which are always different at different times but which, all together, talk about our vision, our poetic?

The target could be identified, intersubjectively, as "Harmony" because the "common" concept of Harmony is clear but everyone (or the same artist at different moments) pursues it in different ways.

Harmony, explicitly referring to the masters of the Renaissance and Baroque, could be constructed by using paradigms able of steering the dynamics of progressive generations, then the dynamics of parallel activities in the generative engine. As happened in constructing cathedrals where each people involved used his own ability and vision for increasing the "common" vision.

Basilicas and cathedrals, centers of experimentation and representation of the Art and of architectural culture of our history, were the results of progressive creative dynamic lines that were subjectively and parallelly developed. Each event belonged to single artists, from sculptors to masons, from painters to architects that, following their own interpretation and exchanging one each other experiences and ideas, gained together complex harmony, increasing their "common" vision.

These different artists produced contaminations and resonances, but always in reference to an identifiable harmonic vision able to establish a common cultural reference, an **Intersubjective Vision**.

Looking at town environments we can easily discover that a city was built as a conglomerate of casual events or, as happened in cathedrals, following an urban harmony. This does not

depend on the quality of individual buildings but on the existence of an intersubjective poetic in the citizens, people, architects, tourists, and wanderers.

If there is a common love for their city, as, for example, citizens of New York, Rome, HK, Chicago, Paris, and Venice have, without a doubt, there is an intersubjective concept that we can call the “**Ideal City**”. This concept is different in each city but it is recognizable as the common logic of looking to the future. It is **the most interesting example of intersubjectivity**. More, this “common feeling” belongs to the field of logics, of “how” to keep alive the environmental identity and uniqueness.

The intersubjective concept of “Ideal City” brings the city to increase gradually its specificity and uniqueness albeit the different and unpredictable architectural events.

This is why an “intersubjective” goal is conceivable, even desirable. The existence of a common vision, that moves from subjective to intersubjective vision, becomes essential to trigger a route to increased quality, recognition, and identity of a place, of a project, of an artwork.

Following this concept, I’m extremely against to generative approaches based on emerging unpredictability through randomness. The “emergent” from random, in my opinion, is not useful because it not pursues, with consciously activated algorithmic procedures, a design vision but is rather surrendering to “not-project” and to “waiting for luck”.

How to manage the overall harmony is the first point to be developed. Without this first step, the results, even if interesting experiment, would have only the structure of a series of random events.

We can identify and design this “common intersubjective concept” as a **paradigm**, as “**cantus firmus**” from what generate contrapuntus variations.

This paradigm defines the rules that build the plot of harmony defining the field of possible interpretation.

But, soon after, we need to clarify that *there are no rules that are always right*.

As in music, when you try to identify the rules of counterpoint to ensure a harmonic result, these rules are always different. There is not, and this is the interesting aspect, not even a unique code of rules regarding the musical counterpoint, but every author has tried to promote their own rules as agreed rules. (note 2)

Therefore, the paradigm is a subjective representation of a recognizable order.

Note

tante sentenze, quanti furono gli Autori “Joseph Fux, Gradus Ad Parnassum. (“Undertake to deal with the matter of Modes, is the same to reorder the ancient Chaos. For there is so much diversity of opinions of the ancient and modern authors, appears to have been so many judgments as so many authors” Joseph Fux, Gradus ad Parnassum).

Paradigm, Harmony and Transforming rules

At this point, a question arises: If the control paradigm of the multiplicity of possible variations follows subjective interpretations and, in the meantime, is so closely tied to the Harmony, designing the paradigm is perhaps the high point of creativity? How could it be, given its multi-subjective structure, the engine for intersubjectivity?

The question is legitimated but we must consider two question:

1. the paradigm by itself is empty. (note 1) Its quality is being ready to be easily filled with different progressive interpretations. Interpretations that we cannot know in advance.
2. also, if we can consider the paradigm as “**cantus firmus**” able to define the structure of variations, the concept is the same, because this primary event cannot live by itself but can be represented only when contapuntus will develop the complexity starting from its “topological structure”. Like the theme in a jazz jam session. The cantus firmus is a melody belonging to his author but, when used as a paradigm, it become **symbolic topological vacuum path** whose potentiality is the ability to suggest and organize incoming other melodies.

The paradigm is an “Ideal Harmony” and cannot explicit itself as an artwork without the creativity of the designer, artist, musician, (but also in the broad sense of the user), without the ability of the designer to repeat himself with creative interpretations, always different. Paradigm represents itself only through “transforming events” and their variations made using the interpretative codes.

It is clear that Generative Design works simultaneously on these two creative aspects-fields: the paradigm and the interpretative codes.

During the progressive evolution of a creative work, the two fields perform different paths.

1. The **paradigm** transforms itself progressively but keeps the same recognizable idea of space-time. Examples are the harmonic structure of twelve strokes of Blues, the character of “Blue Period” of Picasso, or the unique vision of complexity in Gaudi. Or, widening the concept, the “Baroque”, the “Futurism”, the “Minimalism”.
2. If the paradigm changes, it changes completely. And this change is called epistemologically a “**logic jump**”. There is no obvious connection between the before and after. We could say with R. Thom that this moment, inside the creative dynamics, is a catastrophe, even if we can assume that the recognizability, the author's imprinting may remain, but it is not sure.
3. In contrast, **interpretative codes**, algorithms concerning progressive transformation of events, are normally not abandoned in favor of another. They don't change over time, but evolve and proliferate, creating more interpretative recognizable codes that are, overall, better able to represent the “timeless” idea of the artist, that is the idea outside the context of a single artwork.
4. **The codes of interpretation are indeed stratified.** They must be layered to produce the counterpoint.
5. More the codes of interpretation are different, but still born within the same subjective poetic, more they are creatively productive.

The paradigm, therefore, should not be constructed as a functional axiom but as a structure supporting the meeting of perspective variations, as the organizational key of unpredictability, of possible multiple viewpoints, of multiple interpretations of the environmental complexity, of progressive ways of possible transformations that may vary over time even in the same designer / artist.

I, tomorrow, will be no longer what I am today and the stratification, inside my artwork, of my actual interpretation of the world, with yesterday's and tomorrow's possible interpretations, provides the possibility to generate a complex event, which could slide to an intersubjective and polyphonic event if variations are able to go in deep. Like counterpoint that is based on different pathways, on different interpretations, but where all events are part of the same dynamic poetic, the poetic of the artist in his progressive creative path.

The melodic components of counterpoint not need to be coherent one with each other but must be animated by a common intersubjective poetic. The plurality of interpretation belonging to the various melodic lines increases the recognition of the poetic, the possibility of appreciation from different people by identifying themselves into one of the lines of interpretation, then it could bring to the construction in progress, of an intersubjective event. Like in the Bach fugues.

The progressive opening to multiple possible interpretations increases the complexity of the artwork, decreases its axiomatic aspect, that is the possibility to reduce the appreciation only to its unique function, and exponentially increases the chance of being appreciated by different subjectivities, and its acceptability. Avoiding from falling into simplifications and reductions developed in an attempt to optimize and fitting all different needs by fixing an axiomatic optimized objective function. We all know that everyone finds the own way to use the same object. And this possibility is strongly linked to quality.

It is clear that Baroc, and its polyphonic complexity, is the primary referent of my generative approach. But also "minimalist" approach needs to compete with intersubjectivity and multiple interpretations of designers and unpredictable different users. The need to propose an artwork which, despite its "minimalism", is capable of responding to multiple requests, remains. And remains the need to propose an object that can be considered *one of possible variation of shared common Idea*, of a common intersubjective concept.

When, in the late eighties, Decio Gioseffi, the great historic and critic of arts (Trieste 1919, 2007), one of my main reference and a friend of mine, said me that my work was like the work of Canaletto (1697-1768), I didn't succeed in understanding all this concept at once. Following the Gioseffi's book "Canaletto. Il Quaderno Delle Gallerie Veneziane e l'Impiego Della Camera Ottica" I supposed that the relationship was only in defining and using own tools for representation own vision.

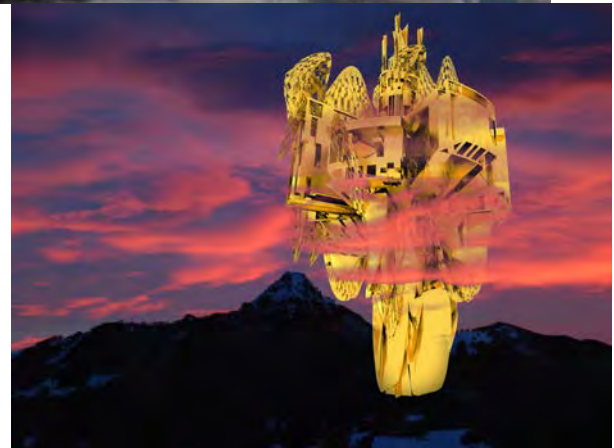
In 1987 I wrote the book "Immagine non Euclidea", (not euclidean image), concerning the "total" perspective, a curved perspective able to contain a lot of different perspectives joined all together in a not-euclidean representation. And Canaletto used his own tool, the camera obscura, for tracing perspective visions able to give wide images of Venice able to contain multiple different tales. But, remembering the discussions that I had with Decio Gioseffi, focused also on my generative software and my book "Citta' Aleatorie" 1989, I have identified the relationship also in the way to get the complexity using "parallel stories", parallel developing engines, in other terms: **contrapunctus**.

In the artworks of Canaletto the perspective, very large, artificially created using the optical camera, is only a main paradigm where each possible observer can look at the most closed representation of space because the "large" perspective push each observer to choose own space of interest. More, each observer can follow a different "story" identifying one of the

represented people, or boat, or people at the window, and can develop his own interpretation of how space dynamically lives.

So I would like to dedicate to Decio Gioseffi my work for the “all different and unique” covers of the GA2010 proceedings, representing, on some pictures by Canaletto, one more story, one more point of view, one more event increasing existing complexity and, why not, existing contrapunctus. Because the Canaletto's pictures are counterpoints, like Bach's fugue. In this complexity I inserted a new event, an unidentified flying object whose own complexity was created, as a fractal, by different parallel transforming dynamics following different subsequent interpretations. But all generated UFO are based on the same paradigm.

An experiment made this year was the generation of “flying castles” based on hypercube geometry, or rather of multiple hypercubes that define the sliding through the possible dynamic point of view, all progressively built on the dynamics of space / time from inside to outside and vice-versa that is proper of the hypercube. Each viewpoint has its own different paths belonging to different dimensions and/or to the angular size of the route point-to-infinity.



Flying Castles variations. The contaminations, the differences and the interpolations between parallel events create the complexity proper of counterpoint, produced by the dynamic progression through multiple interpretations based on sliding from a dimension to another. C.Soddu 2010.

Note 1. See the Palladio paradigms drawn by Rudolf Wittkower. 1992. “Idea and image: studies in the Italian Renaissance”.

Argenia

The aim of *Argenia* is directly opening the generative software to intersubjectivity by stratifying subjective transforming rules coming from a common “ideal vision”, or/and from each subjective interpretation of each artist-designer that will use this software.

For doing that the working windows of *Argenia* are already focused on:

1st window. **Generator.**

The main windows where it's possible to choose how to manage the generative engine. It's also possible to define how many times and following which rule it's possible to applicate “fractal” systems to the generative engine, that is how many times and how it's possible to repeat the transforming cycle.

2nd window Part A. **The Design of Paradigm.**

Identifying each event with 1. Orientation, 2. The role, 3. Topological rules, symmetries and interferences with other events. That is designing something like **stem cells** that can evolve, following a character, to adult events inside the project.

Orientation: When, following the obvious structure of architectural events, and its strong belonging to gravity, the previous *Basilica* software had only one main “orientation”, from bottom to top, *Argenia* uses all six cartesian basic orientations. These orientations are applied to each event defined in the paradigm in the way to create species of objects not limited to architecture. More, orientations are not limited to orthogonality because of interactions with other rules.

Role. When we design an object, each design act, each development of our project belongs to one of a series of transforming actions like: “how this event will end?”, “how it will folds?”, “How can be divided?”, and so on. In *Argenia*, a set of different roles is identified to be used in the paradigm. I.e, when we define a roof we use a “top” orientation and a “how ends” role for the event. Following that, the generative engine will refer to these rules for transforming the event starting from one of the possible matrices and using its points and vectors of congruence. In this definition of role, there is not yet the code defining “how” the event “will end” but only the indication that this event needs to follow this request. How it will follow it depend on the used matrices and the transforming rules, It is only the “starting point”.

Topological Rules, Symmetries, and Interferences. For each event that we define inside the paradigm, it's possible to identify the type of relationship with other events, belonging the topological structure of our project.

2nd window Part B. **The Design of Transforming Rules.**

With the possibility to blend in parallel different rules and the possibility to define where applicable.

This panel manages the own interpretation of the event and the use of moving on and coming back from multiple dimensions. Different transforming rule can be blended and different parameters can be changed. The possibility to choose how to apply each rule helps to control the feasibility of 3D outputs.

2nd window Part C. **Outputs.**

The possibility to save paradigms, species and transforming rules

3rd window. **Cellular Automata 3D** for managing the evolutions of paradigm.
It's possible to define rules for evolving the topological structure of paradigm.

4th window. **Matrix Design**.

Designing, for each possible event, the structure of “starting points” of subsequent transformations identifying the congruent points and vectors to assure the adaptability of the event during transformations. This design activity defines the “characters” of the incoming scenarios.

5th window. **Matrices Activation**.

Identifies the matrices available on the specific project and it's possible to insert and use matrices coming from other projects or other designers following the possibility to activate something like a Design Team and a strong “cultural reference”.

6th window. **A viewer** with the management of further transforming rules to be applied in real time to the generated scenarios.

In this way it's possible:

1. Define and manage the basic topological structure able to be adaptive to multiple possible transformations.
2. Design paradigms for generating a “species”. That is like an artificial DNA.
3. Design the basic characters of each event identified in the paradigm, like Stem Cells. In this way, the paradigm controls the incoming transformations only by identifying the role of the event inside the whole structure, not its form that will be defined later by the transforming rules.
4. Manage the increasing complexity of paradigms using different transforming engines, like Cellular Automata. (users can manage the CA rules and number of repetitions)
5. Design own Transforming Matrices.
6. Manage the active transforming matrices. (users can import matrices from other “subjectivities” and blend them with own matrices)
7. Construct Transforming Rules able to manage each matrix and the whole. (users can define and blend together different transforming rules)
8. Apply the transforming rules separately and/or after the generation of objects for verifying their potentialities.

Output facilities of Argenia are:

1. saving generative projects
2. saving dxf (surfaces), pov, VRML and STL (solid for rapid prototyping) files
3. saving paradigms, transforming matrices and transforming rules.
4. saving images
5. importing paradigms and transforming matrices from other users.

The aim is focused, the structure is in progressive increasing complexity, the results are already coming.

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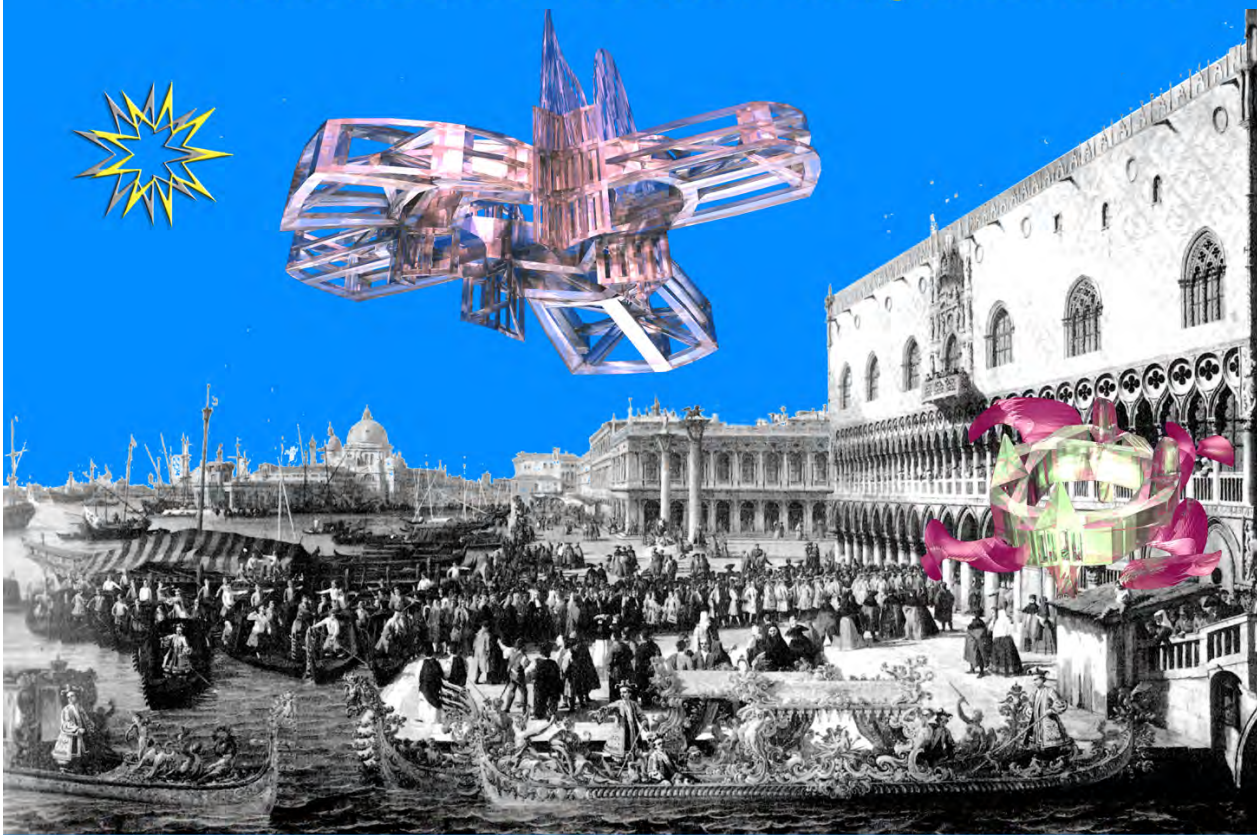
Generative projects made in 2010:

Homage to Canaletto and generated UFO in Venice. The project was made for the generative covers of GA2010

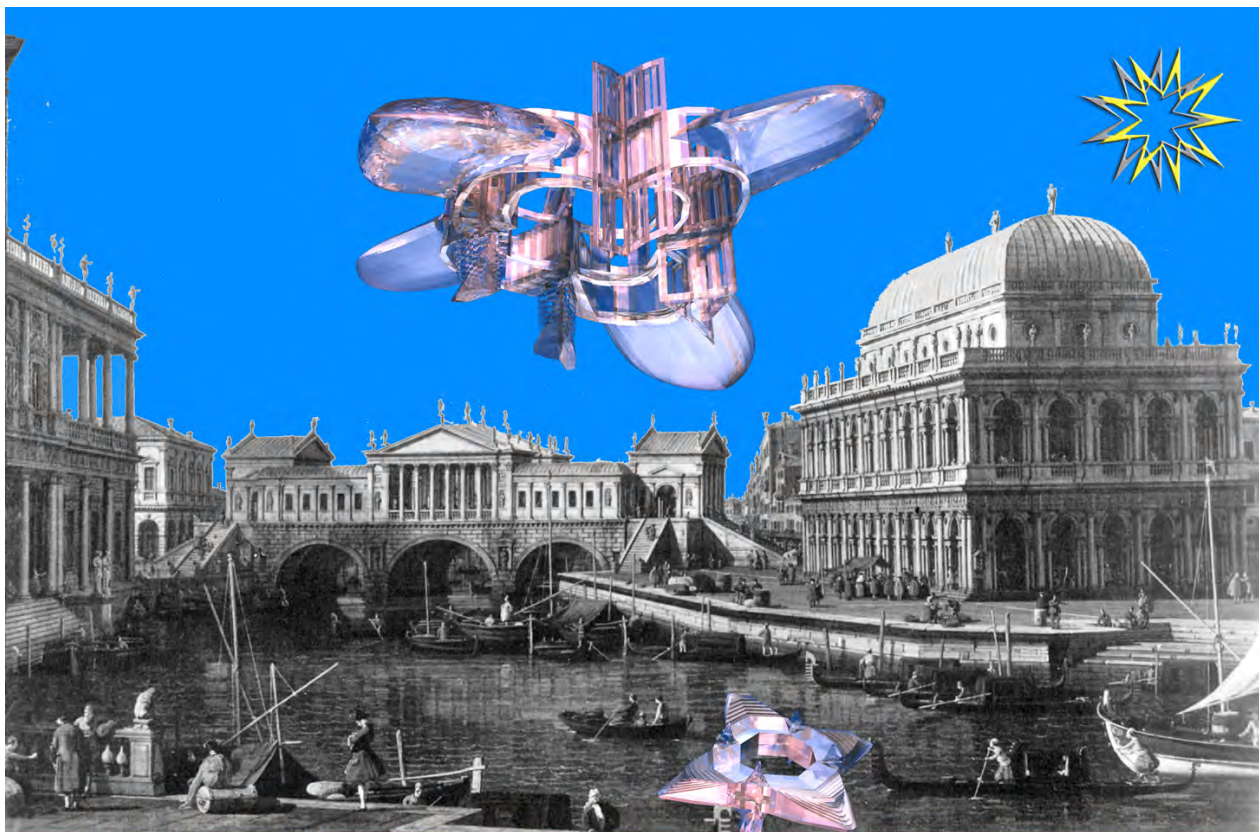




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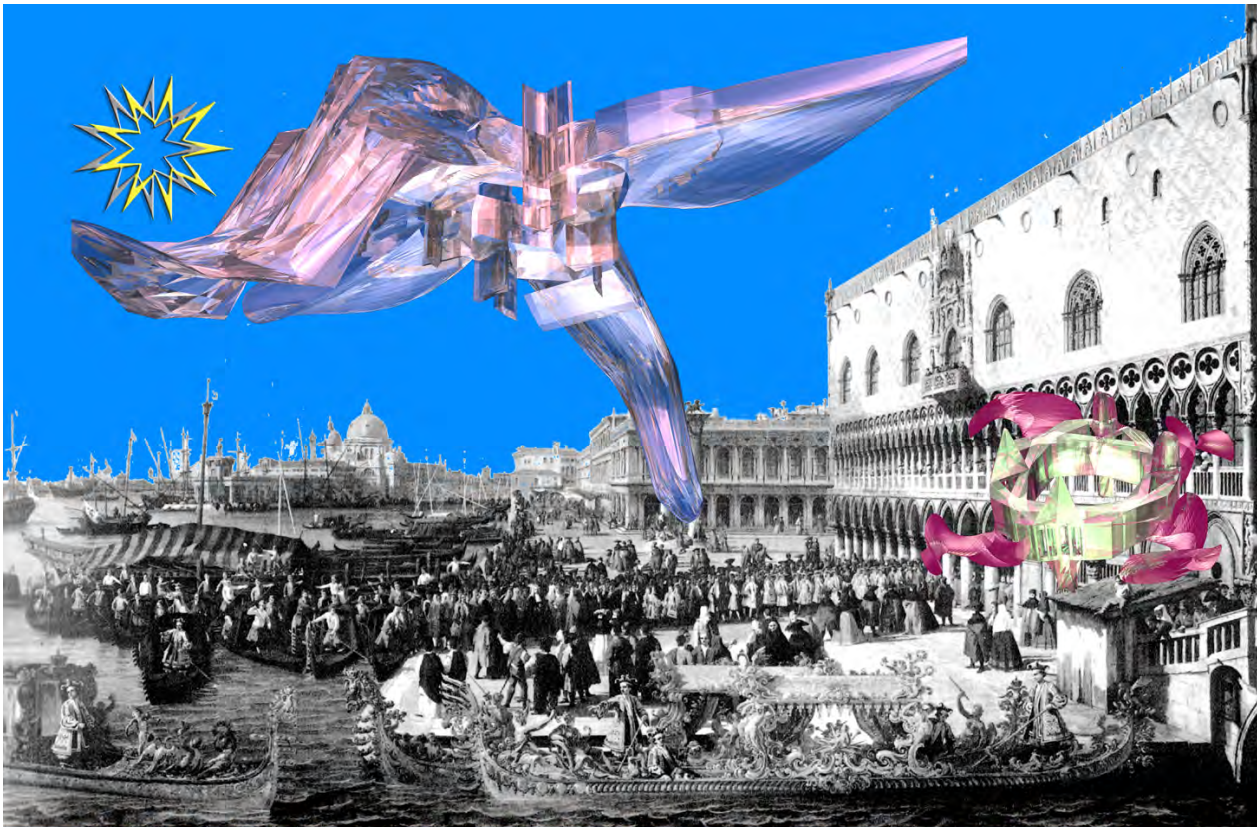
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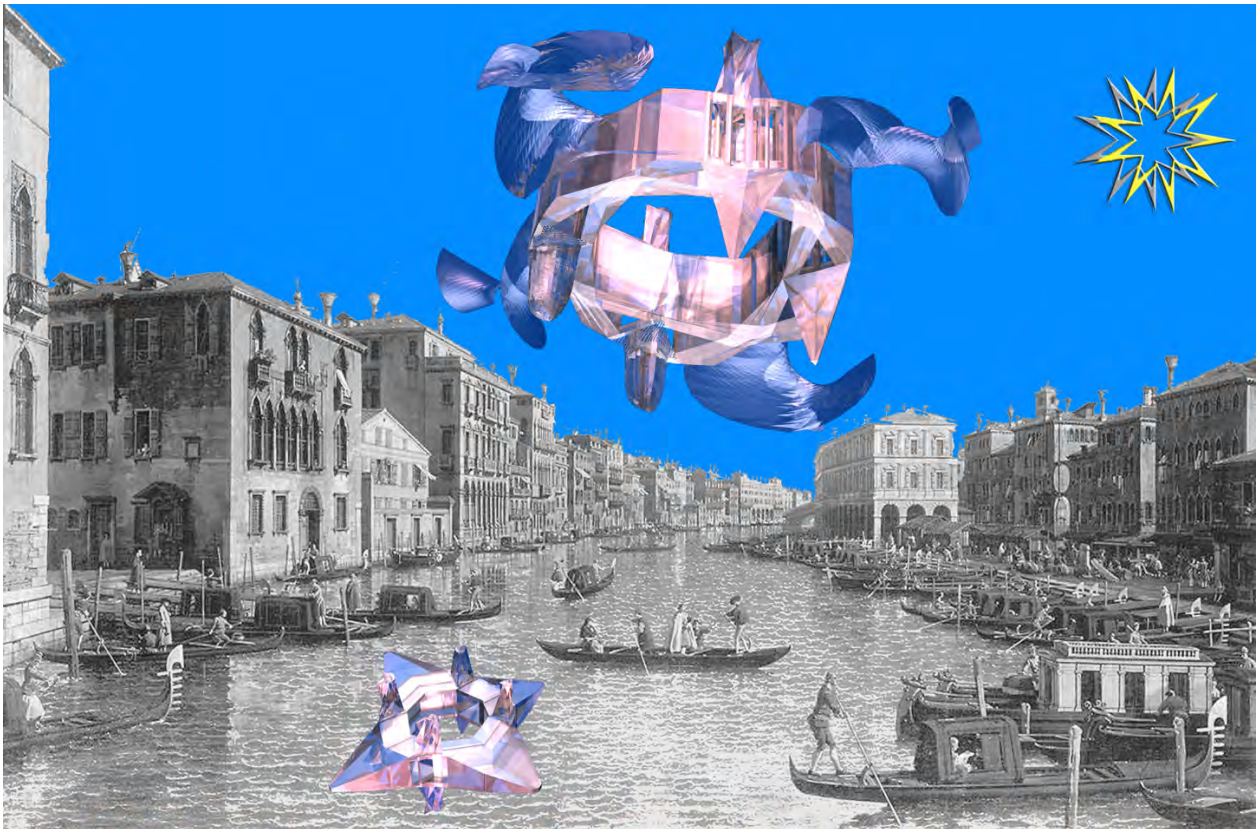
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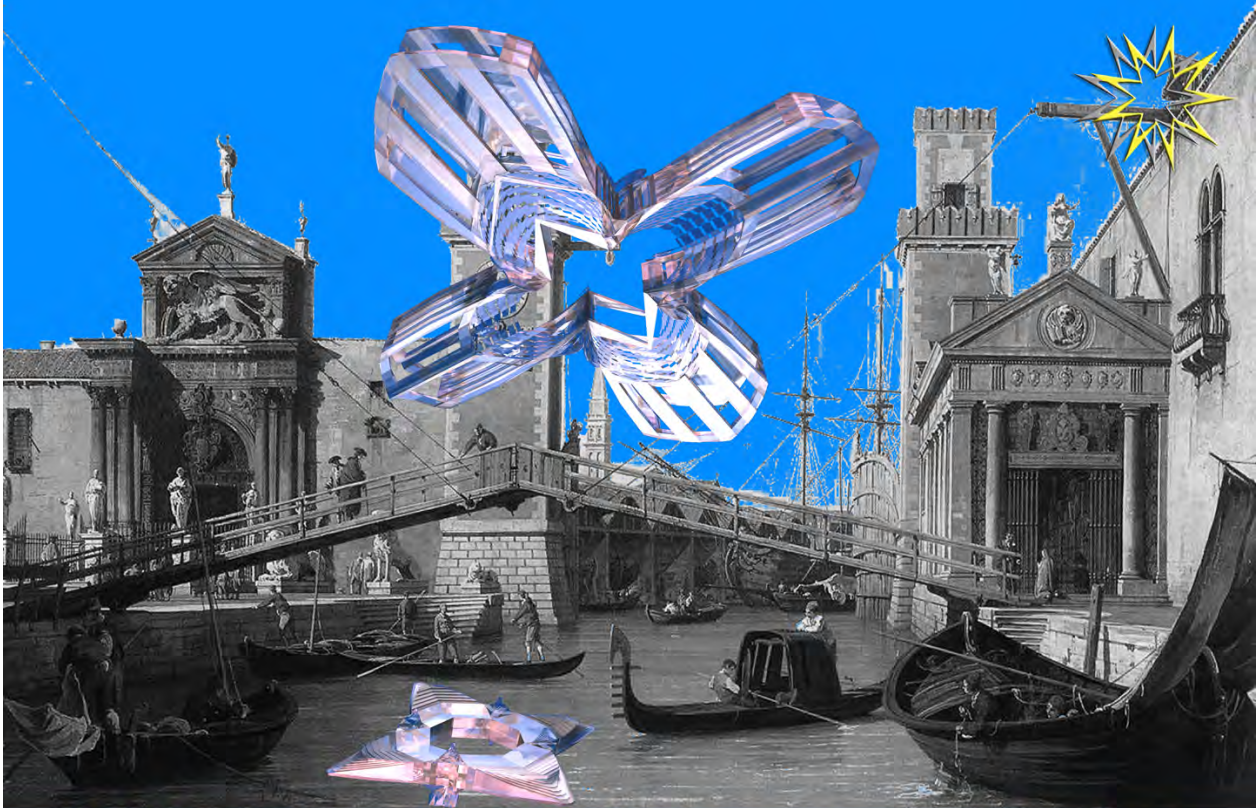
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Generative Baroque Algorithms

GA2011



Figure 1: Generated baroque architecture inside an engraving of Piranesi. C.Soddu, 2011

Premise. Why Francesco Borromini and Baroc.

We are in Rome and I would like to point out my references to the Baroc of Borromini and the essential contribution that I have found in the work of this Master when I developed my generative approach to the architecture.

I didn't love the Baroc for its decorative structure, of for the redundancy of forms and I have never considered it as synonymous with decadence or synonymous with "female culture", definition that was established by some philosophers to expressly identify a culture of the void, of the nothing, almost a not-project in which to lose themselves following empty metaphors without end. Such interpretation of the Baroc and of its architects is, for me, completely out of my experience. I started to appreciate the Baroc contemporarily to my passion for the geometry and mathematics and for the possibility to use them in the creative innovation. And I am interested, above all, of the architectures of Francesco Borromini, not only for his ability to read and use the classical geometric systems as dynamic structures in transformation, but, particularly, for his ability of invention, of going over the remixing, by tracing architectures that knew how to conjugate the unpredictability of the true innovation with the power of being surprisingly harmonic, as the architectures out of the time are.

I learned from this Master how it's possible to operate through logics of geometric transformation, moving from the orthogonality to concave-convex systems, from square to equilateral triangle, as Borromini developed in Sant'Ivo alla Sapienza, not losing the harmonic structure consolidated by the tradition but performing unthinkable creative processes. The progressive transforming rules can perform not only the geometrical basic matrices but also each single events through progressions of orders that could be, as in Borromini, not only unpredictable harmonic but surprisingly carrying of a pleasure of possible variations.

In this field, the Baroque architectures of Francesco Borromini identify a creative logical thought which fulcrum is the increases of geometrical complexity by finding out fields of possible progressions developed without preclusions, neither the constraints of consolidated classical paradigms. If we reduce this approach only to metaphors, as some philosophers have done, we deny the deep sense of the pleasure of complex systems harmony, able to imitate the Nature through a deeply artificial approach.

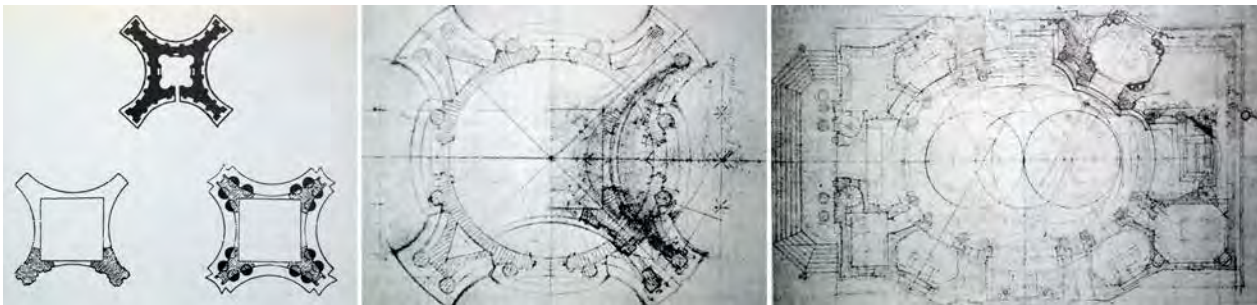


Figure 2: ancient grave, two geometries of F.Borromini, S.Andrea delle fratte and S.Carlino, from H.Sadlmayr, 2-3, original drawings of F.Borromini for S.Andrea delle Fratte and S.Carlino.

The variations are fundamental for the Baroque approach, as they are for the Generative approach. The architectural variations of Borromini, as the variations in the Baroque music, succeed in increasing the appreciation of the subtended logics, of the identity and recognizability of the creative thought, of the pleasure of living the architecture, its creation, and its fruition. As, centuries later, it's possible to find in Gaudi, other my great reference for establishing my Generative vision.

It's not easy to read the geometries subtended in these architectures. After all, Francesco Borromini has carefully avoided communicating the geometrical generative structures, particularly when, as in San Carlino, he introduces a complexity not easily readable through simple forms. This approach, typical of great masters in all cultural fields amplifies the need to operate through logical interpretations that must be a subjective interpretation, by rendering explicit, and at the same time stimulating, the vision of each people that look at these architectures. It's not casual that a lot of books and innumerable articles are full of different interpretations of the works of Borromini.

Abstract

A constant of my generative operative research was to "abduct" by the Baroc a series of transformation logics that characterize my generative architectures. More specifically

identifying and writing as algorithms my geometrical interpretations of the dynamics of the architectures of Francesco Borromini. The approach was to try to discover a possible interpretation from the complexity of Borromini architectures and not to analyze and copy them. Recently I have developed more in detail these potentialities by focusing these logical interpretations from Borromini dynamics that, for the first time, I try to render explicit in this paper telling how I designed "baroque" algorithms, a work that, as I already said, started from 1986.

Conceptually it was not difficult for me since my interpretation is based on the possibility to read not only the existing forms but how these forms could spring from progressive transformations of pre-existing events. This is organized by the morphogenetic process when it runs and performs the complexity. Following my approach, the Borromini architectures are like progressive tales of a creative thought able to generate complex and unique events based on progressive increases of three-dimensional geometric and topologic logics. And sometimes the third dimension, operating logical translations from the traditional bidimensional formal orders, unexpectedly finds again unthinkable and amazing fields of development. These are like progressive stories where each person could be able to find again a really unexpected, subjective and suggestive path of discovery and to follow his own increasing ability to appreciate the beauty, and to find out how to generate it. In other words, interpreting the Baroque structures as algorithms are surprisingly immediate. And it is what I have done in the last thirty years; increasing my generative approach starting from my vision of dynamic baroque architecture.

In this paper, I use as an example some logical-operational interpretations of mine, many times very "out of rules", like, after all, Borromini was; and I identify the logical-geometric structure of these algorithms and the use of them inside the progressive project Argenia, my generative software for artificial events.

Basic Structure of architectural events. The paradigm "27" and the paradigm "21".

The reference to Borromini, in my project Argenia, is constant. Both in the paradigmatic basic structure and in the progressive logics of transformation.

Borromini affirmed that the number 27 is at the base of his primary constructive structure of the architecture. This affirmation was not well specified. It mentions it in his only written work, the "opus architectonicum", by the way, written by another person over his suggestions.

My approach is using the number 27 as the definition of space (1) surrounded by 26 interfaces that organize the relationships with the other surrounded spaces. If we verify this structure in the schematic constructive order of an architectural simple space like a parallelepiped, around space we will have a floor, four bases of columns, four beam-connections among the bases, four columns, four walls, four capitals, four beams, a coverage. In all 26 interface events + the inside space = 27.

I have directly used this systematic structure in my generative software of architecture. And I discovered that it is a geometrical extremely open and transformable system. Not only, it is able to guarantee the feasibility of the generated architectures and also their harmonic structure: once the relationships among these 27 elements are progressively defined, they mirror a geometric logical approach. Results are recognizable as built following our cultural

traditions and the specific progressive vision of our poetic. In fact, once that we apply progressive three-dimensional transformations to a so conformed system, by foldings it for fitting topological needs and by applying other geometrical transformation mirroring our architectural vision, our cultural tradition, as the Baroc is, we succeed in generatively easily managing the complexity of the architectural systems and the relationships among its events.

This adaptivity and ability to keep alive harmony happens also when we apply transforming rules able to capsize the topological system. A geometry, that we could identify as “not Euclidean” geometry, can be found by using algorithms able to transform the parallel straight lines by bending them in a way to converge them in two points. Other possible logics can be reached designing algorithms able to transform the orthogonality into hexagonal systems, into concave-convex systems, or in three-dimensional hyperbolic geometrical systems, or other. And into all multiple possible systems based on their mutual contaminations and convergences.

As examples: Euclidean – Not-Euclidean geometrical system, from rectangle to ellipse, the “flower” transformation, Orthogonal into Hexagonal System (Sant'Ivo), from orthogonal to convex systems. (S.Andrea delle Fratte, Sant'Ivo), from Rectangle to rounded Cross (Can Carlino), from Rectangle/Triangle to concave-convex sequence (Sant'Ivo).

The difference between working on forms and working on transformations is simply identified: we can hardly stratify forms but the transformations are easily usable one after/over the other. The forms are data ($A=B$), also if “parametrical” data $A=\text{function}(B)$, the transformations are algorithms that transform what was before in what will be $A=A+1$

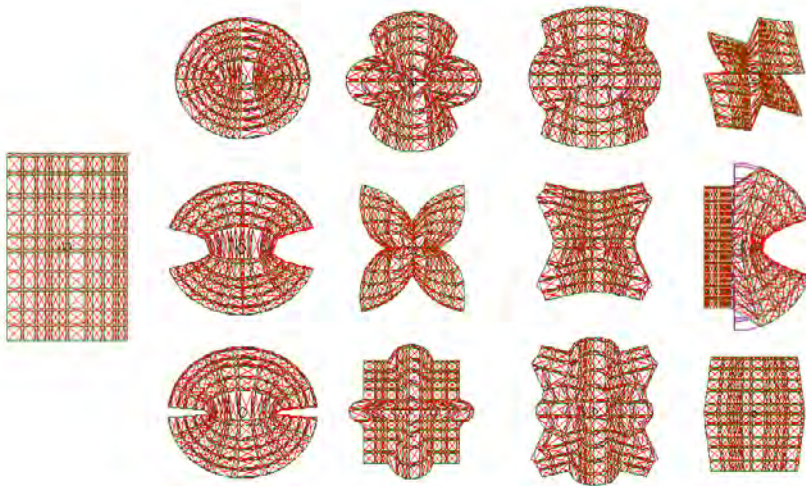


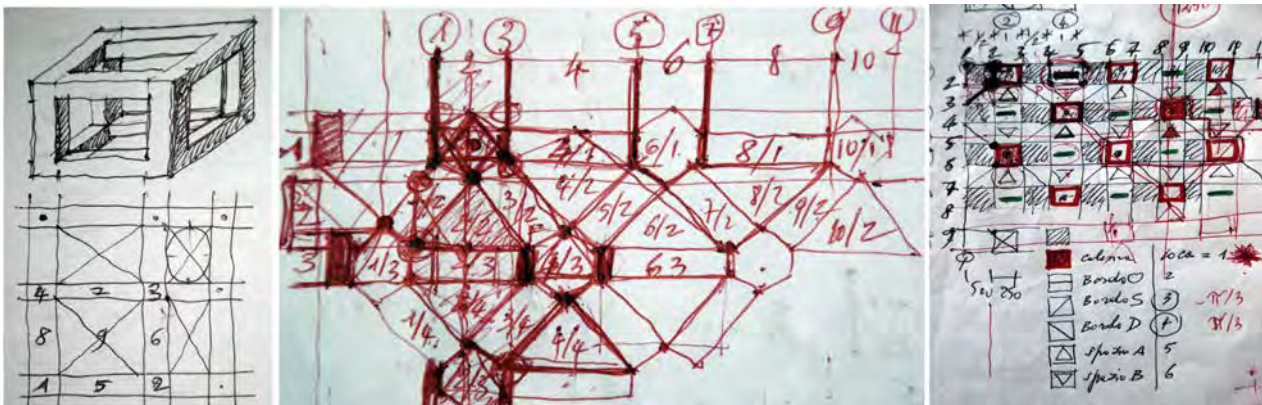
Figure 3: Starting from the orthogonal system, possible transforming algorithms to fit Baroque geometrical systems. The used paradigm is “27”.

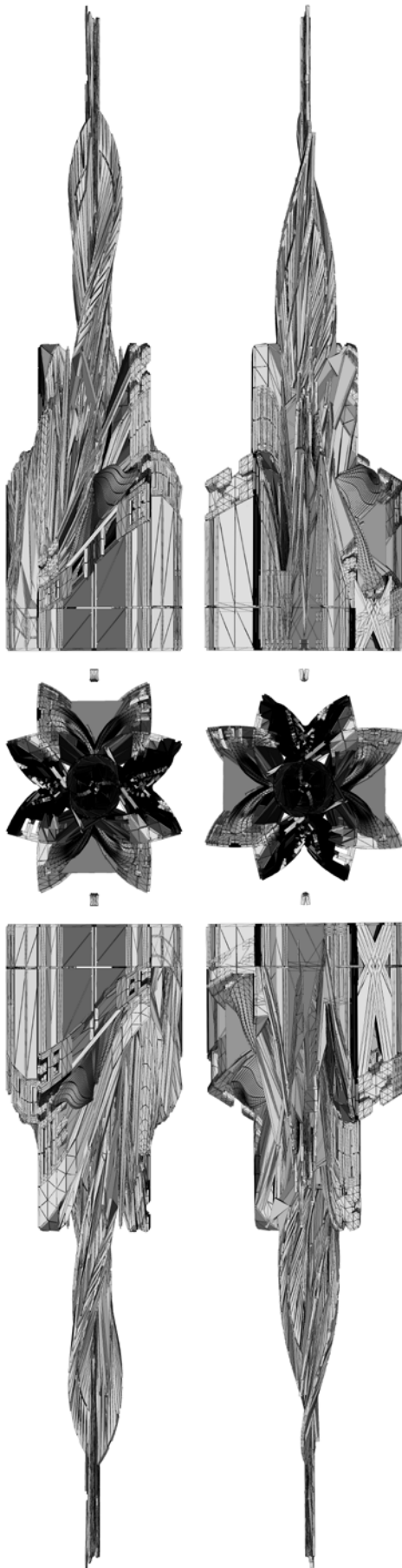
Reflecting on the quality inherent in the geometrical idea of Sant'Ivo, I have tried to move from the orthogonal structure to a triangular-hexagonal one, with the aim to enter into a system able to manage the generative progressive path to which this work of Borromini alludes. I have built therefore a geometrical system not based on 27 but on 21, that is an

interior space based on the equilateral triangle surrounded by 20 interfaces. Running again the constructive schematic example used before, but with a based triangular prism, a floor, three columns, three beam-connections, three walls, three capitals, three beams, a dome. The number of all these interfaces are $20 + \text{the inside space} = 21$.

I have realized that this paradigmatic system, also if similar to the one based on 27, don't has the same feasibility in being subsequently transformed since it is hardly able to maintain identity and harmony through transforming paths. Maybe that this is the reason why Sant'Ivo alla Sapienza is unique: it appears as a perfect architecture but hardly repeatable with variations.

However, the based paradigmatic matrix on 21 is able to produce variations if directly used inside its geometric logical specification. In other words, the initial order doesn't easily admit to being forgotten, as instead it happens for the based paradigm on 27 that is extremely adaptive and able to forget its own basic apparent order to strongly reach unpredictable and innovative orders.





In other words, we can apply transforming rules if these logics are based on polar coordinates and not on cartesian coordinates. And the center of these coordinates must be located in the center of the main triangle and cannot be easily moved.

How to contaminate the orthogonal matrix and the hexagonal one in managing the generative processes? A purely geometric contamination was obviously impossible. I tried to follow a different approach. The main idea was to use a geometrical system based on orthogonality, and, when the system needs an hexagonal plot, making "empty" 6 events of a the system 27 so that to reduce the operational events to 21, and defining some specifications of transformation and mutual correlation, in other terms defining the preliminary behavior that every event that "remains" must activate before being object of the following transformations.

The result is interesting, also because it is possible to make experiment already based on transformations around three Cartesian coordinates, and therefore based on the orthogonality, on the hexagonal system, not limiting it to the transformations based on the polar coordinates that, instead, directly appear operational in the hexagonal system.

The 3D models generated are amazing and imitates the innovation paths without prejudices that, for me, are proper of the work of the Borromini.

Figure 5: baroque architecture generated using transforming rules from orthogonality to curved spaces. C.Soddu 2011

Progressive logics of transformation

The most Baroque of these logics of geometric transformation is, obviously, the algorithm able to turn a rectangle into an ellipse. Instead of progressively bending the sides until everything becomes "continuous" as a circle-ellipse, logic that I have used sometimes and that has, as possible result, the possibility to move

from convex system to rectangle, to ellipse, and to flower, I have preferred to imitate a possible path of transformation from the Euclidean geometry into Not-Euclidean geometry. In practice, in a rectangle, my algorithm operate in a way that the two opposite parallel sides meet themselves in two points, as it happens in the Not-Euclidean Geometry. The transformation acts progressively moving the vertexes of two parallels sides with the aim to bring them to coincide two to two: while the sides among the two vertexes that are going to coincide fold up itself toward the inside, the other two sides bend toward the outside, in a logic of concave-convex. (*Fig. 3, first column*)

Potentially the two vertexes have the tendency to form one of the foci of an ellipse through the point of progressive folding of the side, and they identify it if the side is completely folded up in two, abandoning its convexity. But it is not necessary to arrive till this final order, also, because when it happens, the generated Not-Euclidean system apparently comes back to Euclidean. The best "baroque" character appears during this process. Enlarging the transformation rule to the 3rd dimension is completely inside the Baroque character, as the images (*Fig. 8 and others*) can explain,

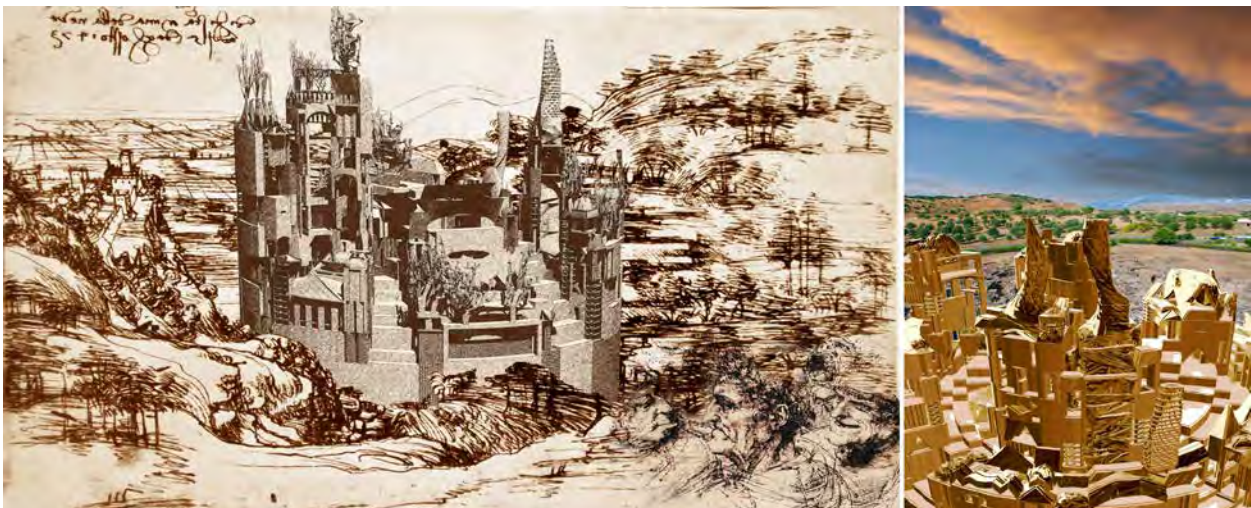


Figure 6: The bending process from Euclidean to Not-Euclidean system. A generated city with the Non-Euclidean system performing the bidimensional plan inserted in a drawing of Leonardo da Vinci for Tuscany environment. In the other image a generated city in Sardinia. (C.Soddu 2009)

The interesting aspect of bending in this way the rectangle-parallelepiped is that the system of the three-dimensional points insides the transforming space maintain their congruity and correlation also if they tend to perform a specific unpredictable complex "baroque" space. Congruity that also remains not only when transforming a single event but also when a connected net of events is globally transformed. Until a "city" system (*Fig. 6*). A concave-convex structure that, in a new curvilinear structure, surprisingly is able to maintain unchanged the initial topological connotations. More, these transformations are able to increase the topological relationships by structuring new relationships (the contiguity of two vertexes that were before distant) not as a change but as an increase of complexity.

All these logics of transformation remain, however, very "axiomatic" if they are not used in series and if they are not contaminated one each other. The more satisfactory results, mainly

from the point of view of the possibility to generate "baroque" architectures, is reached through the progressive use of different logics, and the application of these algorithms to the whole structure and to single parts.

The experimentations that I did by contaminating different algorithms of transformation are very complex and diversified. I try to show some meaningful examples always drawn by my interpretations of Borromini.

The algorithms interpreting the Baroque geometric dynamics are transformations applicable to the pre-existing form (even if already transformed) and they are finalized to an increase of complexity and to a further stratification of identity and recognizability of the idea. They are dynamic tools for performing the vision. As we use tools for drawing, and we choose each tool following our singular vision, in the same way, we use algorithms as possible tools for performing our subjective vision.

For instance, the concave-convex algorithms, that are my interpretations of Borrominian architecture, are my tools for generating my architectures. In my experimentations, this Borrominian character is reached using, at least, two different tools, two or more different algorithms able to perform, step by step, my baroque idea of architecture. (*Fig. 3, 2nd and 3rd column*)

Transform the sides of a square, or as in Sant'Ivo of an equilateral triangle, setting to the center a bending (a niche) and in the vertexes a convexity is not transferable in algorithms if not through a specific interpretation of the dynamics of these subsequent transformations.

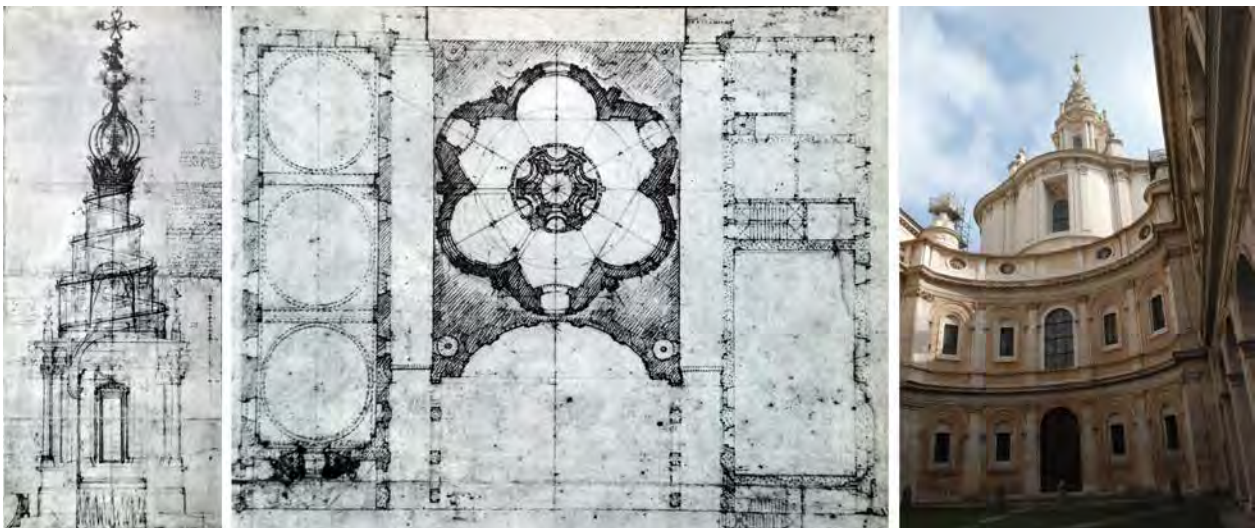


Figure 7: Sant'Ivo alla Sapienza by F. Borromini. Original Drawings and photo.

One of my interpretations was based on exploding each internal virtual point from the center, according to a logic curve (the niches of Borromini in Sant'Ivo are not semi-circles). The whole three-dimensional space, not only event belonging to the sides, are pushed to the exterior when they are inside the angle focused on the middle part of each side. This because the aim was not to form a niche in a wall but to operate the spatial transformation of the whole space. In the same moment, I performed the algorithm for lifting, with the same logic, the same points by harmonically increasing the Zs in a relationship with the

transformations in the other dimensions. The result is surprisingly very Baroque (Fig. 8 for the “27” paradigm and Fig. 9 for the “21” paradigm). The harmonic transformation of the heights with a tied up progressive logic to the concave-convex one is inside the Baroque identity and recognizability.

Another algorithm of transformation, applicable and able to contaminate the first one, realizes the convexity of the angles. And the parallel use of these two algorithms produces the concave-convex geometrical system that we are looking for.

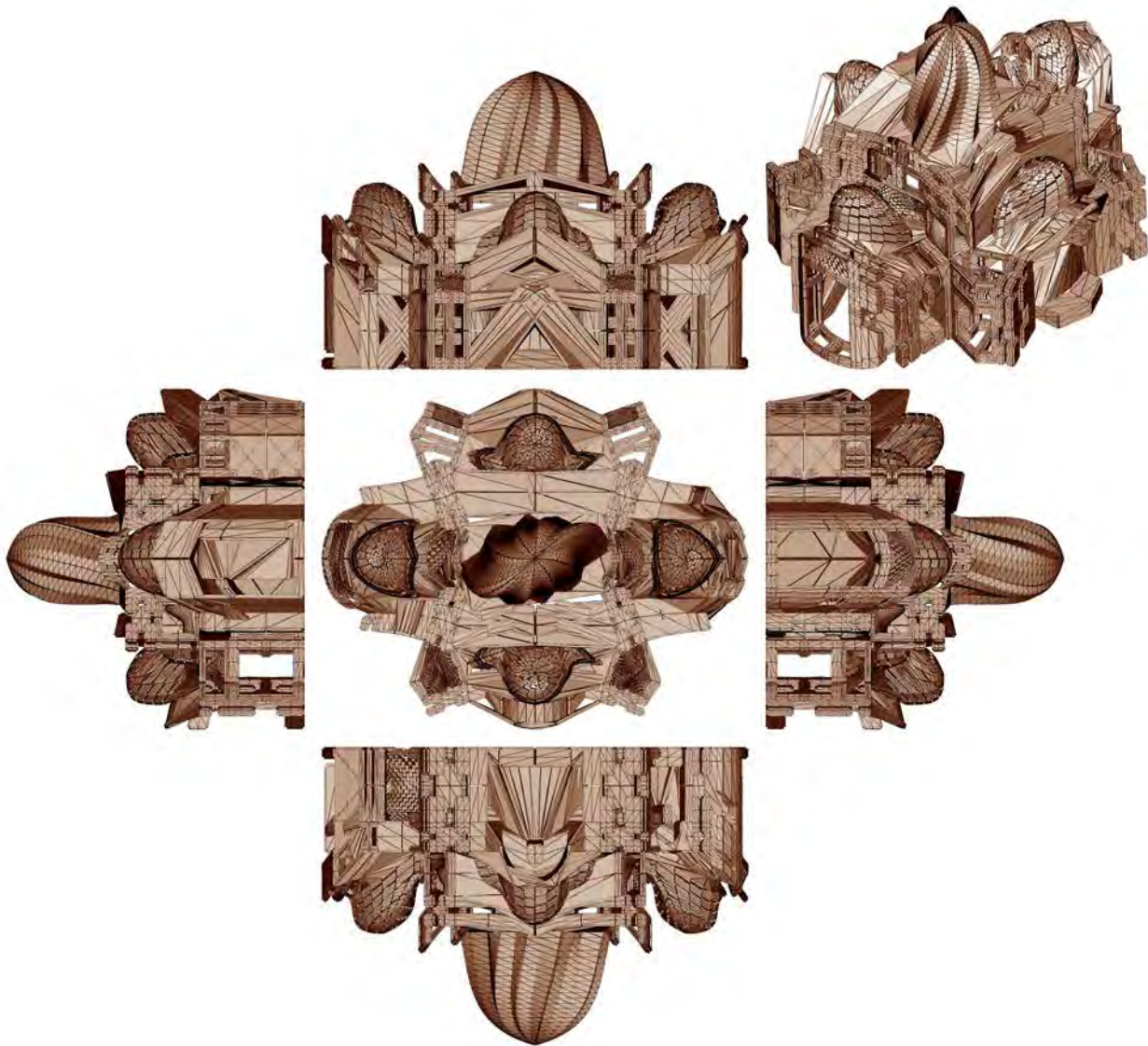


Figure 8: Generated architecture using different “baroque” algorithms with the paradigm 27. The contamination of two geometrical transforming logics: the Baroque niches and the orthogonal-convex system. In the following images, the generation is made using the 21 paradigm with the same transforming logics. (C.Soddu 2011)

Progressive logics of transformation of the local events

First of all, it is necessary to clarify that, inside each event, the structure of the relationships

with the surrounding events (but not only) are primarily managed, at topological level, by the position of the event in the system 27 or 21.

Every single event has inside the possibility to refer to a series of spatial points, around 2500 characterized 3D points), divided in A) parametric points, based on harmonic relationships and parametrically connected to the geometrical basic paradigm of the event, B) varying spatial points, based on progressive "topological" sliding of series of points.

Figure 9: Generated architecture using different "baroque" algorithms with the paradigm 21. The contamination of two geometrical transforming logics: the Baroque niches and the convex system. (C.Soddu 2011)

More, there are C) a series of just-generated points, generated in real time following polar coordinates and following NURBS surfaces in a way to fit the increasing complexity request by the complex system. In other terms, the starting event, before subsequent transformations, springs through the contemporary use of parametrical, dynamical and

realtime-generated coordinates. Each 3d event springs by varying dramatically its possible starting structure in relationship to the context in the moment of its birth, and such variations will not be casual but tightly in conformity with to the logic and subjective references of my architectural vision and peculiar aim of each project.

Then each starting-event will vary following the subsequent geometrical transformations and the codes of congruence that define the relationship with surrounding events with which it has to be connected by respecting specific rules identified and defined by the topological structure. If for instance, the event must be a “capital”, it will owe “to lean” on the column, a “wall” on a “beam”, and so on.

The generations and transformations of local events are managed by “matrixes” able to control the incoming transformations by using subjective interpretations of specific cultural references. In other terms, all events, starting from their first generative step, are not static structures but dynamic events able to answer to each incoming algorithms, each interpretative dynamic code belonging to own subjective cultural, historical, constructive, geometrical and material references and preferences. These matrixes are, therefore, the result of a further oriented reading of own cultural tradition through algorithms. In my generative work, I didn't designed algorithms using only the references proper of my cultural tradition, but also of those with which I came in contact. Starting from the late seventies, in my experience of designing algorithms for the generation of architectures, I have tried to identify the characters of different environments and cultural contexts and I have tried to build progressive logics able to represent their identity and, obviously, my interpretation of their uniqueness.

All the environments where I had the occasion to interact by designing these generative architectures, were interpreted by me by building original algorithms based on each different local cultural identity. Through solo exhibitions and lectures, I tried to verify with the local people if these interpretations of their cultural identity were legible and pertinent to their vision of the genius loci, of their Ideal City. And this was the way to increase the complexity and to fit the possibility to reach each unique environmental identity.

Nothing can be identified by a form. Designing with generative algorithms, every event belongs to a progressive tale springing from a creative approach to complexity. As, for me, the Baroc is.

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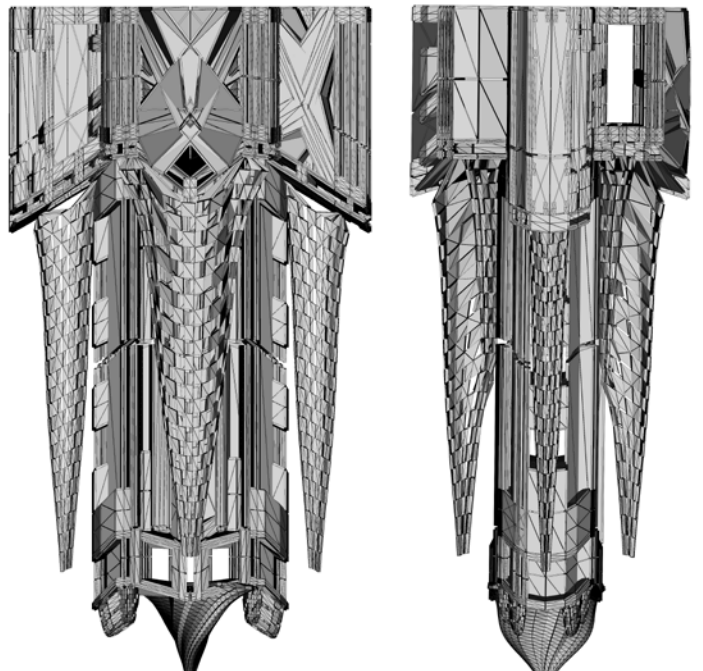
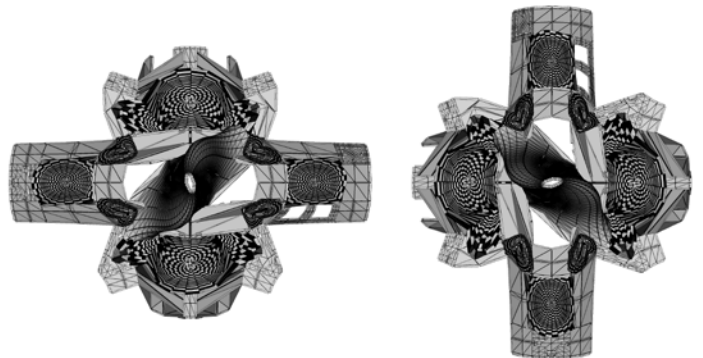
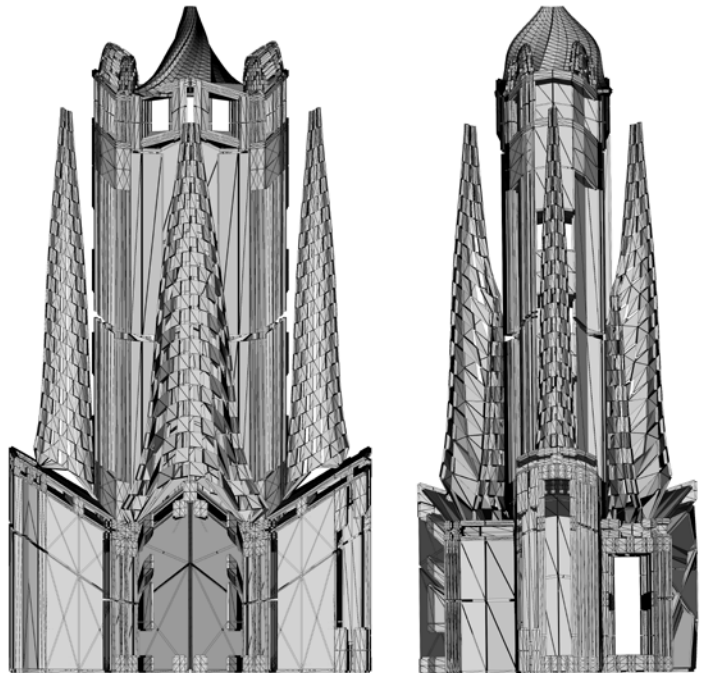
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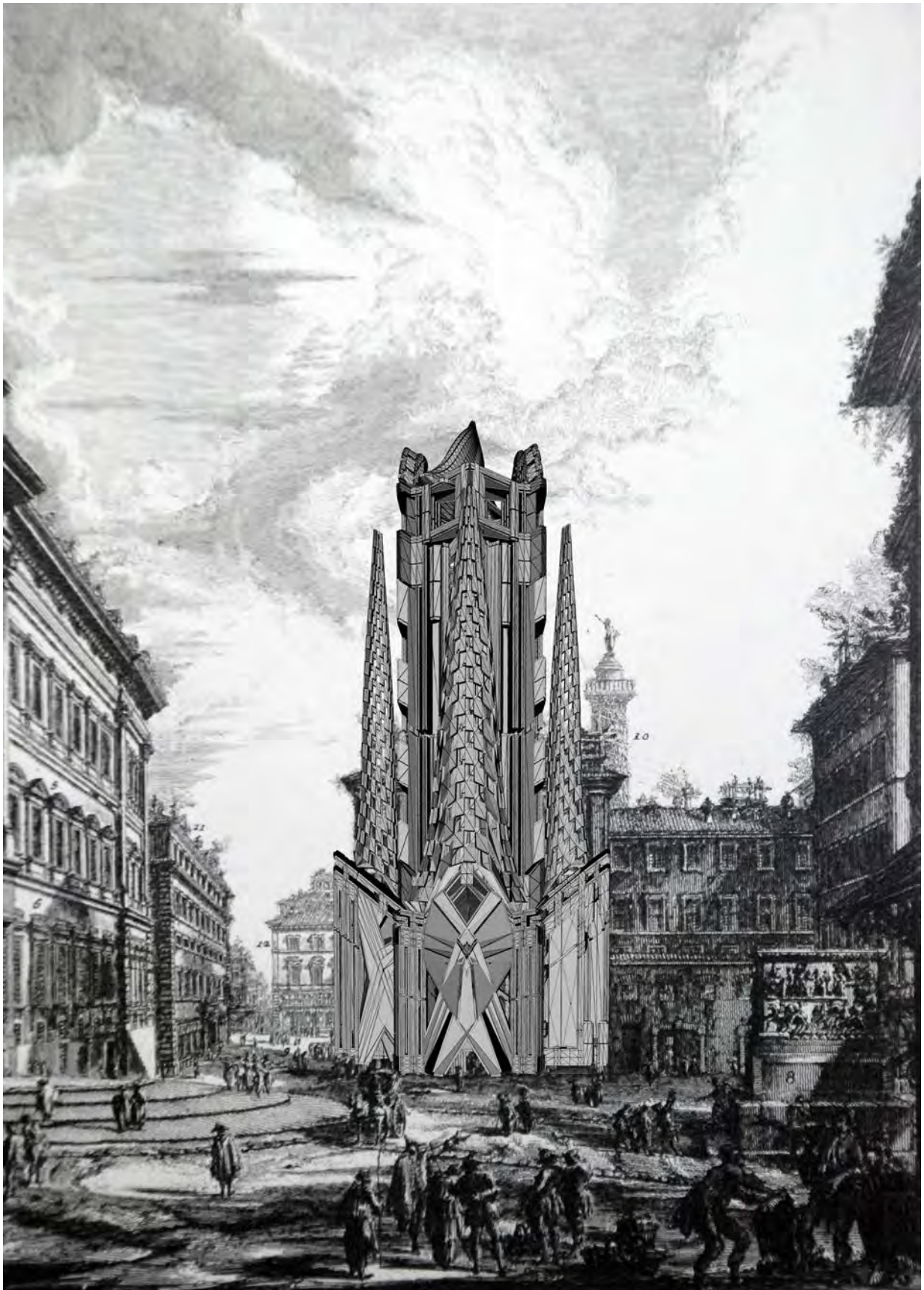


Figure 10: Generated Baroque Architecture inside an engrave of Piranesi representing Rome. In the previous figure plan and elevations. C.Soddu 2011

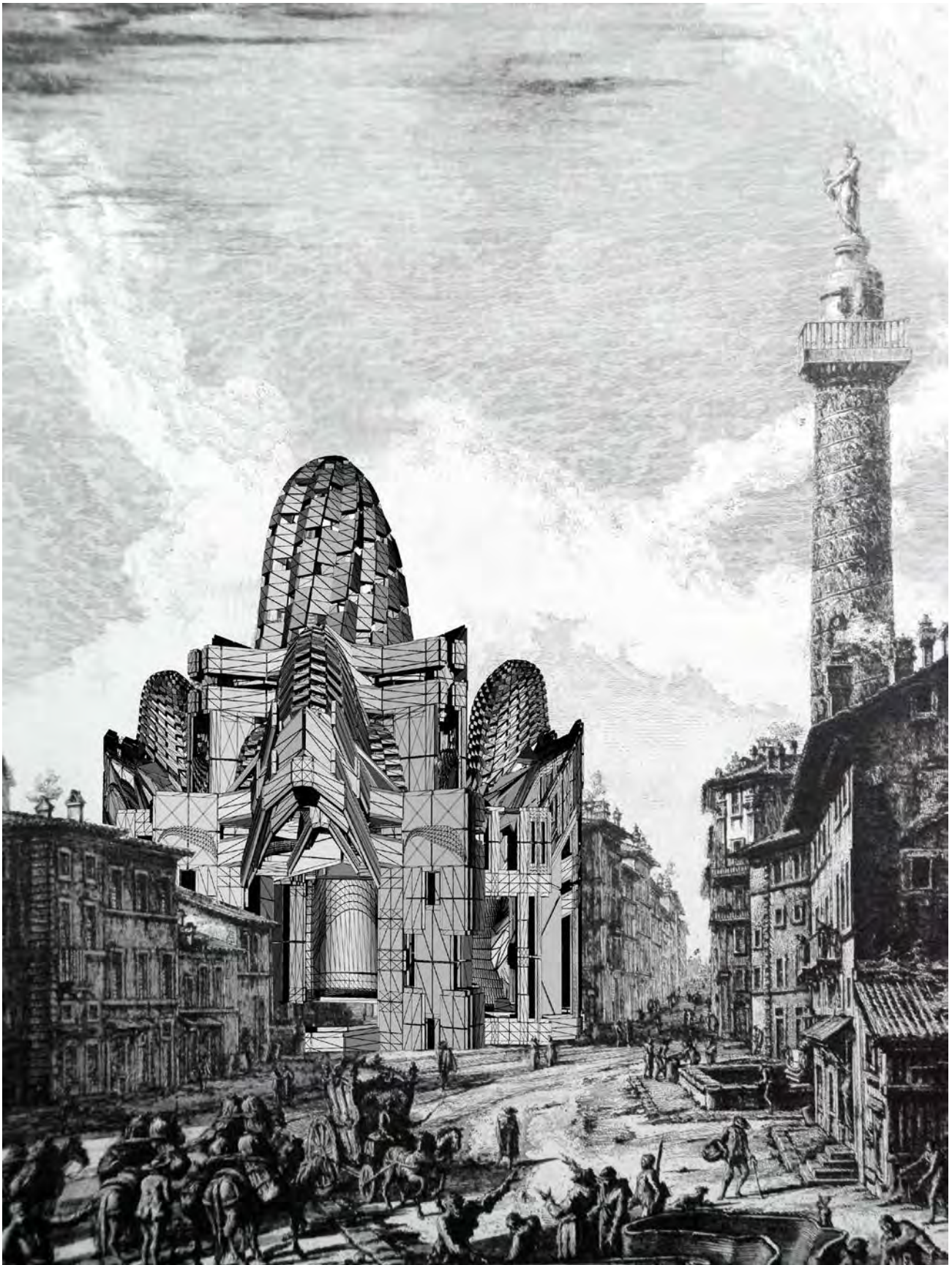
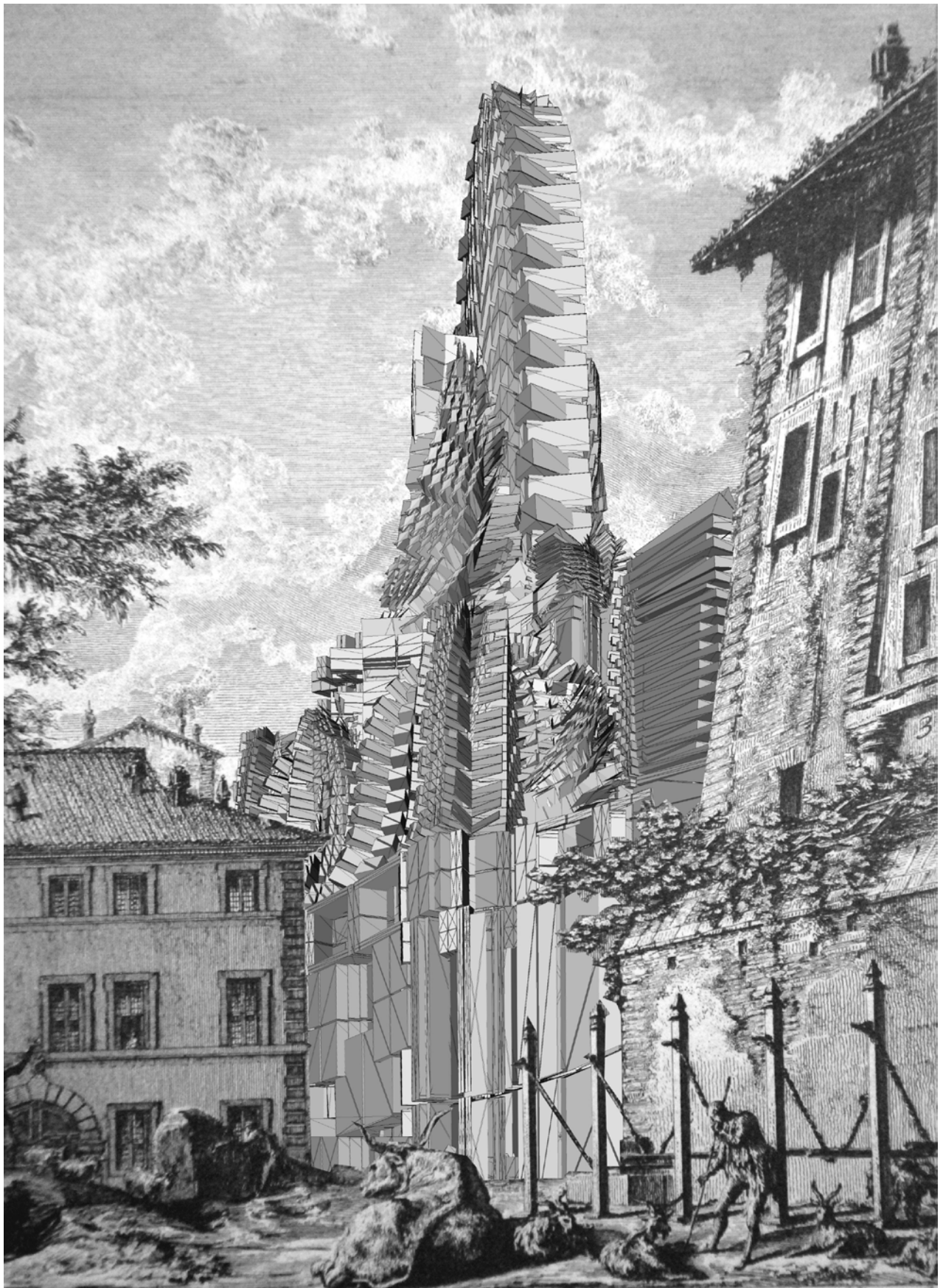
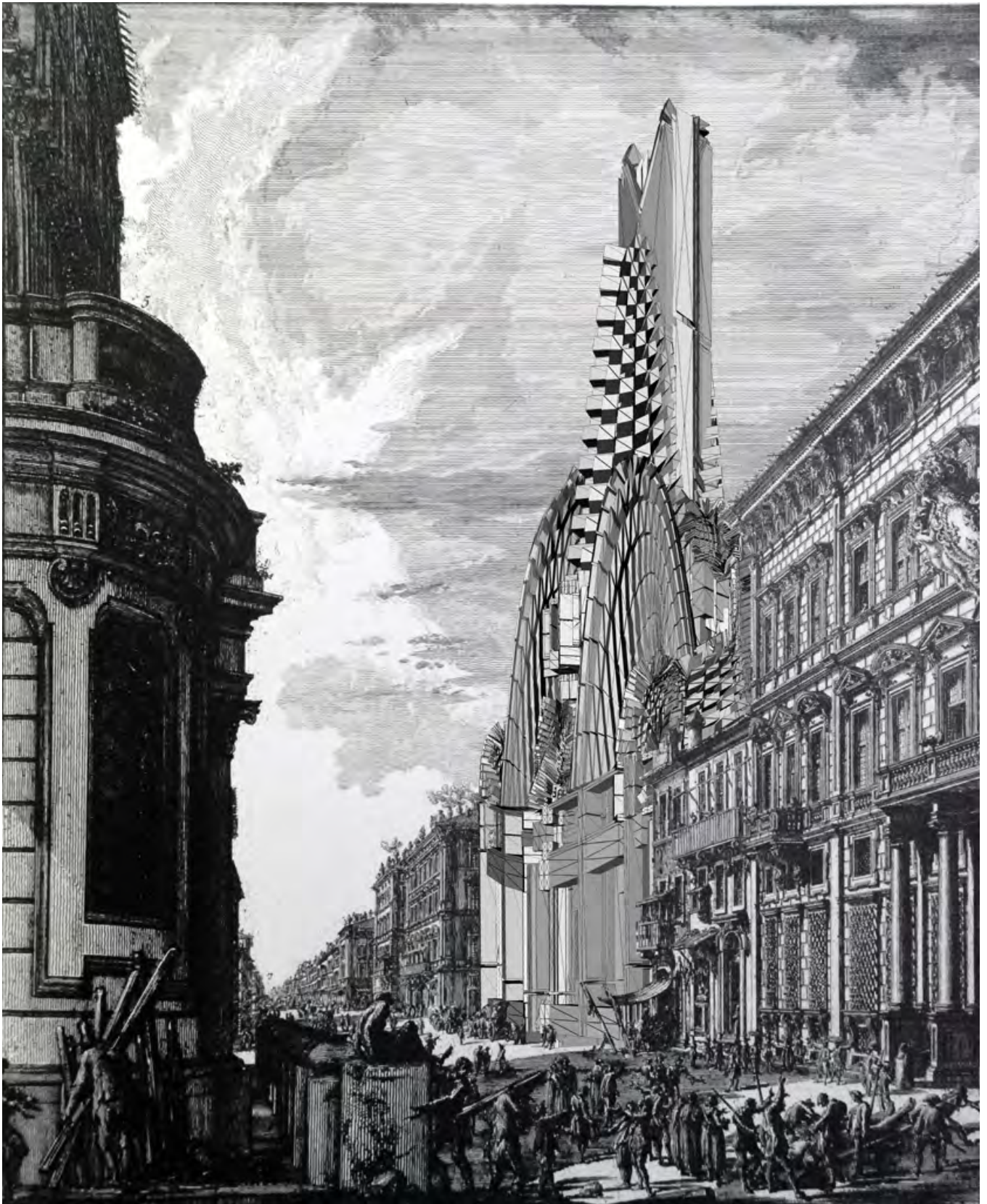


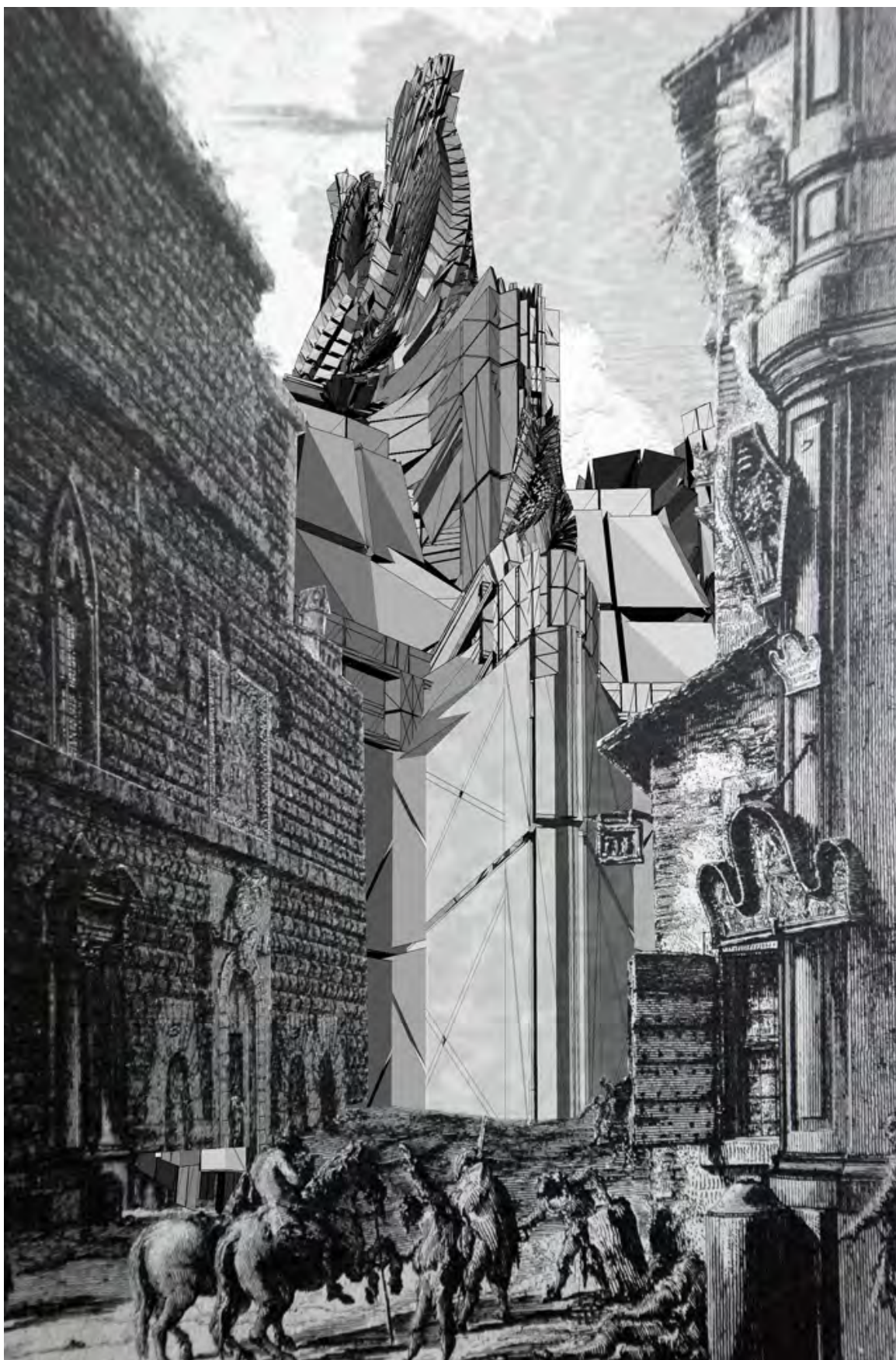
Figure 11: Two Roman Piranesi "locations" with generated baroque architectures. C.Soddu 2011













Generative projects for investigating the Jerusalem identity.







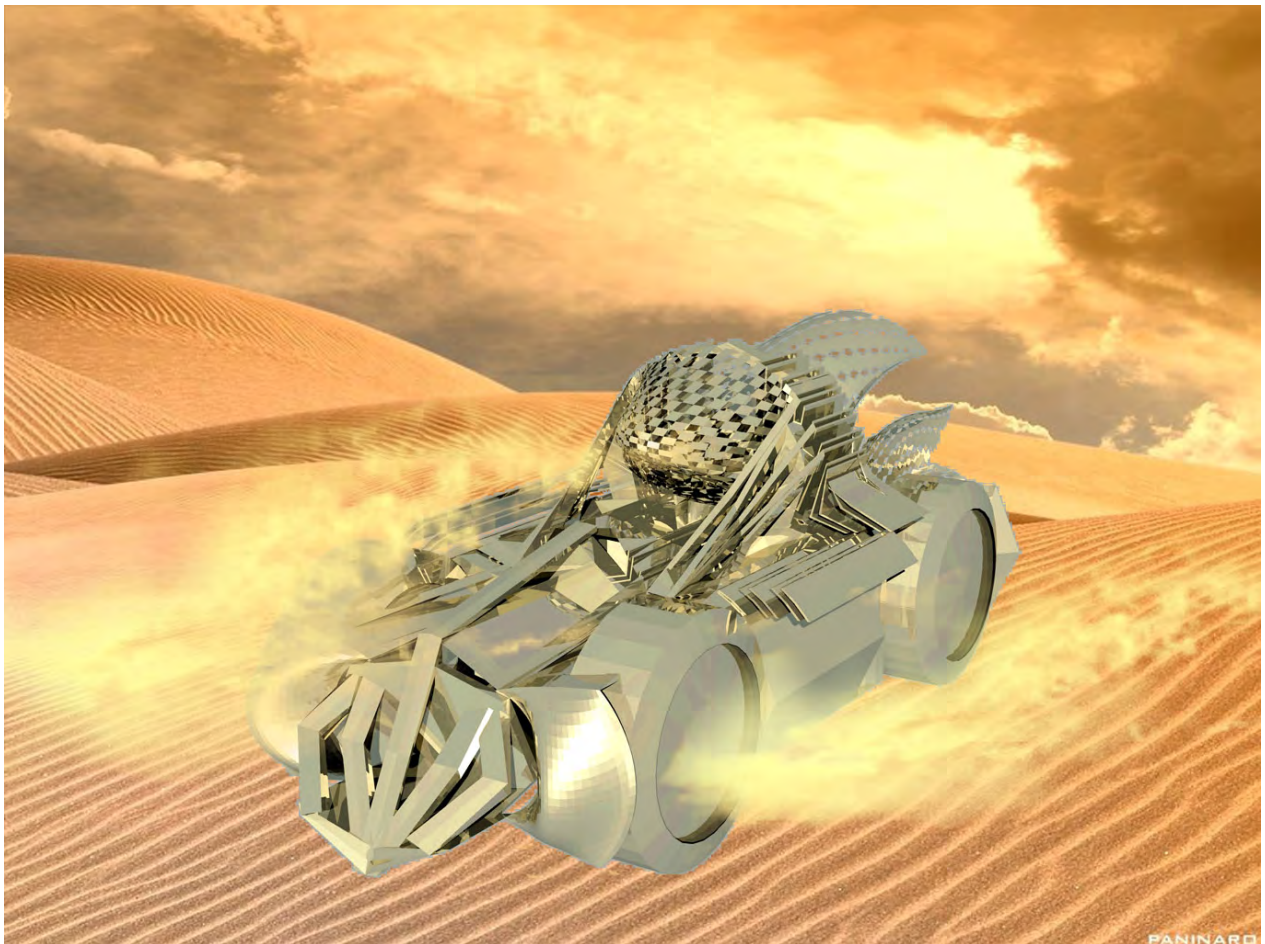




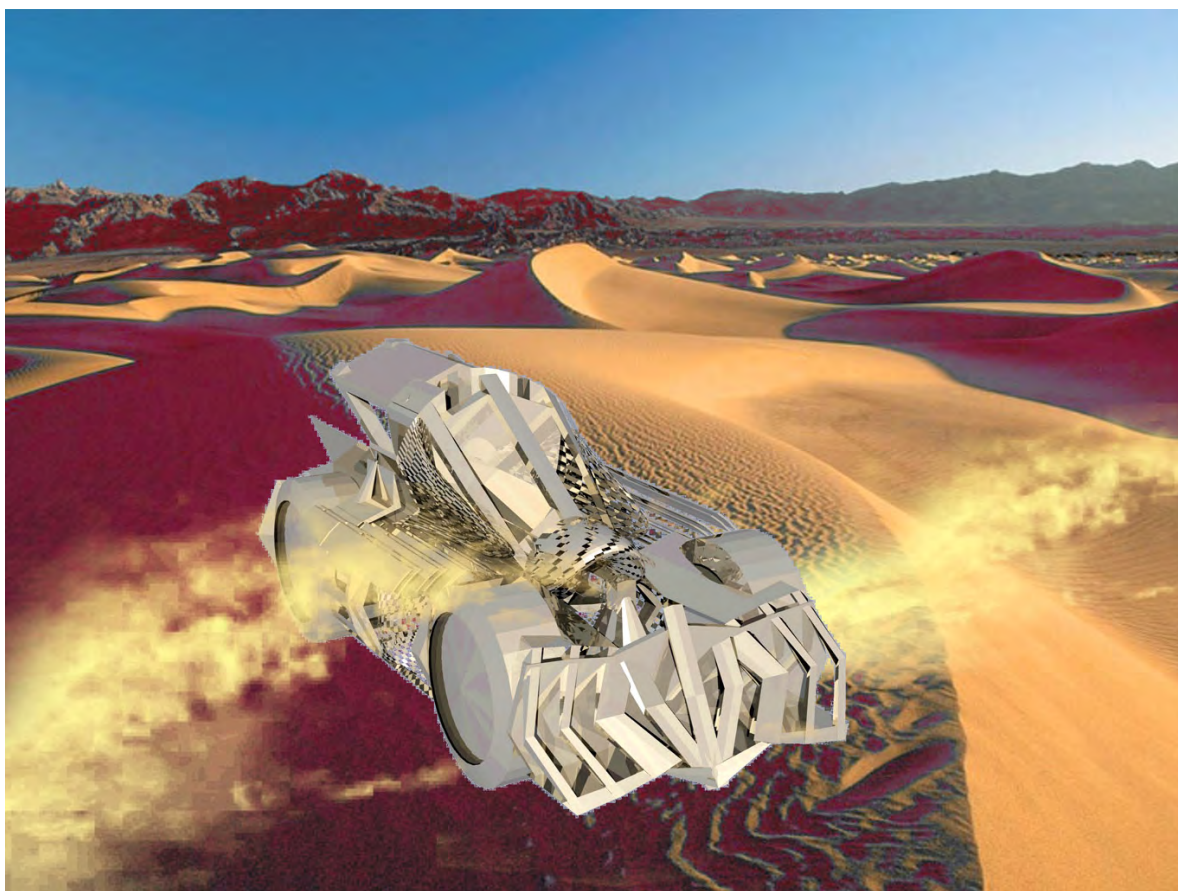
and a flying hypercube castle in the sky of Jerusalem



Generative projects of cars







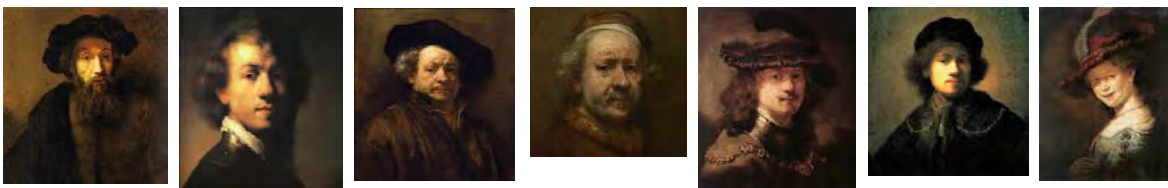
Logics of Imagination

Generative Art performs a Style as Executable Process

GA2012



Van Gogh, a sequence of landscape “variations”. We recognize his imprinting at the first glance. Rembrandt, a sequence of his portraits. where imprinting is immediately recognizable



Premise. Logics of imagination, some considerations

From a photo of a flower pot with sunflowers to a painting of Van Gogh there is a transforming process as an increasing identity; together with a recognizable feeling. It is not an analytical process but a transforming process based on logics of subjective interpretations: *the logics of imagination*. The same process that we can find in each scientific discovery path.

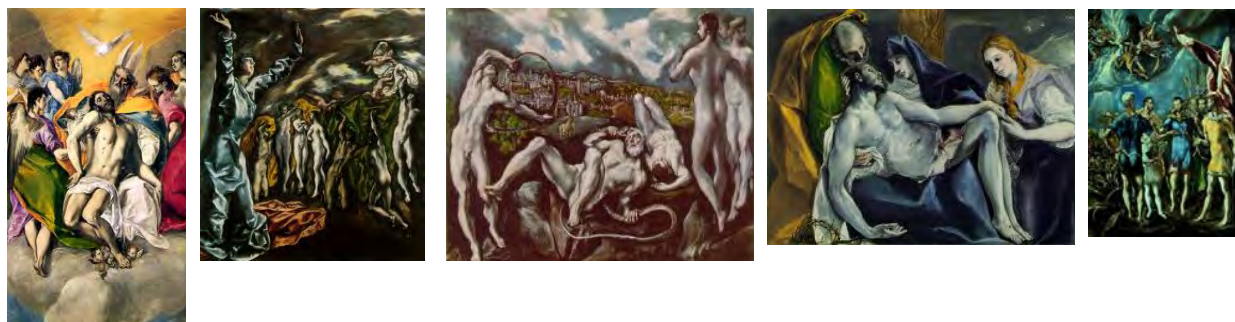
If we look at a Van Gogh painting and at a painting of Monet, all showing a flowerpot with sunflowers, the underground process appears different. There is a different observation, a different feeling or, we can say, a different imprinting able to generate a different style.

The conceptual frameworks and the creative processes are different because the transforming process is different: How the stem folds, how the petal ends, how the flower is divided, how....how... how. It is a discovery following an observation for defining a hypothesis as a subjective identification of a possible “generative” process. Art/Science is interpreting what exists for transforming/representing it into an artwork/idea/scientific hypothesis.



A photo of sunflowers, Vincent Van Gogh, and Claude Monet paintings

As we can suddenly recognize, without any doubt, the paintings of El Greco



How the bodies fold, how each people lands, how the arms involve the space, how.. how.. how. There are several possible subjective interpretations of the characters of El Greco representations. In any case, we recognize them as belonging to El Greco so we identify the characters that fit our own imagination.

50 years ago, before the computer era, was used a term, *meta design*, for identifying a peculiar creative process. Metadesign was used firstly by Adrien van Onck in 1963 for identifying the moment when an idea can develop itself before any possible subsequent final result. And the use was not limited to the design processes but involved other fields of Art. The problems were that in that years with no computers, no tools able to execute a sequence of orders (In Sanskrit old language, Art is *Are* and means ordering) it was impossible to carry out a meta-artwork able to really work for producing artworks.

The aim was to create something like the project of the possible projects, the meta-artwork of the possible artworks with the ability to identify the character of these possible results. This meta design needs to use the abstraction, that cannot be a simplification owing only to the theme, functions, tools, forms and so on. The used abstraction must have a high level of definition of own vision able to be correctly used for performing the character of each result. Today, after our experience in GA, we can say for generating different but well identifiable multiple results.

In other words, meta-artwork is the first identification of what today we can call Generative Artwork. Or, adopting the biological language, the artificial DNA of each possible artworks of an artist.

How we can first identify, second create and then make usable a Generative Artwork? By performing it as a conceptual framework constructed as executable process. You can do that in different ways: with a set of algorithms inside an original program, or with a mechanical, chemical or biological device able to run a complex process of subsequent transformations and increasing complexity.

The common aspect of these processes is their being dynamical, complex, non-linear systems.

It's arguable that these processes include two different parts: the subjective creative approach (the style) and the organization of the theme / precedents (the sunflowers in the previous example). The first is similar to a DNA code, the second is the logical subjective observation of the contingent occasion for performing artworks.

As well as DNA in nature, the first part is a set of multiple and different logics of transformation. Each code could be identifiable as able to represent, create and enhance a peculiar character of what exist before, able to perform a recognizable aspect of the artist style.

The second part focuses the subjective point of view used for acquiring the environment. In fact for reaching the searched results, it controls the structure of each possible topological interconnection and possible contaminations among the multiple and parallel transforming processes.

The character of this creative framework is the high level of not-simplified abstraction that, referring to Nietzsche concept of Art, create a dynamical level of complexity where the possible meanings are infinite, and where the forms could be considered as possible interchangeable formal matrices (C.Soddu, Citta' Aleatorie, Masson Pub. 1989) inside a well-identified framework belonging to the artist vision.

In these last decades, with the Generative Approach and with the help of computers able to keep in memory and put inside an executable process our multiple and subsequent key of observation, we can work directly on the increasing complexity process of the creation of a peculiar style. Because we can work inside the core of this dynamic system in the moment of its construction, applying in progress a sequence of our logics of imagination by following our subjective and contingent point of view.

Some consideration about “new”

New things, new forms cannot exist. If we are looking for a new form, we cannot go over the existing forms. The “new” belongs to possible complex transformation processes. The “new” belongs to an interpretation, a tendentious open observation of already existing events.

Many times, the transforming process is expressly applied to another existing artwork of another artist, increasing the sequence of subsequent interpretations. We can see this process in Picasso following Velasquez. Picasso interpreted the portraits of Velasquez, particularly the "Meninas", for constructing his own portraits, his own "style" that is strongly unique and identifiable, so strongly recognizable. A style that is without doubt "new", but coming from the interpretation of already existent artworks. It is new because the process is new, being a not-analytical process but a discovering non-linear path as new imaginary logics.

Forms are not an essential matter in creating a style and subsequently, their identity is not essential in the core of a generative process. They are only interchangeable possibilities that

we use for managing multiple exits of a creative process. In the multiple variations, the formal matrices identify each single result, not the species of results and consequently the style.

New is never new as a form but as a new interpretation. As it happens in scientific discoveries.

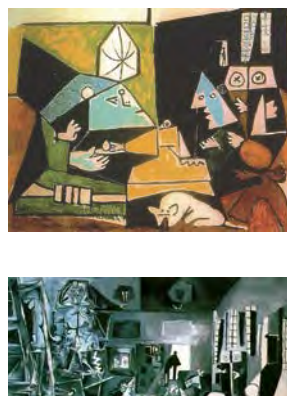
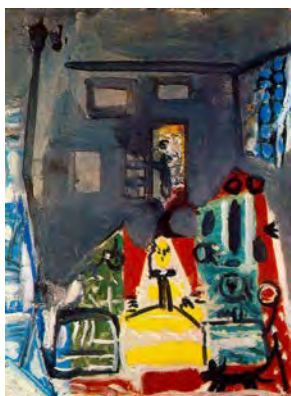
The "new" style happens when the artist identifies own set of interpretative logics and related feasible devices being able to make them executable. Quoting Focillon, each visionary artist builds his own tools, not his own forms.



Velasquez, “las Meninas”, a detail and another portrait

Picasso, re-painting by interpreting many times “las Meninas”

by Velasquez



In Generative approach, each generative artist builds his own logical imagination with his own tools. It's difficult to be a generative artist without constructing his own software or other executable devices.

First part. Generative Art and logics of imagination

Basically, all the Ideas are generative matters. Each one could be identified in the progressive process of generating the future from the preceding events.

The style belongs to the complex system identifiable in interferences, contaminations and reciprocal similarities and symmetries among multiple logics. This complex set of rules and their reciprocal relationships comes from our own imaginary. It constructs an evolutionary code, a *modus-operandi*, able to characterize and make unique each act of an artist.

The Generative Process is constructed as a labyrinth, where each time we use it, we can run a different path by using, in a different sequence, the same doors of transformation.

Using algorithms, the generative approach allows us to easily perform this system because we can create the transforming doors, one after the other, following our multiple references to our imaginary. We can design them with no care to their mutual relationships leaving open different possible interferences and contaminations with parallel algorithms. In this phase, the only aim is to fit each peculiar character that we need to have in our artworks. So we are constructing our style. We can operate several different abductions from our imaginary, focusing them as logics of transformation, without any need of choice but only for fitting our “style”.

Only in a subsequent moment, we can put them into a logical paradigm able to promote the mutual contaminations, interrelations, and symmetries. We can identify the theme of our possible artworks by structuring the control paradigm of such interrelations able to manage in progress the topological structure of our observation and of our preferred references. More, as I normally do in my generative software, I fix the usable doors but I link the sequence of some of these doors to the time of the beginning of the process. In other words, as happens in all chaotic systems, the flight of a fly, in this case, the different starting moment of the process, can change the weather in the other part of the world.

The great possibility offered by the generative approach is the construction of own unique style with subsequent steps, by creating and modifying in progress the structure of synthesis that will perform the progressive attainment of complexity and recognizable clarity.

Complexity is necessary for attaining the wanted identity. Each single interpretative logics or a simplification of these logics cannot succeed in going over a copy or an emulation of already experienced. The increasing of possible logics, parallel different logics oriented toward different characters and adjectives, also as alternative logics, creates the necessary complexity for moving from a linear system with predictable results to a non-linear complex system, with chaotic structure. Where we can find progressive bifurcations and, quoting R. Thom, unpredictable uniqueness, and catastrophes.

With its border of casualness inside the choice, each bifurcation increases the complexity, pushing the process toward the exploration of possible. But only if the generative process will be so complex to manage these unpredictable events as increasing identity of the style. As happens in our life, where the catastrophes can enhance our identity if we are strong enough to manage them.

The high level of complexity, and, therefore, a critic mass of algorithms that can work in parallel, is necessary for performing Generative Art.

Second part. Identity Codes

Just a path around possible fields for identifying own identity codes, own logics of imagination and dropping them into an executable process. For instance, by using

interpretative relationships between different dimensions, or using different geometrical points of view, or multiple perspective points of view, and so on.



Images of medieval cities by Simone Martini (1 and 2) and Giotto (3)



A sequence of generated medieval cities (C.Soddu 1989) in a painting of Simone Martini.

I used, as reference imaginary, the medieval artworks by Simone Martini and Giotto. I made this choice because they are meta-perspective representations. So they can be interpreted as dynamically fragmented perspectives along an interpretable time. Quoting my book "The not Euclidean Image", Gangemi 1986, the paintings of Simone Martini can be logically interpreted as a dynamic movie along a path from outside to inside the represented medieval city. Using this interpretation and moving from the time-dimension to space-dimensions, it's possible to manage progressive transformations from the existent city to its representation. This can give a dynamic unique character to the results, the same character that we appreciated in these frescos. These transformations can be used, performing appropriate algorithms, into a generative process. As I done for my first Italian Medieval Towns Generative project (1988).

We can find in Picasso a similar field for developing own interpretative structure. He used the possibility to perform together several different points of view, as Simone Martini done. But

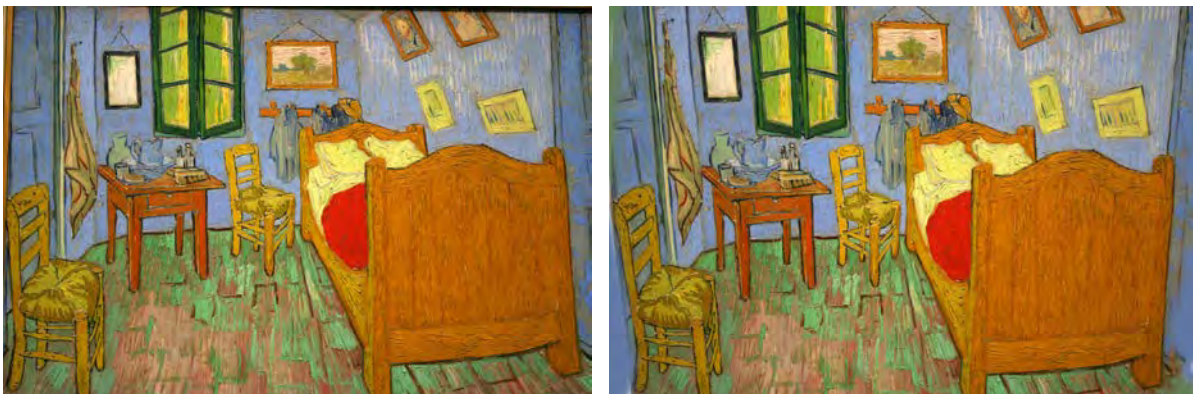
the Picasso process uses this multiple points of view for “exploding” the painted object. This defines his imprinting.

We can find in Balla, and in other futuristic painters the same field of interpretation but with completely different characters and results. In Futuristic paintings, the presence of different points of view and related facets is not own to the interpretation of the discovery path of space but to the representation of the speed of this progressive discovery.



Balla Futuristic, the speed representation.

In Van Gogh paintings the transforming process related to the multiplicity of points of view is completely different and unique. Looking at the painting of his own room, we can identify two different and conflicting perspective visions. (C.Soddu, "The not Euclidean Image", Gangemi 1986). The perspective view of the room uses a point of view from the top down. But the structure of the perspective representation shows that the look is not from the top down but, on the contrary, bottom up. This communicates multiple conflicting feelings that are one of the characters of his whole opera. And of his unique and unmistakable style.

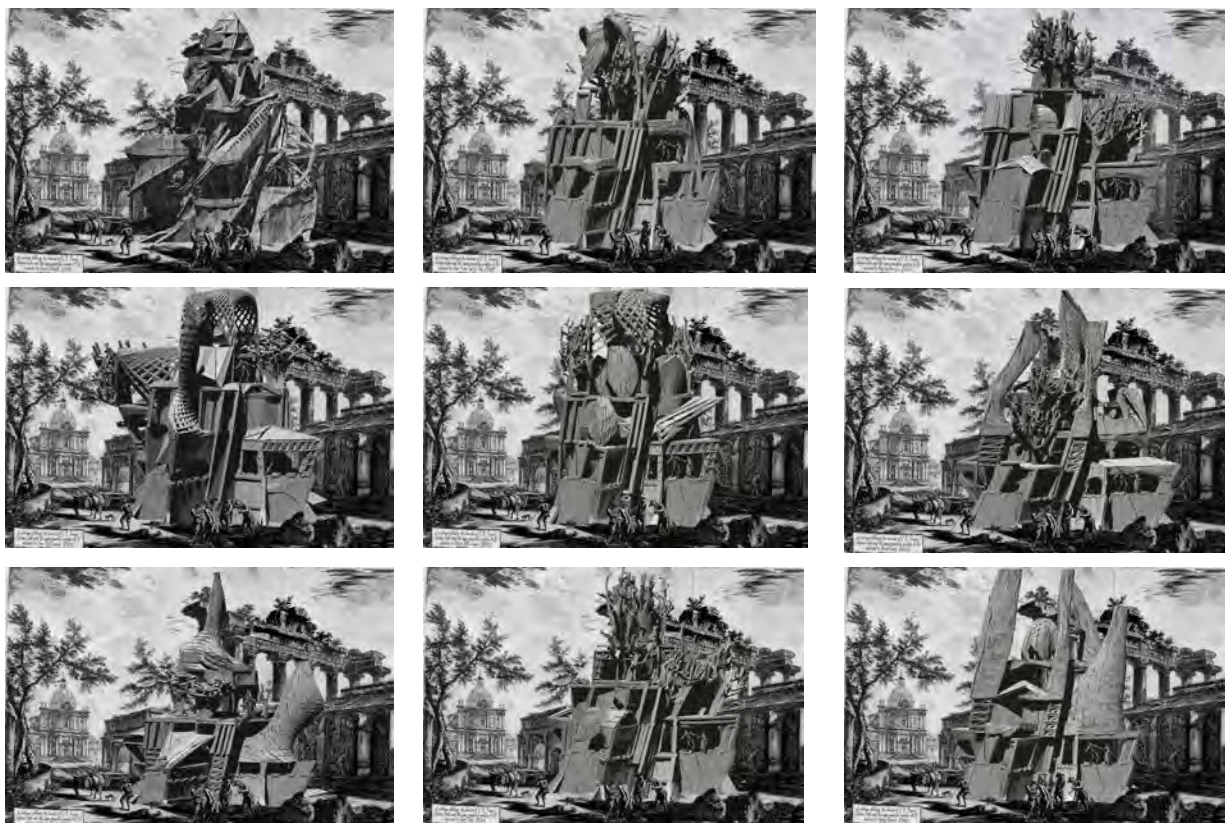


Van Gogh. His room in the original image (1) with the contamination of two different points of view and a transformation to a “normal” perspective (2) that loses the unique character, style and feeling of the original painting.

We can find in the artworks of Piranesi the same multiple points of view, but with different logics. In his engravings, mainly the "Le Carceri d'Invenzione". Piranesi represents the far objects by changing the rules of the perspective, by moving forward the point of view. The result is that these objects are magnified. More, he progressively slides, just a bit, the point of view on the right or on the left. This transforming logics give to his opera the unique imprinting, a strong uniqueness and identifiable clarity.



Piranesi, “Carceri d’Invenzione”. In the bottom 9 variation of “Babel tower, an homage to Piranesi”, C.Soddu 2008 made for the covers of GA2008 proceedings, using the same multiple sliding perspectives.



If the aim is to interpret as transforming rules some characters of our surrounding world and to run a process able to generate representations as a mirror of own feelings, we need to focus these characters.

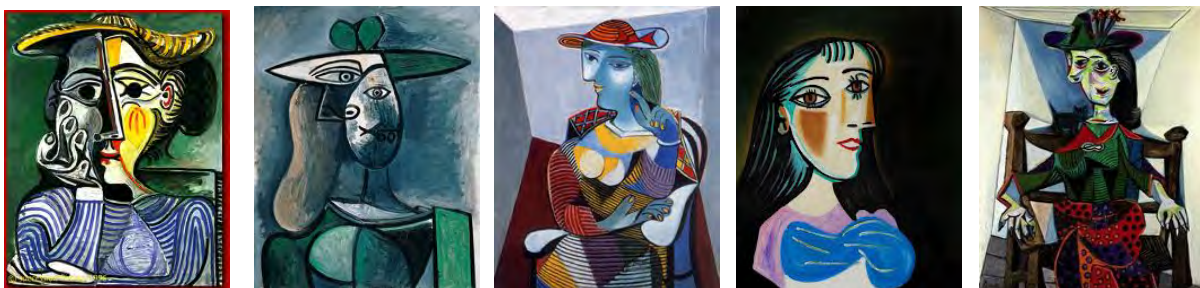
In our teaching activity from 1989, Enrica Colabella and I firstly ask our students to identify these characters through three adjectives. And we ask to abduct different transforming rules from the surrounding world for each different adjective. In this way, the students learn how to focus their subjective identity and how to construct their uniqueness and style. For instance, if one of them identifies an adjective able to represent one aspect of his creative identity, of

his style in construction, he tries to find out when this adjective can be found in his imaginary.

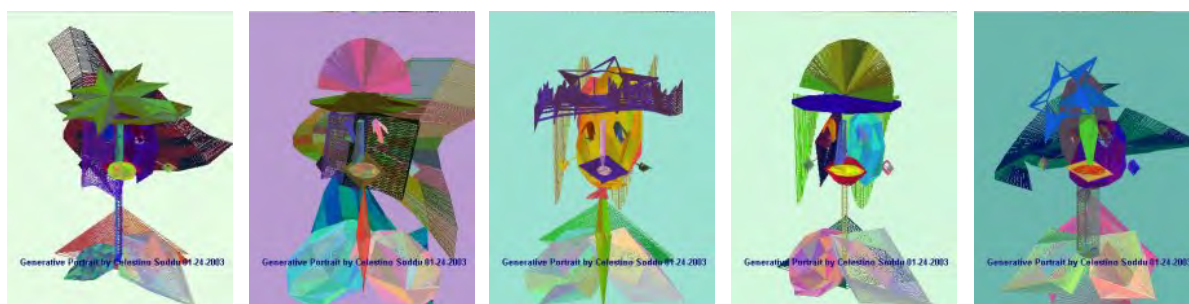
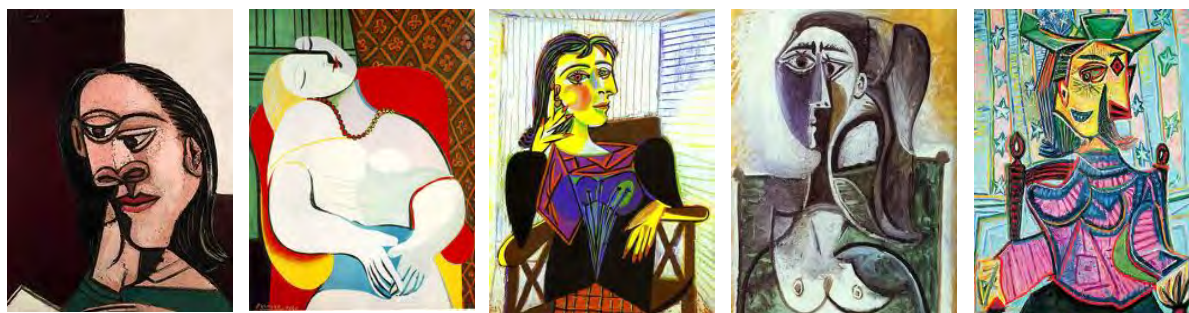
For example in the artworks of other artists that seems to perform the character of the adjective.



Van Gogh portraits and Francis Bacon portraits. Their logical imagination is unique and well recognizable, also if Francis Bacon made some of his paintings as “homage” to Van Gogh, explicitly referring to Van Gogh character. But he interpreted these characters following his own logical imagination.



Picasso portraits



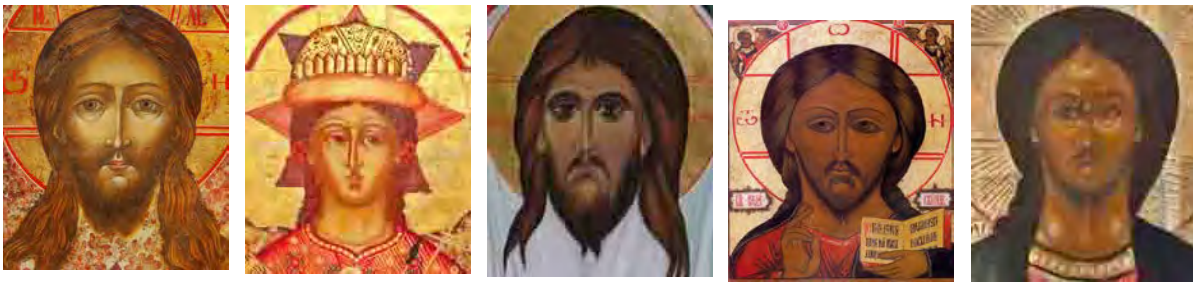
D'apres Picasso



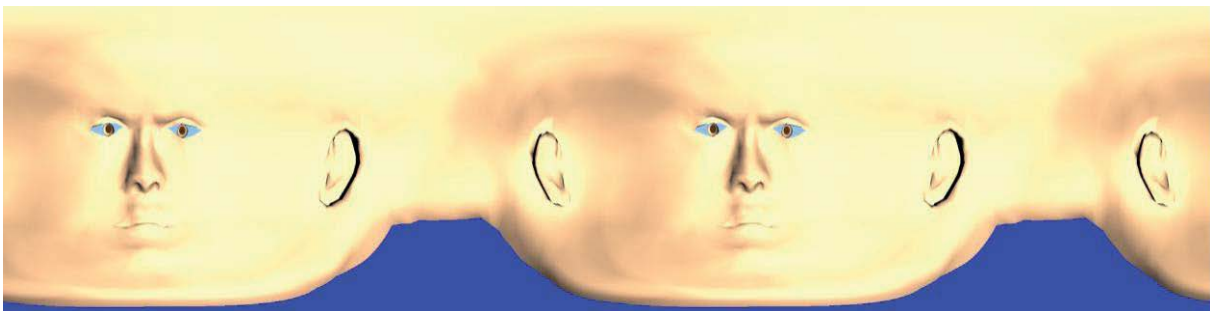
10 portraits of Picasso and my artwork “d'apres Picasso” (1996) with 10 generated variations made as an homage to this great artist.

Interpreting the Picasso women portraits I created a generative artwork “D'apres Picasso, women portraits”, able to generate an endless sequence of variations. My aim was to create variations where we can identify Picasso interpreted from my particular point of view able to focus the characters that I like in these paintings. But the aim was to represent my imprinting too. Identities can come together as happens when Picasso interpreted Velasquez

For constructing possible interpretative codes as algorithms inside the generative process we can use, one time more, the perspective geometry tools. For instance by defining, inside the perspective representation, the variation of the point of view. The example that I like to explain is the Russian Icons. These images have, following my subjective interpretation, a peculiar character, something that seems to be far but in the same time able to involve, This character is common to Velasquez and Picasso and it is designed by the presence of multiple points of view.



Faces of Saints in Russian Icons. Represented with reverse perspective.



The use of reverse perspective. The image is a perspective at twice 360 degrees from the inside of the face. C.Soddu.

In the Russian Icons, the double point of view is one inside and one outside the head of the represented Saint. The image of the saint is like the image of his face when it is seen from a point of view inside his head. So we can identify a double vision but, on the contrary of what happens in Van Gogh, Piranesi, Balla, and Picasso, one point of view is from outside and seems to be in front of the Saint and the second one is from inside the head of the Saint improving the involvement of the observer.

This approach refers to the reverse perspective identified by Florenskij, and to the operative interpretation that I done in my article (Soddu C., 2010. *Perspective, a Visionary Process: The Main Generative Road for Crossing Dimensions*. NNJ v 12, n.1, Springer Pub.) by constructing the algorithm of this particular representation.

The possible outlet of these algorithms of reverse perspective into an executable generative process is in the possibility to upgrade the involvement power of the generated artworks. In my experiments, I tried to define some rules of transformation by directly operate on the 3D model and not on its representation, by transforming it using anamorphosis.

By the way, many of my generative algorithms were done using transformations based of contaminations among different points of view and different dimensions. But these transforming processes operate directly on the three-dimensional geometry of each event. A movement pendulum-like between 2D, 3D, and 4D that can increase the complexity of each possible result and gives the opportunity to enhance the wanted identity and its clarity and recognizability.

These contaminations between different dimensions are used in all the creative fields, not only in generative processes involving visual art, design or architecture.

In music this increasing complexity approach involves different possible points of view that we can identify as different melodic lines running together with symmetries and mutual contaminations, As well as different solos in Jazz pieces where the different subjective interpretations run together. Enhancing the style of each musician.

In Bach, in his Art of Fugue as well as in his Well-tempered Clavier fugues and in Goldberg Variations, the rules were rendered explicit by the structure of the counterpoint. The logical structure of counterpoint seems to be univocal but, as it's possible to verify in many different theories about counterpoint, are substantially subjective different interpretations of the basic rules involving the resonance between sequences, the symmetries, and reciprocal contaminations.

The Bach fugues are unique and un-repeatable. Each fugue is different, all together are strongly identifiable as belonging to Bach style. It's a wondering Generative Artwork.

J.S.Bach, Well-tempered Clavier Fugues. The beginning of fugues #1, #2, #3, #6, #7.



In the same way, we recognize the songs of the Beatles. There are not codified rules that we can discover analyzing their songs. We can try to interpret them by constructing, one after the other, possible algorithms able to represent the different characters that we appreciate. No analytical processes can be useful. Also, if we identify some relationships that seems to be useful, for instance, the relations between the last two notes of a sequence and the beginning of the next one, and we try to construct an attractor, we cannot use it. It's not an algorithm, it cannot be used inside a generative process. The only way is to identify, in progress, a set of algorithms and set up this executable process until the results will fit our interpretation of the character (the subjectively pre-identified character) of Beatles music. At the end, we cannot say to have written the Beatles generative algorithms, but our interpretation of Beatles.

Third part. Some considerations about subjectivity, casualness, variations, and complexity

The results, together, represent a set of Variations. Each result is different, unique and un-repeatable, by depending on the contingent moment or environment in which the process is running. But all variations together represent the artist idea, his own unique style.

In Generative Art, there are many different ways to perform variations inside each generative artwork.

1. the environment changes-evolves each time the process will start. This can be managed by using a random number in the parameter used for starting up the process, or, as I do in my generative artworks, by using the time and the date to make the difference among all the results without having two times the same starting point.

In this way, each different starting point will identify the uniqueness of each result.

2. the environment changes-evolves owing to an external interaction made by the user. As happens in the interactive installations.

3. there is a third way to perform variations inside a single generative artwork: using the random inside the logical structure and compositive rules. This possibility could be extremely dangerous. It should be done only if the results continue to represent the artist idea, and these results are recognizable as variations belonging to the same subjective vision.

The two possibilities are:

A. Random inside the compositive algorithms manages only the possibility to use a fuzzy approach. That is the possibility to manage only a minimum variation of some parameters that can be evaluated as wide tolerance, as the grey margin between black and white, as fog. This approach could perform the possibility to manage bifurcations in the dynamic non-linear system of our creative process. And to manage singularities, following the concept of R. Thom. As all creative acts, the generative process, by simulating the creative process, must evaluate possible alternatives that seem, at first, to be adequate to the artist idea. Once chosen, this choice determines the subsequent ones and the uniqueness of each variation.

B. Random is used to produce main changes inside the generative algorithms or inside the geometrical structure of the generated forms. This approach performs casual results that cannot be recognizable as belonging to the artist aims. In this case, we could identify the process as a generative process, but it cannot be called Art because the strong link artist-artworks disappears. So it is my opinion that it's better to call it Generative (Emergent) System. We can verify it simply looking at the management of these results. Following this random approach, the artist needs to directly interact with the results by choosing the results that seem to represent his own idea and by discarding the most because they will be strongly divergent from his aims. This "final" act seems to represent more a shopping act than a creative act.

4. Variations and Complexity

Quoting G.N.Ilya Prigogine, each system is adaptive to the surrounding environment. In other terms, several alternatives are possible for the same process. Only the casualness of the context will decide which of these alternatives will be adopted. This fact gives to the system its *historical dimension, a memory of the past by performing the evolution*.

Complexity grows in parallel with a history. For giving complexity to our artworks we need to run a (virtual) history. Generative Artworks are virtual histories that will run every time in a different way but with the same style.

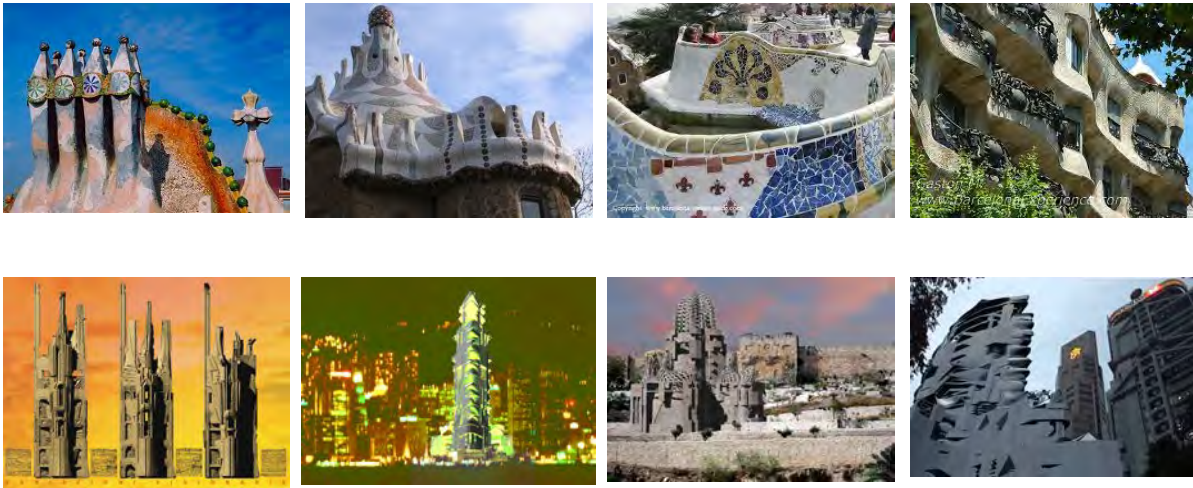
Complexity is inside the ability of generative processes to manage the unpredictability of "observed" surrounding environment. The complexity appears with the ability to satisfy not predicted expectations and unpredictable requests. So we can see that the quality of the results is not static but dynamic. This ability, proper of the generative processes, belongs to its auto-organization potentiality. It keeps alive or, better, enhances the identity, recognisability and uniqueness of the generative artwork. We can experience that:

1. More the interaction with the environment is unpredictable, more the identity of the result is high;

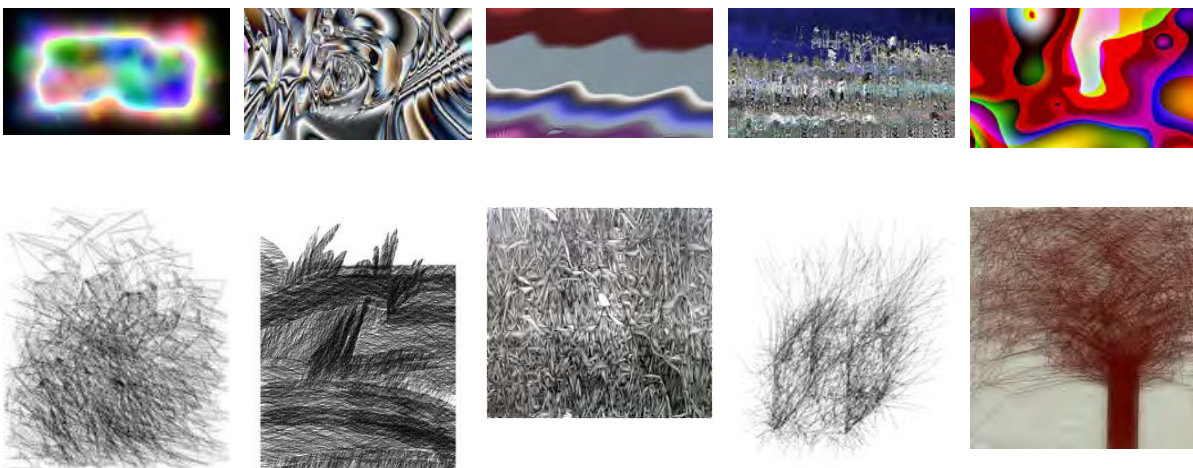
2. More the random factors involve the logical process, more the identity and complexity of the results is low;

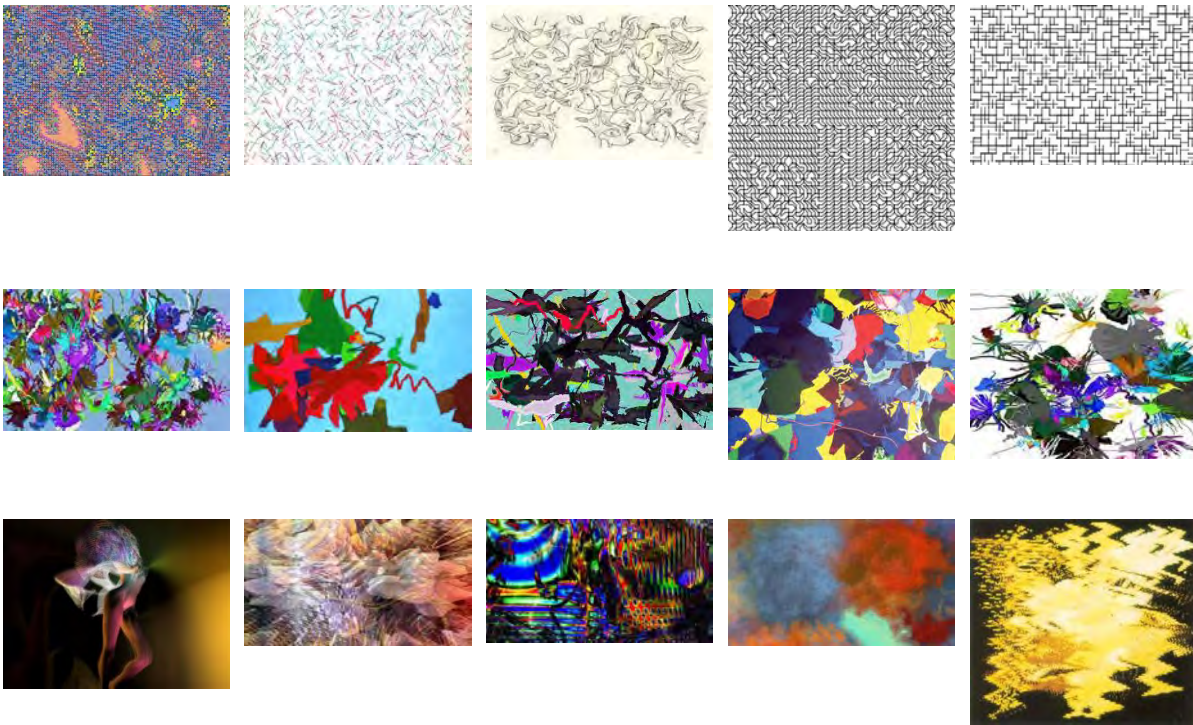
Generative Art, putting aside the Art path based on the oneness of creative acts as well as optimized single forms, can run an "open" creative path by creating a non-linear system.

This Generative Approach defines again the similarity between Art and Science. Following the concept of T.Kuhn, (the structure of scientific revolution, 1969), The generative approach is not an analytical approach but it is something similar to a scientific discovery path.



In the 1st row four images of the architectures by Gaudi, my great master, and, in the 2nd row, my homage to Gaudi together with 3 other architectures (Hong Kong, Jerusalem, and Hong Kong Central) made by me referring to Gaudi.





5 artworks of generative artists like Yoshi Abe, Hans Dehlinger, Peter Beyls, Harold Cohen, Alan Lioret . The style is recognizable.

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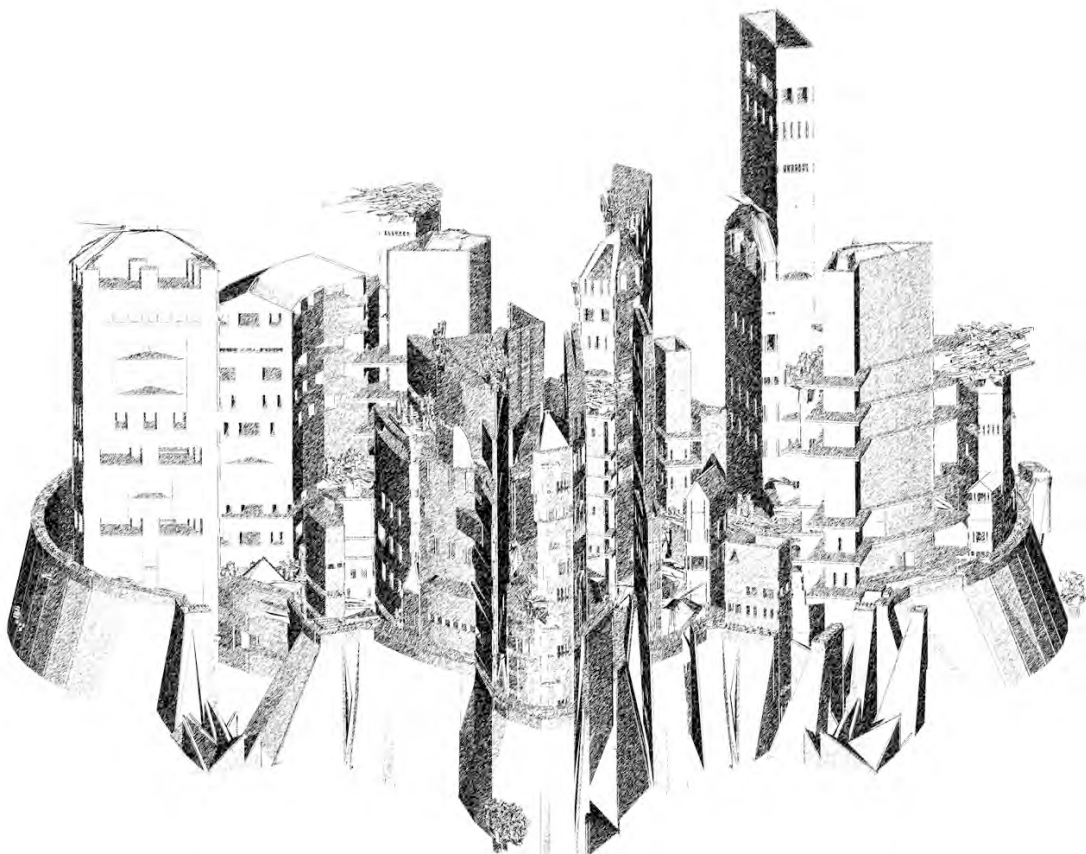
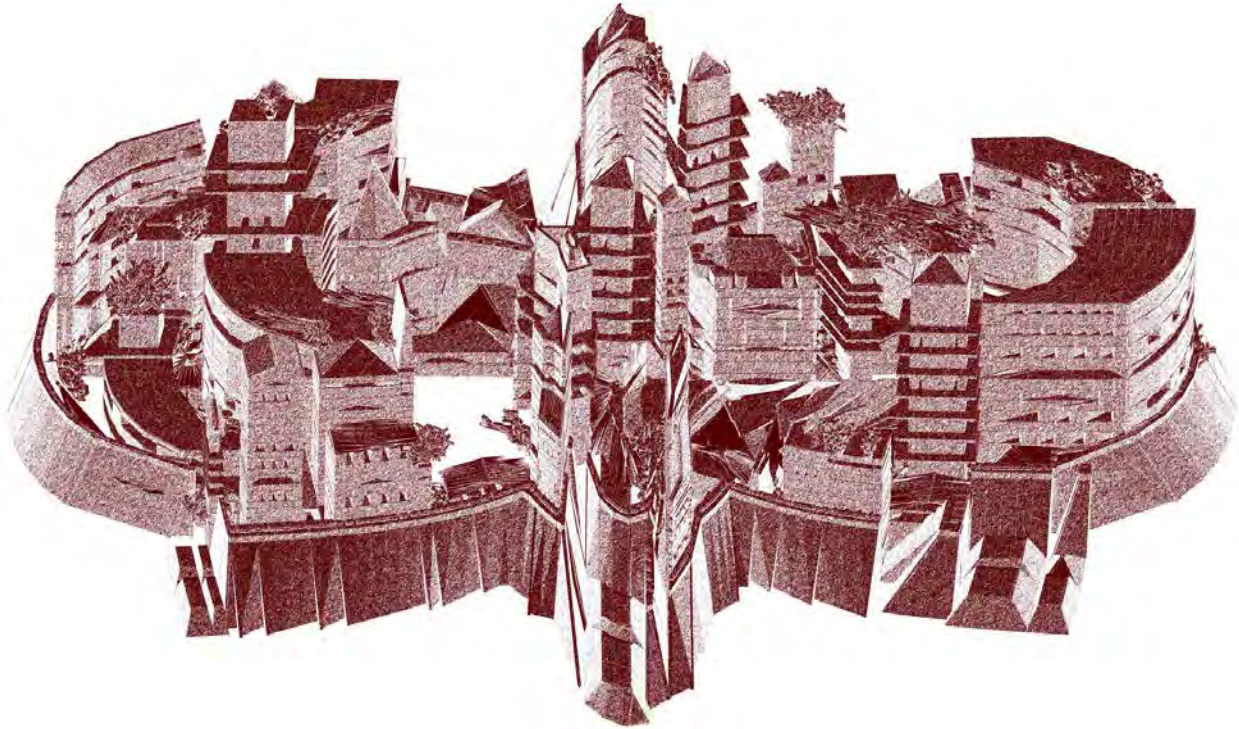
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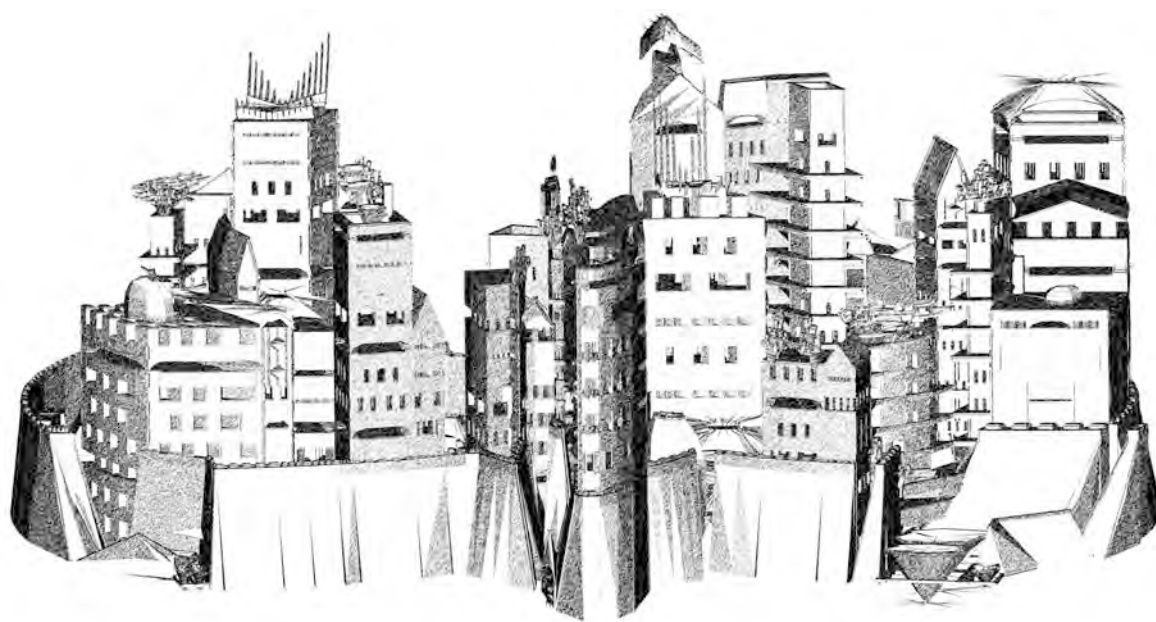
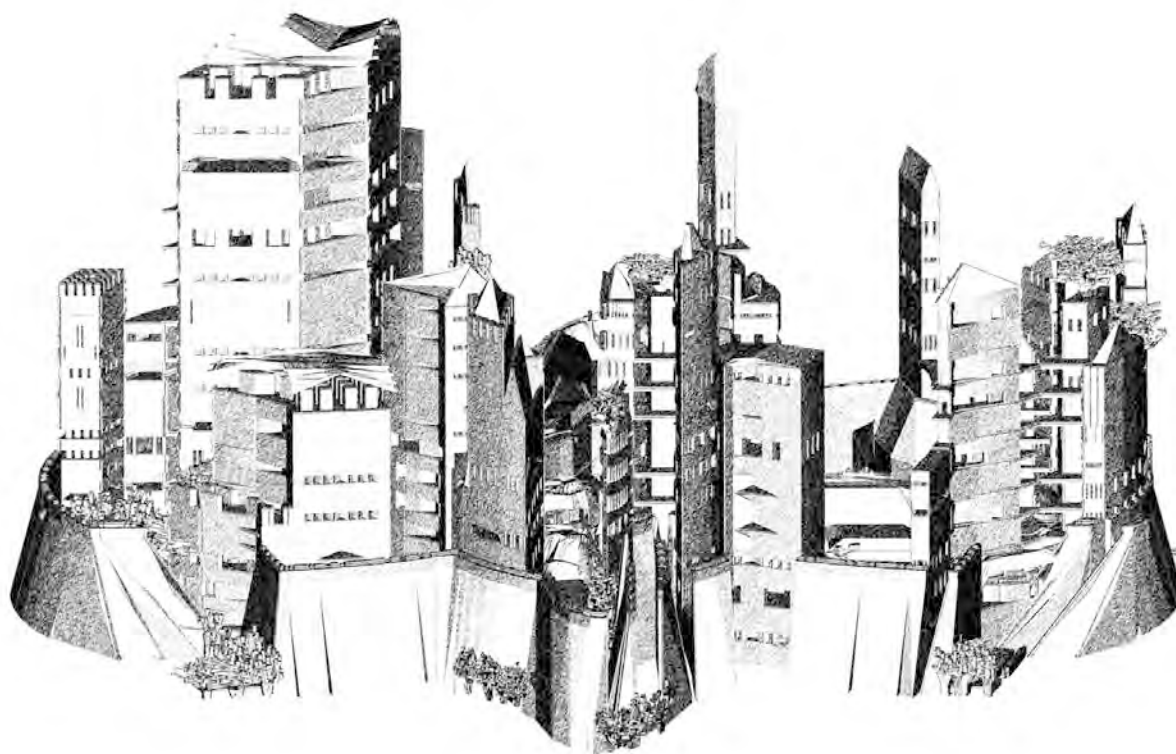
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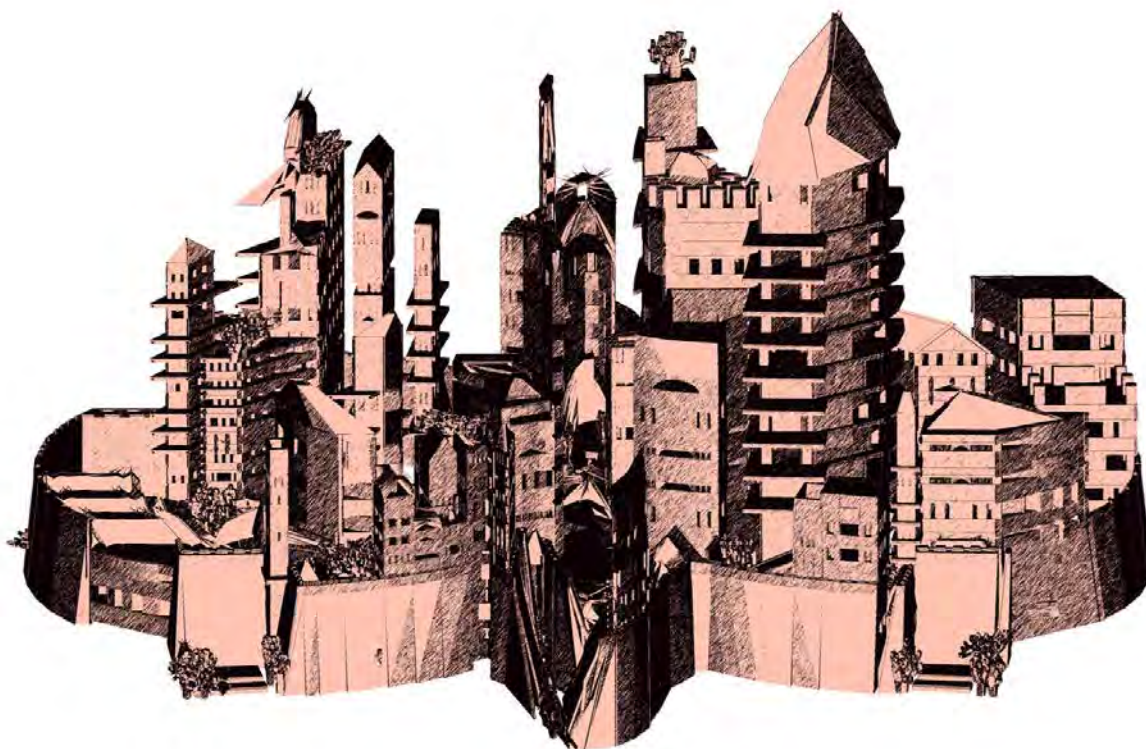
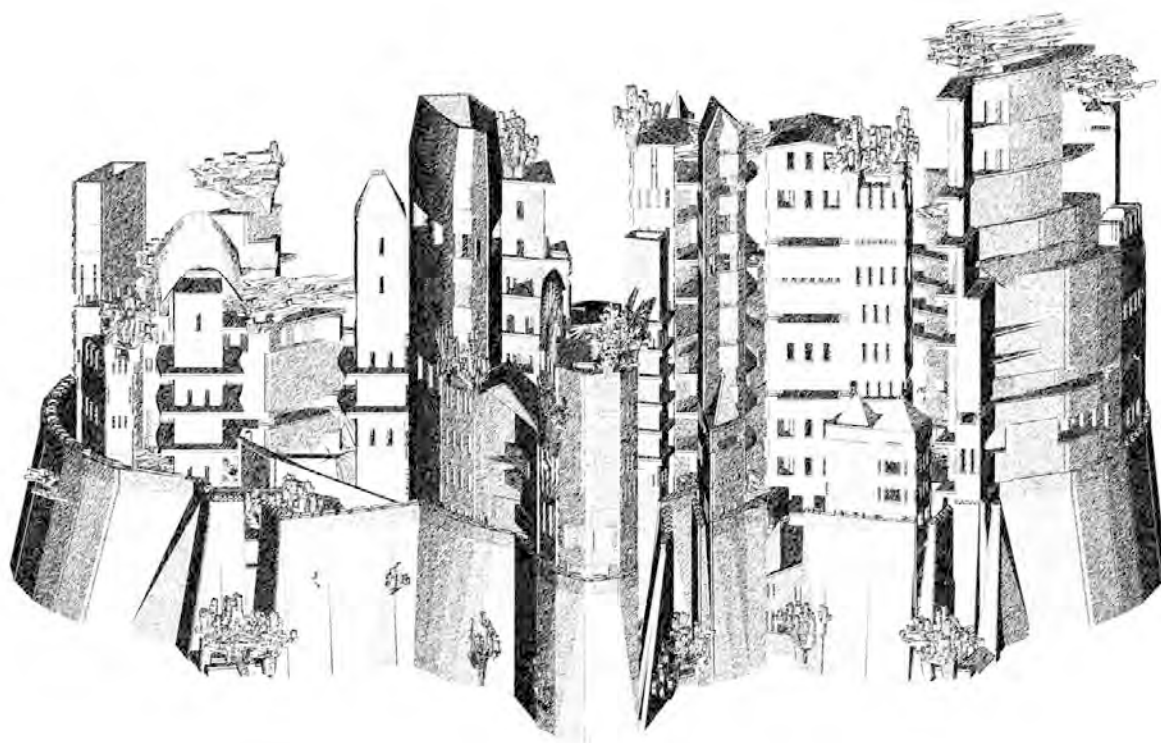
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Generative projects made in 2012

The generation of Medieval Cities looking at Lucca, This Generative project was made for the cover of GA2012 proceedings.







MUSICABLU

Generative Music Design software for increasing human creativity and generating unique and not repeatable musical scores

GA2013

Premise

Following the generative approach that I developed in the last thirty years, I worked on a project of **music design** able to produce musical pieces and to record each result in a midi file with fifteen tracks, each one generated following a peculiar instrument and a peculiar and identifiable player. This was the main choice: **to generate the musical score and not only the sound**. These scores can be played using other programs and, if necessary, they can be upgraded with different instruments. More, they can also be played and interpreted by a human orchestra.

Following that, the focus of this generative process is in the musical Idea and its structure and not only in the sound, that belongs also to the player's performance and to his subsequent interpretation. This approach tries to mirror what happened in the time of Bach and Mozart: The musician creates his music writing the score. Only in a second moment, the composer plays his music or another player can interpret and performs the piece using this score.

I had developed this project starting from 2003. But until now it was in a starting phase. I only presented the live performance “*Out of hours*” at GA2005. It was performed by interacting my generative music with a human jazz singer, Josette Marcial, the poetic text by Enrica Colabella and the live generation of my woman portraits able to interact, in real time, with the music. This year I suppose to have reached more advanced (also if not “final”) results and, for the first time, I am happy to present MusicaBlu at this Generative Art conference.

The aim was to *create a generative software able to support the musician creativeness by following the own cultural references and own subjective preferences*. This approach is in tuning with my preceding experiences of generative design that involved different fields, from the visual art to the architecture, from the city design to the industrial objects. **This generative structure is based on the interpretation of my own peculiar imaginary references and works by creating a set of transforming rules (algorithms) able to perform events in tune with own peculiar vision.**

So I used this approach also in the music field. My generative software **MusicaBlu** is based on my subjective vision, and particularly on my experience as a jazz player in the sixties. By the way, this experience was at the base of the generative approach that I have developed in all my experimented creative fields.

As in jam sessions, the main elements are:

1. the composition of a melody, and/or of a motif;
2. the subjective structure of riffs able to identify own musical character;
3. the creation of a harmonic and rhythmical structure;
4. the improvisation and the subjective interpretation as transforming process;
5. the harmonic and melodic interpretation;
6. the use of the cultural references in the field of the music, but not only;
7. the possibility to interact with the other soloists during the dynamic evolution of the musical session. And to develop together unpredictable musical events.

In order to clarify, and to specify my adopted references, most of all related to baroque and to the sixties and seventies, my main references were: Bach, particularly the Fugues, Mozart, the Modern Jazz Quartet, Miles Davis, Coltrane, the Weather Report and the Beatles.

I have built in progress the software *MusicaBlu* by actively interpreting these references.

But the jazz approach was *only the starting point*.

The aim was to ***simultaneously act on the various logical components of a musical composition*** not limiting me to the interpretation and the progressive variations on a theme, as happens in Jazz, but directly involving the music creation. These logical fields are the *generation of the riff*, the *melodic construction*, the *harmonic construction*, the *rhythm* and the *adjectives* that identify a piece of music: "*largo*", "*adagio*", "*andante*", "*allegro*", "*allegretto ma non troppo*", "*prestissimo*", and so on.

More, my aim was also to operate generative actions on the orchestra and on the management of the players group considered as different and identifiable soloists, and also the rhythmic group and the accompaniment group.

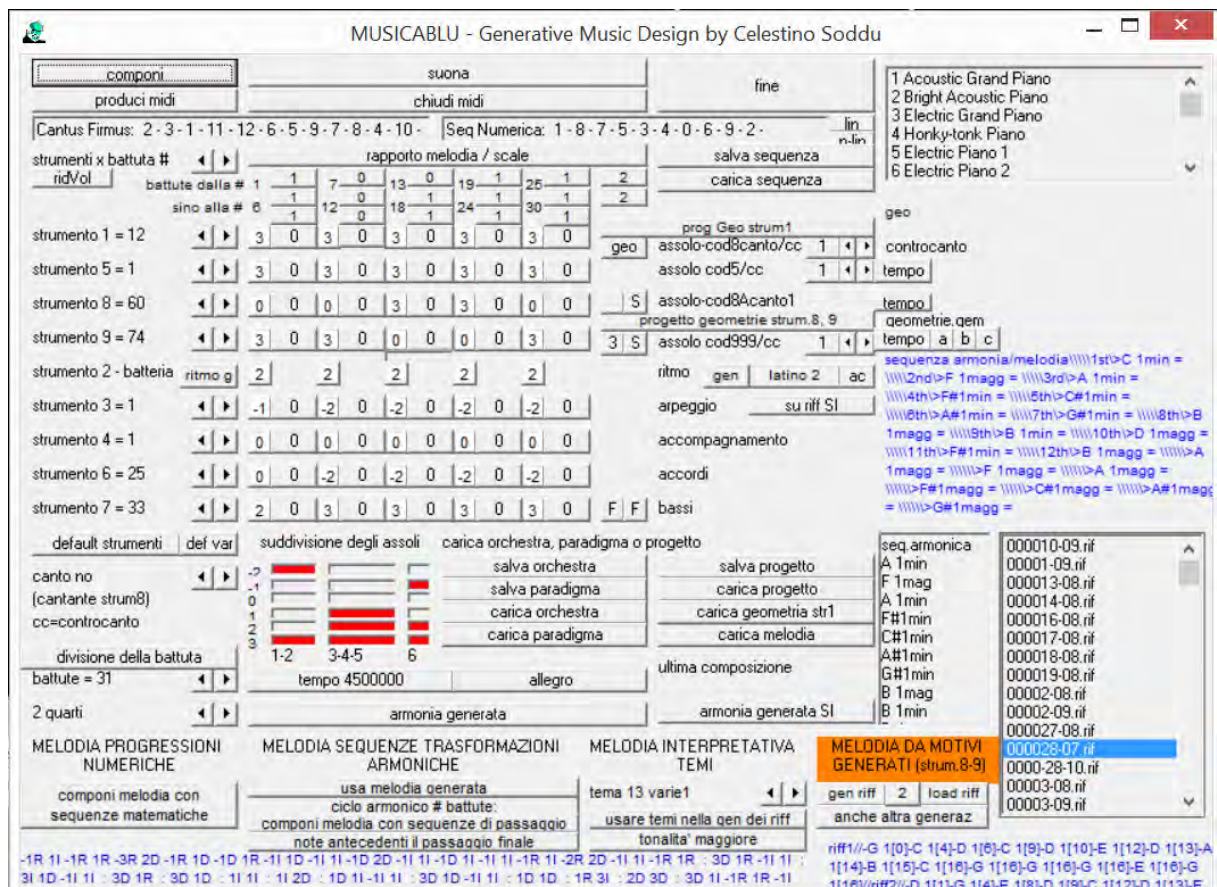
The most important and hard part was designing algorithms able to *generate the melodic construction*. I tried to enlarge the field of melodic possibilities. Melodies are not confined to "classical", "Jazz" and "popular" music, but I have also experimented "numerical" melodies and dodecaphonic melodies, having as a reference, in this last case, the structure proposed by Webern in his 1932-1933 famous conversations "*Der Weg zur Neuen Musik*".

The structure of *MusicaBlu*

As well as in all my experiments of Generative Art, this generative software is structured in two parts: *the first part* for managing the piece, concretely for creating and managing the paradigm of possible results, and the *second part* able to manage the music generation by using parallel transforming devices and their reciprocal contamination and interactions.

The **structure of the paradigm** is based on the possibility to choose the orchestra and the schedule of each player. Together with the character and the possible instrument of each player. This orchestra can be created and used in different generative paths. The paradigm of the orchestra is the basic choice at the beginning of each generative process. The paradigm doesn't have inside generative algorithms but only requests of specific characters and "constraints" able to control, in progress, the music generation.

The second part is a **set of generative devices** structured as a not linear system. These devices work in parallel and are focused on different fields: the generation of riffs, of melodies, of the progression of harmony, of rhythms, of time geometry inside each bar and each bar sequence, of various symmetries among notes, riffs, and melodies.



Screen dump of MusicaBlu interface.

The Melody

Going in deep by the melody generation, I have designed the generative algorithms for *four different generative devices* for fitting a range of four possibilities related to the structure of the melody. These four sets of algorithms create four parallel devices able to work together, interacting with them and managing reciprocal contaminations.

The Melody generative device #1 - Numerical sequences

The first melody generative device uses the **structure of numerical sequences** as the *Prime* numbers, the sequence of *Fibonacci*, the sequence of the *squares*, the sequence of *Hailstone* numbers and the sequence of *Alcuin*, but also it is used a calibrated mix of these sequences. This mix is structured following a similarity with a sequence of different accords inside the structure of harmony. For example, the first numbers of Fibonacci seem more not far to a major accord when the Prime numbers seem near to a fifth diminished accord. So it was possible to manage the moving from different numerical sequences as well as the moving from an accord to the next one.

These numerical references are used for **creating the base of each small sequence of notes**, from two to a maximum of 9 notes, that will fit the generated harmony sliding the starting point to the tonic and, sometimes, to the 5th dominant.

The character of this generation belongs, obviously, to the 12-tone chromatic scale. But the parallel generation of the harmonic sequence will also interact with the numeric sequence by applying a subsequent transforming action involving the notes. This could be done by increasing or decreasing each note of an half-tone; by enlarging the time of the notes in a way that it will fit the harmony; or by decreasing the time when it don't fit the used scale and accord. For example, a possible feedback from the generated sequence of notes and the parallel generation of harmony is to move to a minor accord if the generated notes are the 3rd minor, and so on.

The Melody generative device #2 - Dynamic structured passages

The second melody generative device works through the **generation of notes of passage among notes distant each other from three to seven half-tones**, with few exceptions. This possibility was created for interpreting the possible structures of the *catchy songs and* of the catchy motifs.

“How” the motif *begins*, how the motif *runs in the movement from one accord to the subsequent one*, how *the last three, two or one notes are structured before the final note*, and so on, were considered and interpreted with generative algorithms.

The aim was to create, interacting with the parallel generation of harmony and rhythms, generated **riffs** that could fit the character of a catchy motif. The results were interesting but, as normally happens in music composition, not all the variations fit this quality at the best.

This generative device can also work applying these “*passages*” to the motifs generated by the other parallel devices, in a way that it's possible to increase quality and character to the musical piece.

The Melody generative device #3 - Imaginary structured references

The third set of melody generative algorithms uses a **structure of references** from Bach to Coltrane from the Beatles to Mozart. These references are **logically interpreted as progressive dynamics** and as the relationship among norm and exception. The algorithms produce progressive sequences of notes.

This third possibility works as the previous one, but the structure of the passages are constructed starting from the interpretation of well-identified references, well-identified melodies.

The possibility to quote own references but *not to excerpt a copy* is based on the structure of subsequent transformations managed by the generative algorithms. *The own imaginary interpretation operates by identifying one of the possible sequence of few notes inside the melody and focusing only a peculiar aspect of the geometric structure of a sequence.*

In a second step, the sequence will interact with a generated geometry able to redefine the time sequence. More, each sequence will be transformed, upgraded and structured through the concomitant generation of harmony and rhythm.

The aim was to reach the construction of possible variations, and to reach results where the reference will be not so explicit and cannot be easily recognized. But the generated music will be able to communicate a recognizable feeling, as happens when we appreciate the improvisation of a jazz player.

In other terms this set *doesn't use a database of melodic references but uses logically possible interpretations of passage sequences from one note to another*, trying to identify a dynamic structure able to perform a recognizable feeling.

The Melody generative device #4 - Riff generation and progressive transformations

The fourth possibility, that it considers the **most productive melody generative device**, works through the complete generation of a “new” **riff**, a small and catchy motive that *will be interpreted by the other parallel generative structures for transforming it into a melody*. This is not in alternative with the previous three sets of algorithms. It performs a starting possibility that will be developed by the other three devices. The results of this algorithm, as completely new riffs, are used as reference by the other devices and, sometimes, interact with them for increasing its possible quality.

More, each riff is directly generated as a set of several matrices able to perform notes, duration, accentuations, volume, and characters and it contains several other parameters as the number of notes and the geometry of the bar.

A particular attention is focused on the downbeat or upbeat of each note, following a possible harmonic geometry.

Each riff is generated in *four parts*, where the first one is the main riff, the second, third and fourth are riffs directly contaminated by the first one but with more soft sequences, that means with more long notes and with a different structure of time sequence. The reference was to the main motif of a song and to the variation used for composing an insert. This second associated riff is generated completely different but with an identifiable point of similitude with the main one. Each riff, when generated, is recorded in a separate file so that it can be used again, in another piece of generated music.

Two bars of sax solo generated through a riff generation:



But the riff is not the melody. For moving from the riff to the melody, the riffs must be used by the generative engine many times. Each time it will be transformed with the contamination of the other devices and with a set of transforming rules created following the concept of **counterpoint**. This works by using different symmetries and some mirroring possibilities. *Inverse canon* and/or *retrograde canon* are the two most used transforming rules in MusicaBlu. There are also inside the generative engines a set of other transformations, coming from my experience in 3D geometry. These are used in peculiar events.

The harmony

The generative device for the structure of the harmony was the easier to design, in how a lot of explicit references exist. It's possible to follow these references for performing the sequences of accords and reach appreciable results. Also, if some exceptions and peculiarities can be managed for reaching more rich results.

Also in the dodecaphonic music, called also twelve-tone composition, the structure of reference is able to be easily interpreted with algorithms working essentially with mathematical rules. The sequence of notes, for example, could be managed to structure a sequence of 12 notes, that might be called “cantus firmus”, where no note will be repeated before starting a new sequence, as Webern said. An example of a possible Cantus Firmus might be: 8 - 4 - 2 - 11 - 5 - 10 - 7 - 9 - 12 - 3 - 6 - 1

More, it's possible to opt for working with the harmony structure in the classical sequence of the 12 bars of the Blues or with four bars of the song in major or minor tone, and with other classic harmonic structures.

But MusicaBlu is not limited to these possibilities. The generative approach was used to **produce, in real time, progressive dynamic sequences of accords** and to operate interactively in real time with the melodies produced by the parallel algorithms.

This last possibility is, for me, more interesting because the dynamic harmonic sequence runs following the different harmonic consolidated possibilities. But it is open to change, also in an unexpected way, by following the melody just generated in real time. In the meantime, the melody develops itself, following the interaction and contamination with the harmonic structure.

The main element able to manage these incoming unpredictable contaminations is the **character** of each virtual player. Each of the fifteen players has its own character but the interactions with the harmony are designed only for the **four soloists**. Normally each soloist plays alone but they can play also together in a progressive counter melody.

[A sequence of accompanying Bass:](#)



The Rhythm

The structure of the rhythm has two generative options.

The *first* option was designed from the beginning of this experience and it is an **interpretation of several rhythmic structures**. These are the consolidated and used rhythms in jazz. The generative possibility that I developed in this first option is mainly based on the interpretation of the rhythmic section of the Modern Jazz Quartet. It was developed through the transforming codes able to represent the variations in the swing operated by drums and bass. But this was only the first approach.

The *second* generative set of algorithms, instead, works directly on a rhythm generation based not only on my explicit references but, above all, on **the use of geometric variations able to structure the dynamics of the sequences and the timbre of the sounds**. This possibility was developed after the first opt and it is certainly more strong and *more generative* than the previous one. It was build reporting to my experience on the geometries and their variations that were developed in the generative software that I had designed for different fields.

This generative rhythm device works in two parallel paths, managing the contamination of their structures. The rhythm is generated by the different sound (no sound too) of each beat that follows the character of the geometric paradigm. The two parallel paths are similar to the two hands of a drums player.

The progressive contamination between rhythms and division of the bars, the number of beats, from 2/4 to 7/8 has allowed generating rhythmic events sometimes amazing but always belonging to my musical vision. In the same way, the interpolation and contamination among various percussion instruments and the relative sounds are designed to generate unpredictable rhythms.

An example of a bar with double generated drums sequence:



The evolution of Complexity, The counterpoint and the interactivity among parallel generations.

All this is, naturally, only the first step in the generation of a musical piece.

To reach a richness and acceptable complexity, the generative program **MusicaBlu** operates both on the orchestra, both on the interactions among instruments and on the possible *counter melody* and *counterpoint* among parallel musical sequences.

This happens:

First, adopting the **counterpoint variations proper of the Fugues of Bach inside the transformation of the riffs**, a small sequence of a motif, when this motif becomes the structure of a melody. The used counterpoints are, as I already said, the inverse canon and the retrograde one, and, in the least part, also others proper of the Fugues of Bach or belonging to a geometric interpretation of possible symmetries and of the variation of points of view.

A really interesting possibility is the **variation of the point of view**, that is the change of the reference harmony or the change of the geometry of the time schedule or the change of other characters. These variations of the points of view transform, *as well as a possible unpredictable subjective interpretation*, the music in progress and give to the piece a range of unusual possibilities.

This use of different points of view is also used for managing the structure of the *counter melody*. Some instruments have this possibility and, in front of each sequence of notes, a counter melody is produced and performed by another or by the same instrument.

An example of counter melody generated for a piano. The generated counter melody, in this case, is played by a piano too.



Second. The “players” themselves have, each one, a **peculiar character**: They are musically identified with *specific subjective attributes*. These characters are not related to the

instrument, that, by the way, could be changed. They belong to a peculiar feeling that should suggest us to think to a soloist with a recognizable identity of his music.

Naturally these "soloist" are interpretations of the musicians belonging to my musical background. I could call them Milt Jackson, Miles Davis, John Coltrane, John Lennon, J.S. Bach, W.A. Mozart... The philosophy of this generative approach is constructed in a way that **each reference has its own peculiar identity but these identities are managed through generative interpretations for constructing the own subjective vision**. As happens when, in the history of art, each artist made own artworks by redrawing his masters: Picasso did it with Velasquez, Francis Bacon done it with Van Gogh, The Modern Jazz Quartet done it with Bach, quoting only some examples. And it's clear that the results were not copies but creative interpretations following and expressing the strong subjective visions of each artist.

These are the first results of Musicablu. It's clear that the steps for reaching real recognizable, harmonic and melodic results, are really *hard*. The walking is in progress toward new codes.

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J.S.Bach, Art of Fugue and Goldberg Variations

W.A.Mozart. Sonata in C major K545

J.Coltrane, My favorite things, Bessy blues, Afro blues

Beatles, Yesterday, Hey Judy, Imagine and other songs.

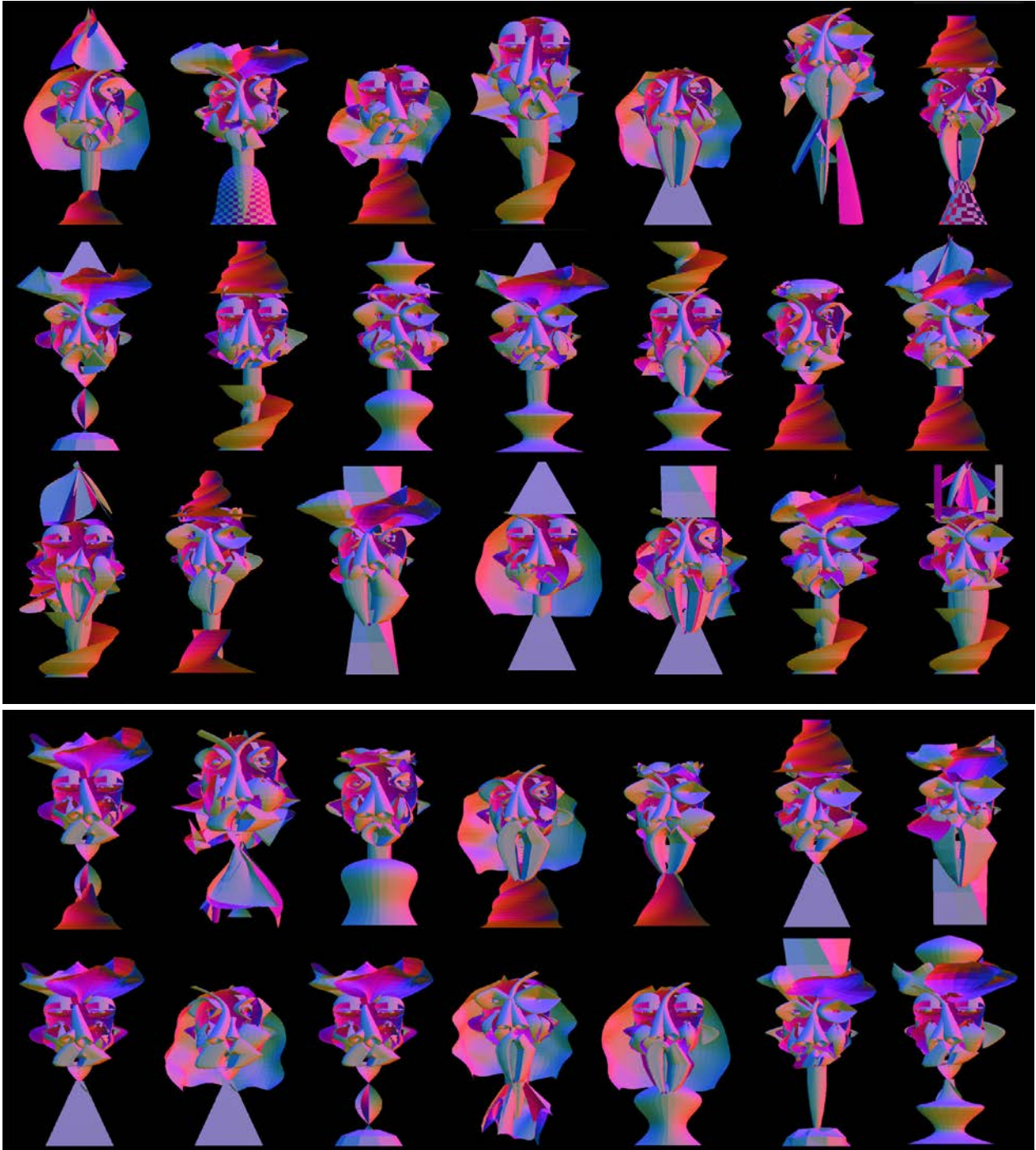
Modern Jazz Quartet, Blues on Bach, 1973

Anton Webern "Der Weg zur Neuen Muzik" 1932-1933

Celestino Soddu, "Music Generative Design", Gasathj Journal #2, 2013

Projects made in 2013:

"D'apres Francis Bacon"

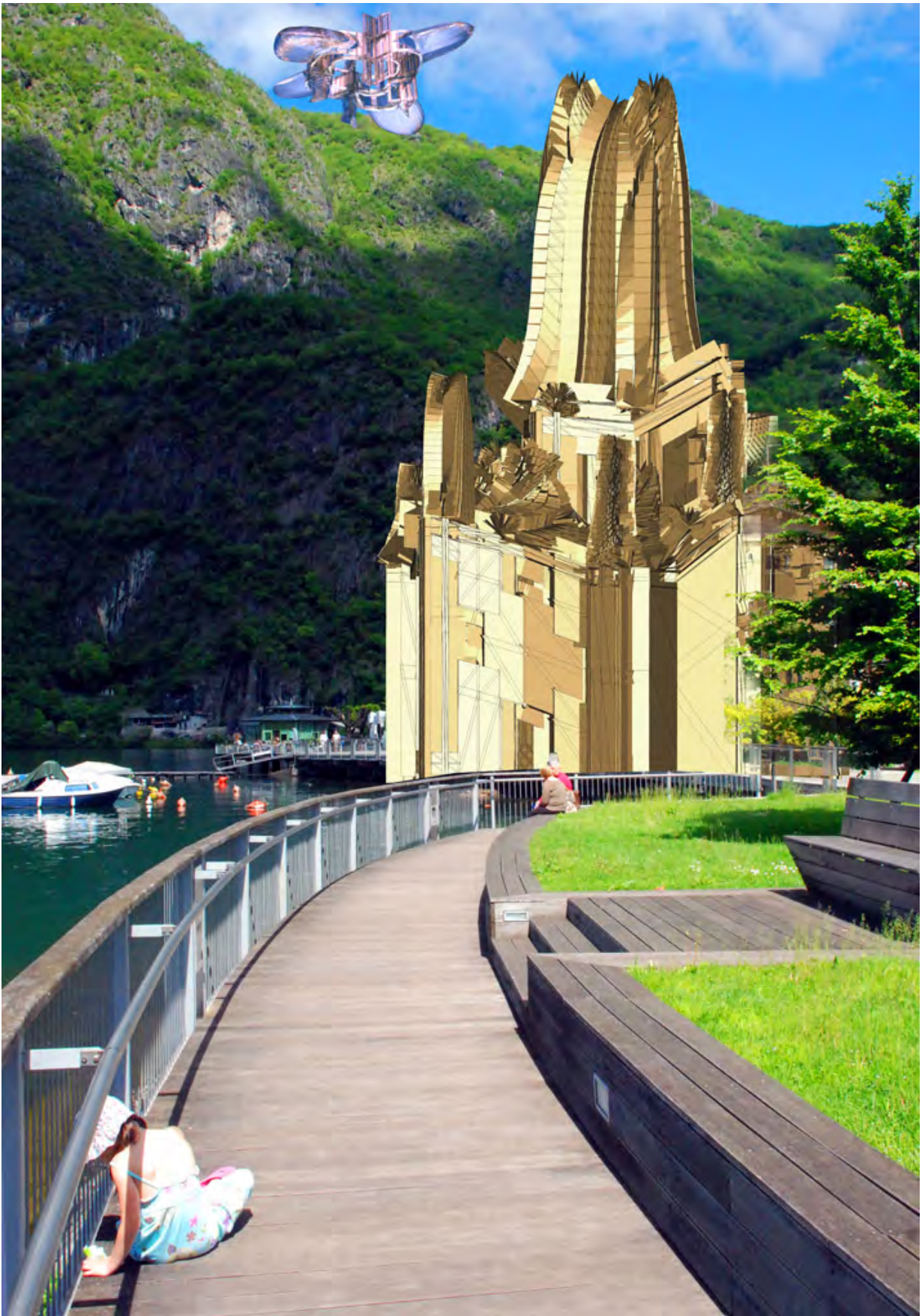


As Francis Bacon made repainting, following his own interpretation, the portraits of Van Gogh, the same I tried to make repainting, followin my own interpretation, the portraits of Francis Bacon.

Porlezza 2013. Generative baroque architectures in the site where Francesco Borromini was born: the lake of Lugano.



These generative architectures were created using my baroc algorithms created interpreting the possible rules used by Borromini. As known, Borromini didn't wrote his own constructing rules but, as all the main artists, destroyed all that could seem an explanation of his design process. So we can only interpret his architectures and create possible design processes.











A tower in the lake of Como, as seen from my home



Brussels, generative architectures trying to interpret the Brussels city identity.
These architectures were generated for a lecture in Brussels.







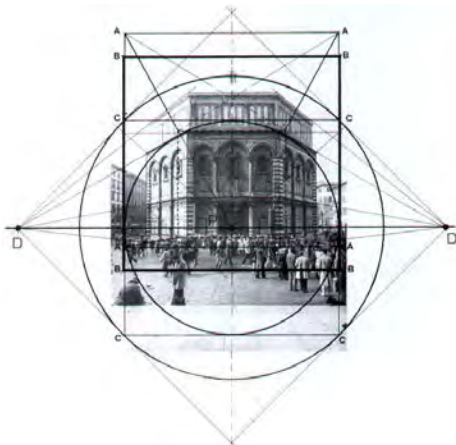
Generative Art Geometry. Logical interpretations for Generative Algorithms.

GA2014

Abstract

This paper tries to identify the creative processes of Generative Art that bring to the construction of dynamic procedures of transformation, generative algorithms, by departing from interpretative logics. This construction becomes possible through a dynamic approach to Geometry. In fact, overcoming the logic of the figures and related rules, this approach opens to the logic of the progressive processes and to the dynamics of transformation of the geometric space.

This dynamic use of Geometry can be performed crossing again the revolution operated by Brunelleschi, by Piero della Francesca and by Leonardo da Vinci. This Renaissance revolution funds on the convergence between Art and Science and on the discovery of the Perspective Logic.



The "formella" of Brunelleschi interpreted by P.A.Rossi indicated that Brunelleschi made a peculiar, not casual choice of a point of view, with a distance from Battistero equal to the side of a cube involving the architecture and the optic cone, indicated by the circle, able to have a correct perspective. This was the approach for defining the structure of perspective the "perspective tool".

Paolo Alberto Rossi, "La scienza nascosta", (the hidden science).

Quoting Decio Gioseffi, "The perspective has been the first mathematical (in systematic and univocal terms) formalization of a "physic" law indefinitely "extensible", of general validity and general verifiability".

The perspective, also in the first geometric tools structured by Brunelleschi, is a logical form of representation of the space that allowed, for the first time in human culture, to represent the infinite. The Perspective performs the representation of the infinite identifying a point of view. This means that the complexity of the space is scientifically investigable through the subjectivity of an observer and his Logical Interpretations. The scientific search, in fact, can

also follow the same interpretative way pointed out by the perspective. Until now, as shown by Einstein and his logical interpretation of the universe through the theory of Relativity, together with Max Planck and his quantum theory that is a different logical interpretation of the universe. Both theories are useful and true, also if so in contrast one each other. The points of view are different but the matter is the same.

Generative Art pursues this interpretative approach. And it does it redrawing its tools starting from the main one, the Geometry. **The interpretative logics, activated by Generative Art, build parallel, multiple and progressive paths of dynamic transformations. These are managed through algorithmic logics.**

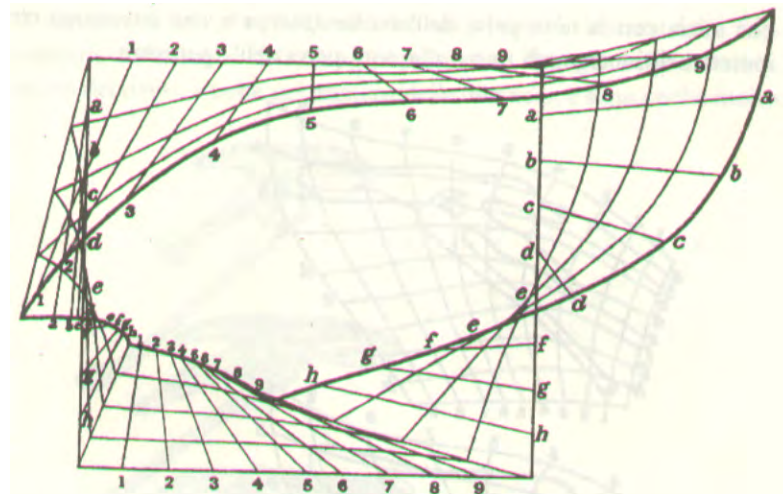
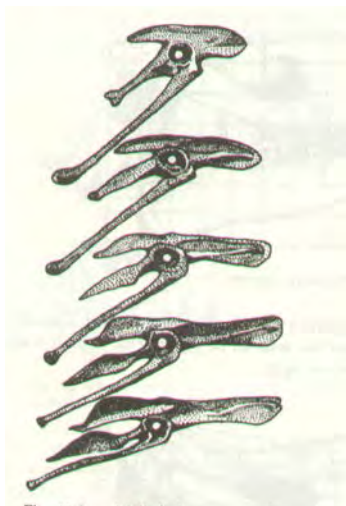
The Generative Geometry really becomes one of the main tools of Generative Art because it is able to logically represent the interpretation of the author performing his artworks in the endless multiplicity of the possible variations.

The act of writing Generative Algorithms is representing and investigating the existing environment from different and progressive logical points of view, tracing the rules for transforming it from the past into the future.

The generative geometry

Geometry is one of the main fields involved in the construction of the generative algorithms. Not only for architecture, design, and visual art, but also for music and poetry.

Since Generative Art moves from static forms to progressive transformations, Generative Geometry should be considered as the main tool for managing dynamic processes of transformation. Generative Geometry moves from geometric figures to the representation of dynamic logic processes, from measures to dynamic proportions, from measurable figures to measures related to a point of view, from representations of limited spaces to representations of infinity.



The transforming progressive process from Archaeopteryx to Apatornic following the Logical Interpretation of D'Arcy W. Thompson, "On Growth and Form", Cambridge Univ. Press, 1961. The Geometric structure is considered in an analytical way following Durer, as a series of deformations. But I like to interpret, with generative geometry, his analytical tables, like the one in the image: a transforming process could be identified because the image looks like a "perspective" representation.

Exemplifying, such potentialities could be represented by the passage from axonometric representations to perspective views, the only ones that logically represent the infinity. But

not only. The Generative Geometry is much more.

The construction of generative and geometric algorithms is based more specifically on logical interpretations of what fascinates us, by fixing our point of view. It's also a way to represent our main references, our preferred results of the past: the work of our main masters. Not copying them but interpreting them as results of a possible progressive process of transformation able to perform the quality that we appreciated. The aim is to construct procedures able to bring our design process in reaching such qualities.

Not analyzing these qualities but identifying which quality we like to transfer to our artworks, which quality corresponds to our own vision. This goal is performed by clearly identifying the point of view and the objective.

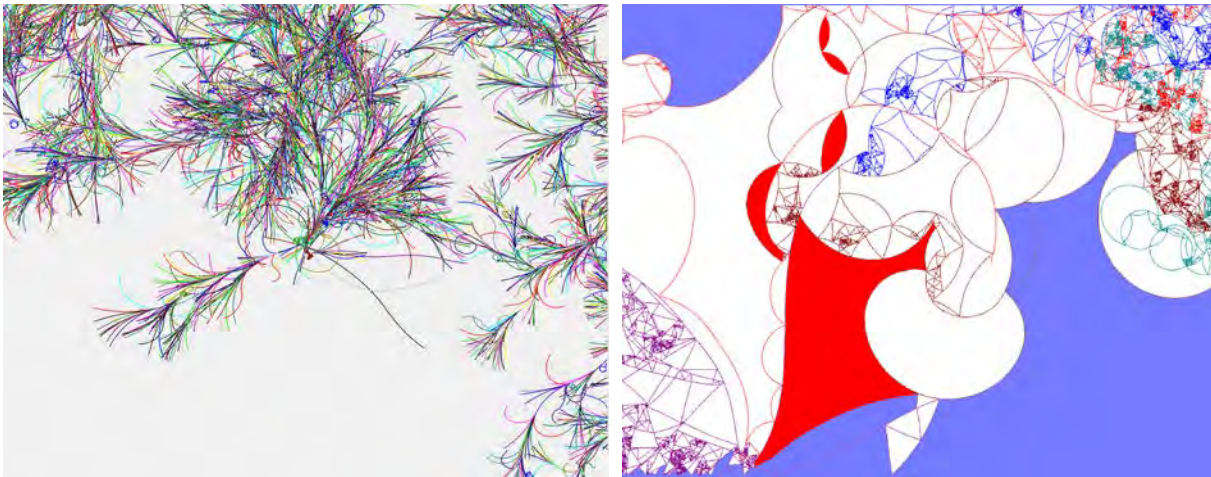
Operationally we are not doing copies of forms that interests us for the construction of a code, of a rule that represents our hypothesis: "how" we can construct events with the character that we like. And we will try to use these rules for managing the progression from the existing events to the possible ones; in other words for designing or making art. The logical-geometric interpretation of our imaginary of reference, of the works of our masters, of what fascinates us, is the core of the construction of a generative engine and of our creative tools.

In my generative design, I have had a preference for the specific field of 3D space, also because my main sector of interest is architecture. But the Logical Interpretation of Geometry starts from one-dimension and two-dimension events as Kandinskij points out in "point, line, and surface". We can find the most simple experimentations of using interpretative logics and managing the progressive dynamics when we construct lines through the generation of progressive points governed by rules. If our reference is the curve structured by Kandinskij, we can build an algorithm that defines, in progression, the following point through the progressive transformation of some parameters able to point out the verse, the dynamics of variation of the bending and the points of catastrophe where the direction suddenly changes, the progressive acceleration, the dynamics of variation of the thickness, etc.

We will never succeed in representing the famous line by Kandinskij (also because we don't like to copy it but to generate a kind of lines fitting similar aims) but we will produce a whole series of lines that represents the character that mostly interests us. The aim is to represent this characterized line with a transforming rule able to always turn a point into a different line but every time belonging to the same species of lines. So we have built a simple generative algorithm. And we have also represented an "ideal" line as whole possible dynamic representations of a point in relationship to the precedents and the following ones. *An Idea is "generatively" represented only when this "representation" can produce endless variations of the same event, all belonging to the same character.* As, in Nature, a sequence of very different olive trees are all recognizable as the olive tree. Variations are infinite because there is no limit to variations of individuals belonging to a species, of representations of the same objects belonging to the same logical interpretation but changing the point of view.

Increasing the complexity of our approach and moving over the simple one-dimension geometry, we can build other algorithms able to define other dynamics of transformation. We can use them in the transforming process from a point to a line, from a surface to a solid, but also in each possible process from a dimension to the following one.

Remaining on two-dimensions, if we, for instance, have as reference the refraction of the light in a prism of glass, we can write an algorithm that, when our progressive line meets another line with particular colour, it defines how it breaks in a series of divergent lines that, after the "impact", will have autonomous life.



On the left a generation of lines that break themselves in a series of different lines when they impact with other lines with selected colors. On the right generation, a line inverts its angle of growing when impacting with another line. (simple experiments by C.Soddu with his soft).

But, as it appears obvious, we are already moving toward an increase of dimensions. The acceleration already points out another dimension that can be represented in various ways. The simpler three-dimensional generative process is the logic of cellular automata when this kind of process is activated in the three-dimensions.

It is difficult to imagine the final result of these progressions even if we can foresee of it, but we can predetermine its character: nothing is left to random and all depend on the spatial topological location of the first events and of the adopted rules.

We can talk, in this case, of a progressive logic, of the first kind of generative approach to geometry. But it foresees an intrinsic difficulty to manage own spatial vision and the characters of each possible result. For doing that it is necessary to experiment and to find connections among the adopted rules and the character of the results. This search is possible because the logical sequence of the transformations is fully controlled by the rules. Even if we can surprise of unpredictability, and sometimes of the unexpected beauty of the results, this happens without using logical random but only varying the mutual initial positioning of the events.

And here a fundamental aspect of generative processes appears the use of random parameters. Firstly we need to clarify that the use of random for the initial data as the positioning of the first events in a process of cellular automata or the first points in the construction of lines through the logical progression of points, are really different from the creation of random forms and the subsequent choice of the form that casually can emerge.

This difference can seem meaningless but it is fundamental.

1. The use of casual data as the beginning of the transforming process is similar to the logical consideration of an existing and unpredictable environmental context in which to activate a progressive process totally managed by well-defined transforming rules able to interact with unexpected events.

2. The use of random parameters in the construction of formal results is an aesthetical blind search instead of following own vision identifying us as an author. It defines an approach that seeks the emergent form from a process totally deprived of controls. It pursues the "death of the project", "the author's death", quoting R. Barthes, with the impossibility to recognize the author vision and identity.

The first type of approach with using different initial data is also a characteristic of my generative software: I manage the oneness of the results and the relative variations using an initial data that always changes: a number that synthesizes date and time of the beginning of the process. Then everything happens without randomness but the results, also being recognizable as belonging to my own vision, are absolutely unique and unpredictable.

Generative Geometric figures

We need to go over the cellular automata, that are only a particular even if extremely meaningful study case of transforming process without random. The generative geometric logics are founded upon different logical interpretations of the same geometric entities. In the generative geometry, for instance, a cube is never the same geometric event, but it depends on the logic adopted for generating it.

It could be generated defining an algorithm representing a dynamic series of solid that can go from the tetrahedron to the sphere. Or with an algorithm generating solids with two shapes existing in an orthogonal axle. Or with an algorithm representing the dynamic series from a cylinder to a triangular prism, and so on.

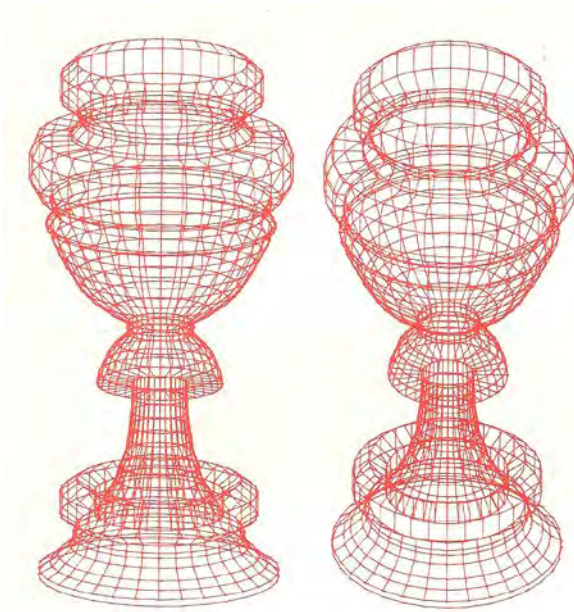
And we could nearly define an endless series of logical interpretations of a cube that would bring to a series of solid of generative geometry that, in the construction of the generative algorithms, they totally behave in a different way.

This is the base of the generative geometry.

If the Geometry is defined as "*part of the mathematics that studies the space and its figures*" **we could define the Generative Geometry as "*part of the mathematics that studies the dynamics of the spatial transformations and the progression of its figurations.*"**

Generative Perspective Geometry

But Generative Geometry would be a sterile branch if there was not the perspective. It is not a case that the perspective, and its first logical form identified by Brunelleschi, has been a revolution in science. The identification of a logic perspective, or more rather of a based logical structure of points of view and observed events, allowed a scientific approach based not only on deductive analysis but also to Logical Interpretations whose multiplicity is based on the points of view. The first and fundamental aspect of this "scientific innovation" have been to discover that these logical interpretations are able to acquire the infinite and "to measure it" giving an essential impulse to the human knowledge.



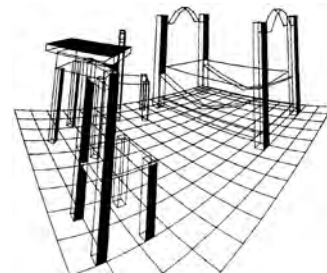
The calyx of Paolo Uccello attributed also to Piero della Francesca in a logical perspective computer reconstruction by Celestino Soddu, 1985, printed at pen plotter.

The reconstruction, quoting Carlo Ludovico Ragghianti in Critica d'Arte n°8, 1986, follows the very particular geometrical approach to perspective by Brunelleschi, interpreted with algorithms ad hoc.

This algorithmic approach was one of the first perspective scientific software in the world. The study and the articles made by C.L.Ragghianti, P.A.Rossi, and C.Soddu, was part of the research "Art Processes and Visual Objects Computer Analysis" developed at the International University of Arts in Florence.

The logical interpretations of spatial events could use different points of view and different perspective logics. These are not limited only to the perspective of Brunelleschi but they can also involve other perspective logics as the curved perspective, the anamorphic ones and the inverse perspective of Florenskij, as well as the three-dimensional representations of events with more than three dimensions.

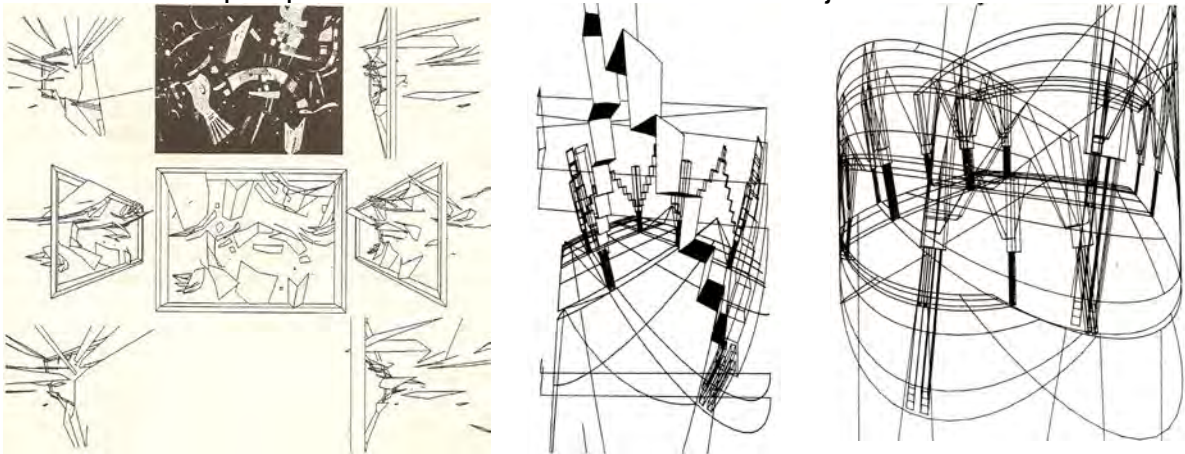
We can start with simple examples. The choice of the point of view and the logical structure of the perspective, identifying a peculiar logical interpretation of the space, can define the character of the artwork and the vision of the artist. Two examples are very eloquent. The "Flagellation of Christ" by Piero della Francesca and "the room" of Van Gogh.



"Flagellation of Christ" by Piero della Francesca and "the room" by Vincent Van Gogh. On the right a reconstruction of the room with a curved perspective from another point of view but with the sight toward the ceiling as the original image.

In both these artworks, the perspective image is paradoxical, absolutely particular and hardly verifiable in the reality. Also, if they both seems to be "normal" at the first sight. In the "Flagellation" the observer is very low, almost to the floor, and he looks toward the direction of the flagellated Christ. From that position he could not see in full the three figures, being these, of fact, out of an acceptable optic cone; he would see only the low part of the dresses. Instead, forcing the geometric structure of the perspective the three figures are fully represented. The use of this point of view constructed an estranging image but geometrically "correct". And in this, it reflects and renders explicit the interpretative logic of Piero. In the room of Van Gogh (C.Soddu, "The not Euclidean image", Gangemi Publ. 1986, and

C.Soddu, "L'idea di spazio nelle rappresentazioni d'arte", (the space idea in art representation), in "Critica d'arte" magazine, n.16, 1988.) the perspective seems, at first sight, a normal perspective of the room seen by a standing observer. But the vertical lines converge upward. Since the observer is standing, taller than the bed and of the chair, these lines should converge downward instead. This converging is estranging because, to find again this possibility in a correct perspective image, or however in a "photographic" view, we must imply that the observer is, as he appears, more high then the objects but, at the same time, he looks upward. The whole room, therefore, would be seen with the tail of the eye while the observer (Van Gogh) is looking at the ceiling (that is not represented in the artwork) and the whole image of the room would be, in a certain sense, out of a "normal" optic cone. This posture represents, through the perspective logic, the discomfort, the character and the vision of Van Gogh. In the use of an "impossible" perspective image, we can find something in common between Piero della Francesca and Van Gogh. Both have used the perspective geometry to clearly communicate a strong subjective vision of a "normal" spaces. And this has produced a spatial order strongly interpreted but, also if impossible, logically correct. It shows how the perspective science can communicate subjective visions.

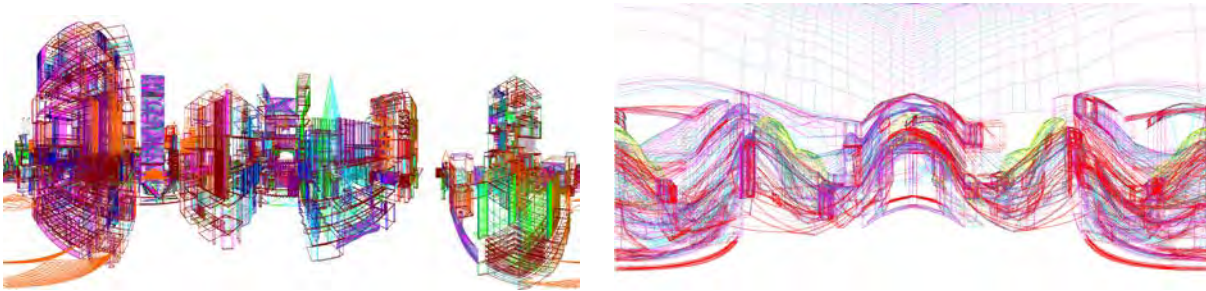


1st Image, a 3D logical interpretation of a Kandinskij artwork (C.Soddu, 1987) and (2nd-3rd image) some unusual perspective images made forcing the algorithms of the perspective. When the distance change beyond its "natural" limits, if we use algorithms following the logical approach of Brunelleschi the image break itself and some elements move from one side to the other of the sheet. This happens in a different way when forcing the algorithms of curved perspective. (C.Soddu, "Not Euclidean Image", 1986. (4th image)The same approach in one of mine oil painting (C.Soddu, "Guggenheim museum NYC", 1986) where the image is reconstructed using a spherical anamorphic logical interpretation forced beyond the limits of this type of perspective.

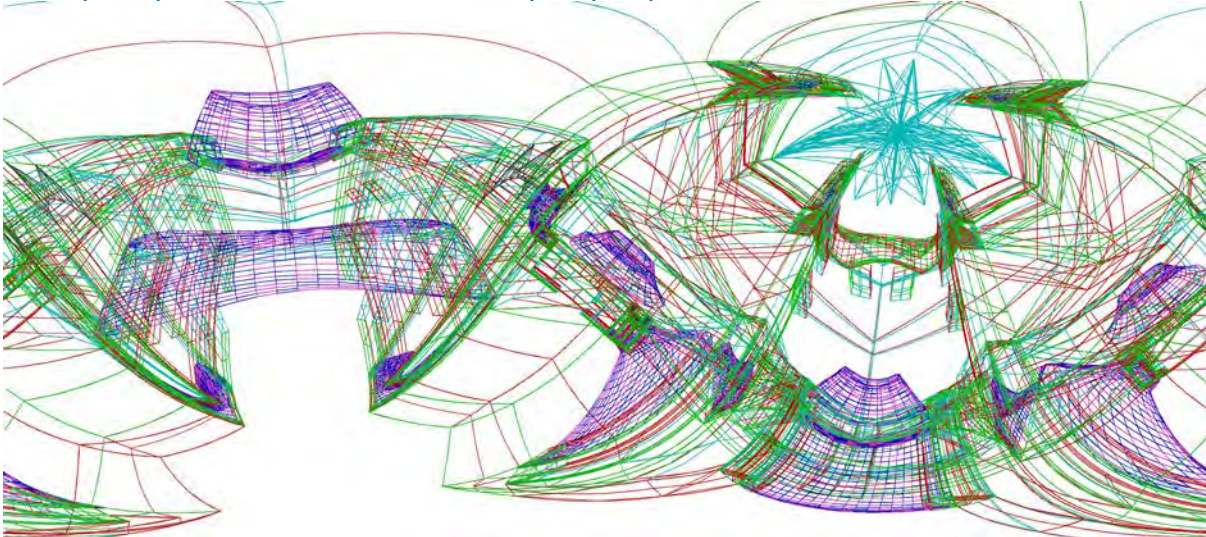


The logic to represent the events identifying points of view and observed events has allowed building different perspective logics. While the perspective of Brunelleschi and Piero della Francesca identifies an observer and an observed point, other perspectives as the cylindrical and spherical anamorphic perspective, of which I have built in 1986 the algorithmic sequences, identifies one point of observation and a linear (cylindrical) sequence or a

surface (spherical) of observed points.



In these cylindrical anamorphic perspectives, representing a generated city and the interior space of a generated cathedral, the observer is in the center of a cylinder constructed by the image wrapping the cylinder. This is the reason why the left border and the right border of the images coincide. The observer can rotate his sight looking at all possible directions. The anamorphic structure of the image answers to these different sights with a "correct" perspective image by straightening the curved lines in the perception. C.Soddu, total anamorphic perspective is done with his software.



In this other total anamorphic perspective of a generated architecture the sight is oriented to the dome (and, on the other side to the floor, being a 360 degree sight. C.Soddu, software "totale" 1988.

This is the first possibility to go over the Brunelleschi perspective going over an axiomatic visual direction, opening to not Euclidean geometries. But it's possible to go ahead. The inverted perspective, identified by Florenskij in the Russian icons, inverts the direction between the observer and observed point. Here, contrarily of the anamorphic perspectives, the points of view become manifold while the observed point returns to be unique. And this is indicative of the peculiar use of Russian icons: a multiplicity of people (points of view) looking at the same event, the face of the Saint. ("Perspective, a Visionary Process: The Main Generative Road for Crossing Dimensions", C.Soddu, Springer, 2010)



As Florenskij argued, the Russian icons have an inverse perspective. It's possible to understand this inverse perspective because you can see, at the same time, the two ears of the Saint as we look from the inside of the head, or from the inside of a cube where the image is anamorphically projected (top fig.). The Inverse perspective is focused by Florenskij saying that we only see the external surface of the objects. In this case, the image (bottom fig) is the same but the cube is inverted and we look to its external surface.

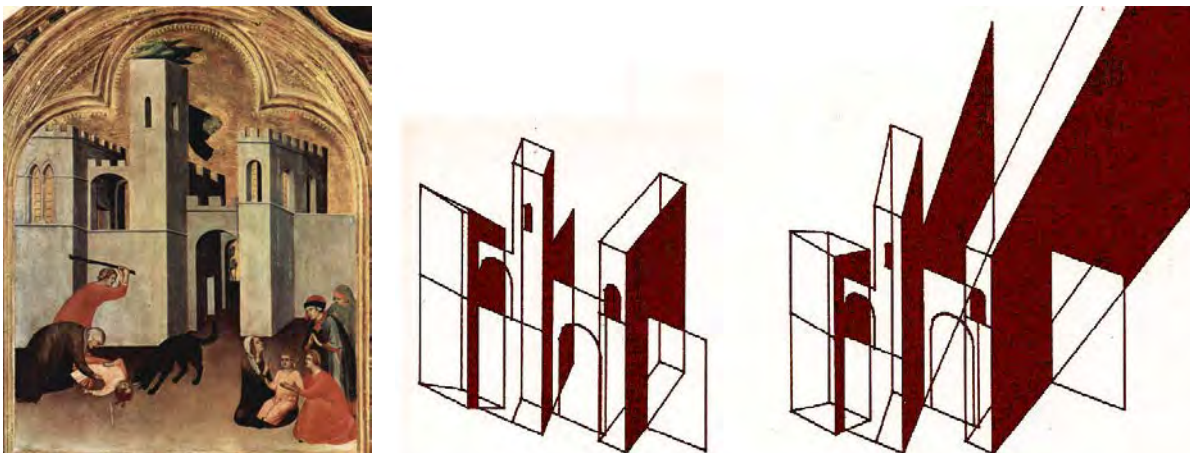
This approach using different perspective logics and the related construction of generative algorithms opened the possibility to "logically" interpret in a different way the same event. The different points of view, all together, can refer to possible variations of the same logical interpretation, opening to the generation of endless possible results, endless individuals of the same species, recognizable through the same logical interpretation.

This is a way to collect our creative investigations, making them executable inside our generative software. It is possible to do that without creating a database but with generative algorithms. They, using as input different "points of view" are able to generate multiple variations. The interesting aspects of this type of generative approach are two: each result is different but each result is recognizable by the same logical interpretation, that is by the same "vision". In this way, the "author" can be expressed, and the style too. This is the reason why my generative software has a lot of pages of statements. I added them step by step by following my design activity during the last 30 years.

This "change of point of view" is normally used by artists, designers, and architects and it is of great utility in the creative process. As an example, today I got a step of my project, of my artwork. Tomorrow I go back to my work and, to go on, I turn the sheet on the other side and, doing that, I easily continue to draw. Making this simple gesture, changing the point of view, I can open new possibilities and I go on expeditious pursuing my vision and managing the complexity and the ability of my artwork to answer to different and multiple requests. Why not manage the same possibility in a generative software? We can do that by using the

generative geometry for constructing our algorithms.

In the generative process, and inside the algorithms, it's possible to perform this possibility and more. I can represent my event through a perspective representation and then I can perform the reading of this "virtual image" as a 3D object represented using a different point of observation. This can be performed according to my logical interpretation, as happened in the medieval artworks by Simone Martini. He made different representations of medieval cities. But when he represented each building, he did it with different points of view. I discovered that it's possible to interpret these points as belonging to a 3D line: a virtual path showing the discovery of the medieval town. It runs from the outside to inside the city wall. In other terms, Simone Martini has used the selective variation of the points of view as a way to represent the fourth dimension in a two-dimension image. (C.Soddu, "L'immagine non Euclidea", "the not Euclidean Image", Gangemi Publisher 1986)



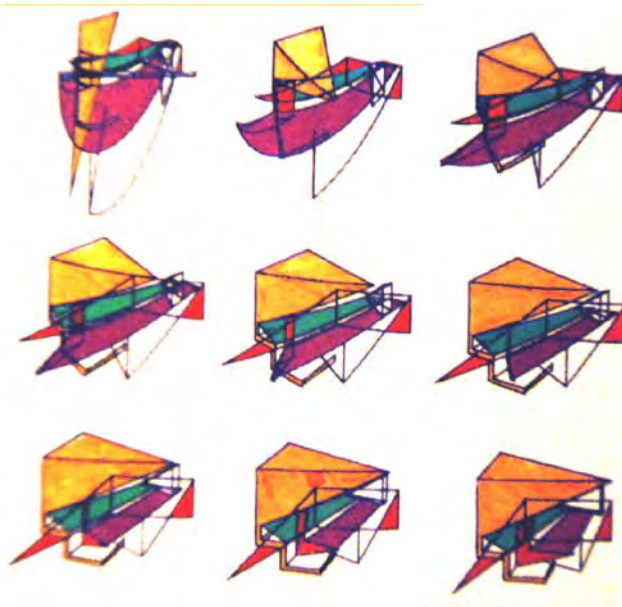
Simone Martini, tempera on panel, 1328. Looking at the different buildings it's possible to verify that each building seems to be represented with a different perspective view. This "interpreted" points of view create a 3D line from outdoor to inside the medieval city. We can interpret it as a representation of the 4th dimension in the two-dimension image. In the right image two frames of the transforming sequence of the solids following the path of points of view. C.Soddu, "L'immagine non Euclidea", "The not Euclidean Image", Gangemi Publisher 1986.

My opinion is that Simone Martini used, for drawing his artwork, the Generative Geometry. And it's possible to find this type of approach in Giotto too, and in some medieval artists living before the systematization of the perspective tools made by Brunelleschi.

If this process is used in the creation of the space, the form of every three-dimensional solid transforms itself in progress, assuming different results and performing events that have characters fitting the vision of the author. Spatial orders and characters that are logically reproducible through algorithms because the process is repeatable.



Balla, "Mio istante del 4 Aprile 1928 ore 10 piu' due minuti". 1928



Moving from the image as a canonical perspective to a not Euclidean perspective and going back. If we read the not Euclidean perspective (first image of the sequence), as Brunelleschi perspective we can have a completely different object with rounded solids. C.Soddu, 1986.

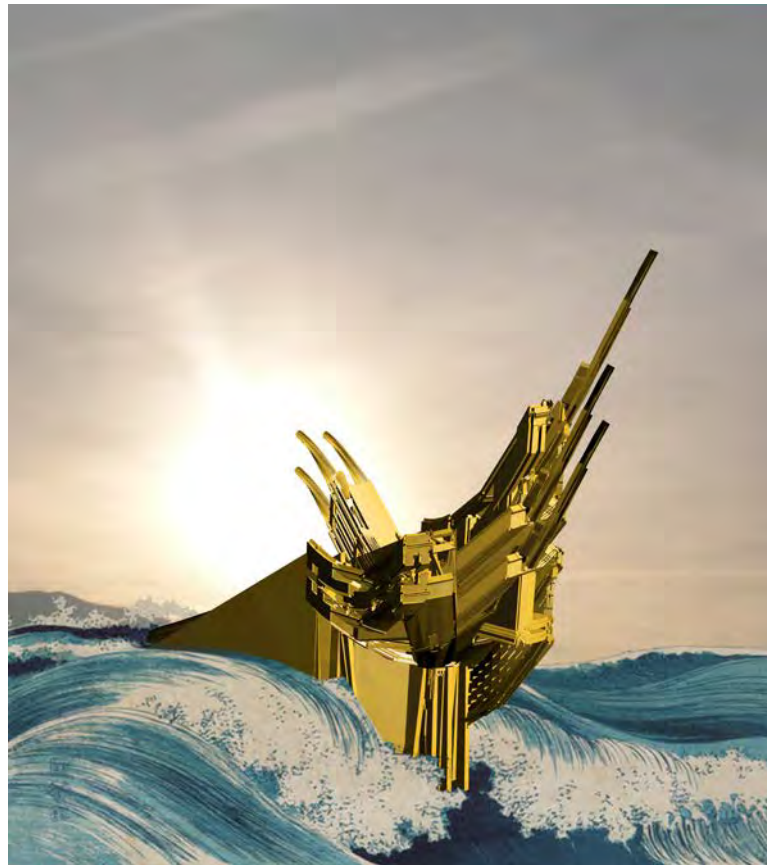
More. We can try to read a canonical perspective as it was a curved, not Euclidean, perspective. ("The not Euclidean image", example of Balla, C.Soddu, Gangemi Pub. 1986) This generative process can produce complex solid events that reflect our spatial vision. In that case, the results are rounded solids where the curved lines are strongly controlled by an intrinsic harmony, the same harmony of the previous square solid but different fascinating. Logics are mathematically describable, therefore, the construction of these generative algorithms is easily prosecutable, together with the objectives and to the characters that they intend to pursue.

Following the same approach, a reverse perspective of a cube, for example, can be read as canonical perspective assuming that it is a 5 sided prism. The increasing from 4 to 5 sides transform the solid in a generative way moving from a logical geometric interpretation to another one. ("Perspective, a Visionary Process: The Main Generative Road for Crossing Dimensions", C.Soddu, Springer)

This is the Generative Art Geometry. The hardcore is constituted by the logical sliding among different representations, among different spatial dimensions.

In fact, another possibility can be performed by sliding from a dimension to another. The base is moving from two dimensions to three reading a two-dimensional image as was three-dimensional and vice versa. But also managing through interpretative logics the passage from three to four dimensions, from the cube to the hypercube by reading this last event as three-dimensional.

The creative world of Generative Geometry is extremely wide, and above all, it can fit the own vision. It can logically reflect our uniqueness of creative people, it is the logical world where we can identify and develop our vision as our style.



On the left a generated baroque cathedral, together with a UFO and a car, all generated with Argenia software, C.Soddu 2013. In the right image a Generated Ship in a Japanese Sea, C.Soddu, 2014. The sea is done interpreting the image of Hokusai, 1830. The ship is the result of a generative process with a progressive geometrical transformation using the same baroque algorithms but going over the predefined limits of these algorithms. Every personal tool is made for going beyond the default limits. As it's possible by using Generative Geometry.

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Generative Design Futuring Past

GA2015

Introduction

Generative Art is inspired by Nature. It proposes the logics proper of the natural events, from the creation of unique and unrepeatable events to the multiplicity of variations belonging to the same species.

But there is an aspect that appears really interesting and essential, and I should like to enlighten it with this paper: *Generative Art can perform the passage from Past to Future*. The memory of the past time doesn't exist if a past logical interpretation doesn't happen contemporarily. We need to re-thinking it in terms of progressive structures able to be used for the construction of future.

The human "*magnificent fates and progressive*" (Giacomo Leopardi), in other terms the construction of our future has always been connected with the ability of our memory and, progressively, with the ability to create artificial events based on our interpretation of the memory of our past as engine to trace a possible future. The logical interpretation of artworks to which we are inspired can be at the base of a generative structure, of the algorithms that progressively operate for producing future scenarios.

Generative Art is based on this structure of continuous progressive transformations.

Generative Design was born as "Art" to design a progressive path of transformation from the initial idea to multiple final results. Then all inside a creative running as "Art" to activate a progressive path toward the future.

Generation and Genetic Evolution

Just considering this peculiar aspect of Generative Art, we must appraise that a deep difference exists among the different souls of Digital and Algorithmic Art. Particularly interesting is the difference among the Generative approach to Art and Design and other approaches founded on the Evolutionary and Genetic structures.

The creative process of Generative Art starts from an idea still not expressed in events. We can identify this "*starting idea*" as a structure in *disequilibrium*. It is an *idea of "species"* defined only focusing some characters and references, but not already focusing a form.

The result, the "Generative Artwork", is the generative engine. This is as an artificial code, that we can identify as the progressive procedure of designing for increasing complexity. We can automatically manage this progression through algorithms able to control the subsequent transformations.

Still reporting this process to Nature, the starting point of generative processes is an embryo of which we build, through algorithms, its "artificial DNA": as a set of codes able to check and perform the progressive transformations toward a growing individual.

As we identified in 1992, (Enrica Colabella and I), in our book "Environmental Design of Morphogenesis" with the sub-title "Genetic Codes of Artificial Ware", the Artificial DNA has the ability to produce a nearly endless series of events, recognizable as an identified "species", by a generative idea, through a progressive path controlled by algorithms. The possible variations, that might be produced, are performed following too the interaction with

the "environment", in which this process is performed. In my projects, for instance, the extemporaneous impact with the "environment" is concretized by a set of variables that are always *naturally* different: the date and the time when the generative process starts.

All happens in different ways, by using genetic algorithms or evolutionary algorithms. The starting point is not an idea but a series of finished events, that operate like "parents" in the creation of "children", and so on. There is not a progressive increase of complexity but the starting points and the ending points are events with *comparable* complexity. In other terms, a generative structure of increasing complexity doesn't exist inside the genetic path, but the possibility to identify the best solution in a set of parallel alternatives exists.

The existence of a "*simulated time of growth*" appears as the difference between these two approaches. My opinion is that the "simulated time" could produce complex results; in the absence of this "time", we could only generate stochastic results. The generative approach proposes the use of the creative time following what happens in all the design activities: today I am interested in one possibility, tomorrow I can change idea and I am fascinated by another aspect. At the end, the design result answers to manifold different requests, sometimes in opposition. And the complexity was born.

The main aims of the generative approach are the progression and the multiplicity. The aim of genetic approach is the optimization toward perfection. Completely different also if both are useful. If we apply these different approaches to re-thinking the past for shaping the future, with the Generative approach we can trace progressive and increase complexity possibilities; with the Evolutionary approach, we can define an optimized possibility by managing the already done.

The first uses poetic logics, the second uses analytical logics

Equilibrium and disequilibrium

As every other creative activity, design is a progressive run of transformations. it cannot be born from an equilibrium but it needs an initial disequilibrium.

My opinion is that the results too cannot be static results, optimized, perfect in the sense of un-modifiable because possible changes might remove the aura of perfection. Also, the result belongs to the progressive path: it is perfectible, dynamically connected to a progression toward future.

In Generative Design, the result is never univocal. It is manifold as the variations are manifold in the fugues of Bach. Variations don't deny the possibility to perform events extremely harmonic and dynamically perfect. In Generative Design, nothing is "statically perfect", optimized; but every event is unique and un-repeatable, belonging to a species in which all the individuals represent together an "idea". They have in common characters and identity of a well identified and recognizable "species". No individual is perfect. But every individual, in their uniqueness, following their progressive disequilibrium, gives an essential contribution to the "*dynamic perfection*" of the species. We can identify the species perfection with an idea of progressive transformation from past to future.

If perfection means that the project cannot be modifiable, it will not be able to gain the increasing complexity of our time, stopping its time toward future. In practice, it might not allow the designer to go ahead. As final results, the generations of a series of variations open toward future, build results through the multiplicity of possible facets of the same design vision. These will give an essential contribution to the next generation of variations, that are a progressive creative reality, as in Nature.

Beauty and Harmony in *futuring past*

Very expressly, Generative Art opens the possibility to represent the progressive dynamics of past-future. It can work re-reading the past artworks by identifying their harmonic structures. Better it could run by logically interpreting, *through a peculiar creative subjectivity*, the structures of harmonic transformations identifiable in the past masterpieces, by transcribing them in algorithms.

It is not a novelty. This act has always been effected by artists of all times. This ability of Art gave an essential contribution to communicating the progressive evolving from past in future. What could appear as the static perfection of a masterpiece will be transformed in progressive harmony. Only quoting some of these "**futuring past**" actions, Picasso has done it, following Velasquez or Francis Bacon with Van Gogh. This is the main condition for tracing the innovation for the future.

My main aim was always to give my possible contribution inside this way of working. I pursued it starting from my first generative work, the "artificial DNA" of Italian medieval cities in 1987. I constructed a generative code by interpreting Giotto and Simone Martini paintings. I followed always this approach until my last generative work: "*Futuring Canaletto*", made by interpreting Canaletto for generating possible Venetian cities, that, in the appreciation of this marvelous city, try to break every residual concept of stillness. Venice as a city, that is not (statically) perfect but it is always able to fascinate us in multiple and parallel visions of its dynamic harmony. We cannot only relate this strong fascinating identity to peculiar repeated forms, colors or presence of particular events. This identity works through the multiple possible interpretations by progressive logics.

In my generative experiments on the past artworks identities, a constant has always been the consideration of their "*patina of time*", more than their formal characters. This aspect concerns what appears "transformed by the time" more than what appears "perfect", as just finished. I must admit that this approach to the masterpieces of Art, Architecture and Cities could be considered as a "very" Italian approach. Piranesi, in his, engraves on the Roman ruins, identified and interpreted this "time patina" in an exemplary way.

Obviously, different approaches exist. The meticulous reconstruction of the past as perfection, as it is pursued above all in a systematic way by Chinese and by some other oriental cultures, is proper of a particular concept of beauty perfection that doesn't find a comparison in the Italian approach. It would be interesting to appraise, in these cultural approaches, how Art supports the maintenance of these cultural identities in the progression from the past to future.

Identification and Construction of Generative codes.

For doing that we have to follow the subsequent steps:

1. Interpreting the past masterpieces for defining the geometrical structure and spatial relationship with the aim of performing a topology of these past events (cities, artworks, music).
2. Finding Disequilibrium. We must identify a point of view able to help us to interpret with algorithmic dynamic structures the past events, also if they seem, at the first sight, to be static.
3. Designing a non-linear structure with generative algorithms able to represent our interpretation.
4. Generating manifold variations able to represent, from different points of view, our complex vision of the past events. And verifying that their identity and our design vision remain well identifiable in their difference, also if interconnected in the generated scenarios.

Futuring Past projects

I would like to shortly re-run some of these experiences of mine about *futuring past* working with generative algorithms.

Medieval city and castles. At the beginning of the eighties, when I was wondering how to build the first generative project able to produce 3D models of Italian medieval city, I had made a real important choice. I had available a lot of Italian medieval cities enough well preserved and with an abundant analytical and historical documentation. But I have preferred to use, as a reference, the artworks of artists like Giotto and Simone Martini where they represented these cities in their paintings and frescos following their visionaries feelings. I have also had a preference for the "perspective distortions" present in these artworks. According to my logical geometrical interpretation (my book: *The image not Euclidean*, C.Soddu 1986), it didn't deal with distortions but with the creation of a disequilibrium able to transform these artworks in "visionary dynamic visits" to these cities. These virtual tours showed the subjective interpretations of these artists by clarifying and communicating, in a logical geometrical way, the characters of their medieval towns. So, the faster and best way to approach the complexity of medieval towns was finding a possible logical interpretation of these artists and operating, on this discovery, my progressive interpretative logic. This excluded any possible simplification, always connected to analytical evaluations of the existing environment. I succeed in directly considering the complexity of the events and, specifically, their disequilibrium as a powerful engine for the progression toward my future vision.



Fig. Generated Medieval cities. "C.Soddu, *Citta' Aleatorie*, Masson Pub. 1989

The first results have convinced me that medieval identity was not based on specific forms but on specific topologies, on dynamics of progression and on harmonies of relationship. The forms easily appeared interchangeable. The relationships were essential to the appreciation and to the possibility of recognizing the identity I was looking for. And I have pursued this choice in the following generative experimentations: the interchangeable structure of the forms and the pregnancy of the topology.

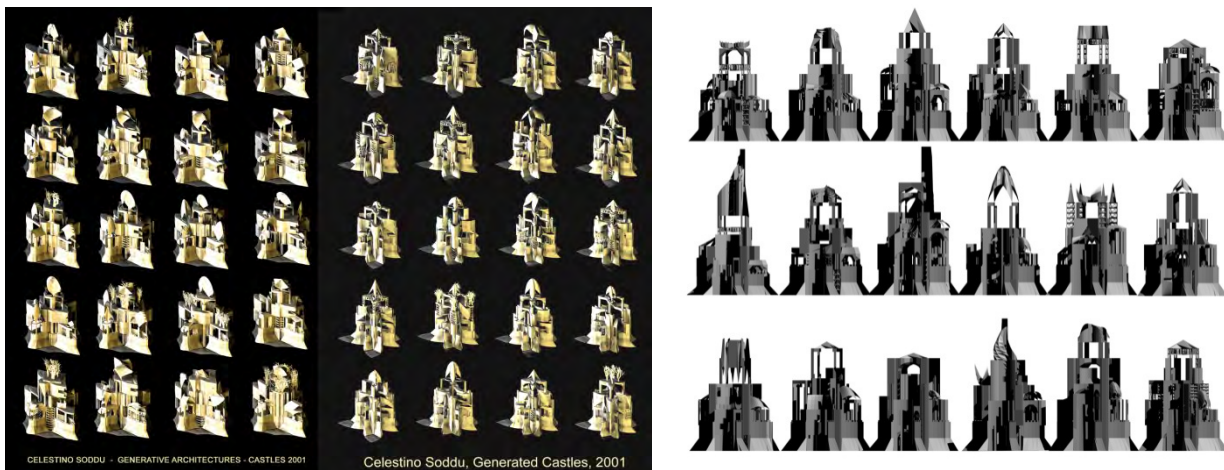


Fig. Generated Medieval Castles 2001 and 2003. Forms are completely different and are changing from a generation to the subsequent, but the character and topology perform the Medieval identity.

The main role of topology emerged also in the following experimentations on some American cities, New York City, and Chicago, of which I looked for the structure of the identity through generative codes. But not only. I was also discovering the importance of their characters, able to consolidate the strong dynamic image of a city living its time and looking to the future. So I tried to identify the Identity of this city, pursuing concepts of "ideal city", that each inhabitant has of his "loved" city, as "*a way to look at the future*". This identity process was clear from Hong Kong to NYC, from Washington D.C. to Los Angeles. And, obviously, also, when I tried to generatively approach the identity of Rome, Venice and other European cities "so loved" by their inhabitants.



Fig. Generated New York City, generated architecture in Chicago and Los Angeles (2002, 2003) trying to fit the Identity of these fascinating US cities.



Fig. Futuring Past with generated architectures in Hong King waterfront (2009), Brussels (2013) and Jerusalem (2011), looking for their identity codes.

Constructing the algorithms for managing these so different city identities, I discovered the strength of the small details and of specific progressive geometries, practically of small variations in the parameters used in the generative algorithms. Small variations were able to identify some characters of specific cultural identities. For example, the attempt that I made for generating an architectural event in Delhi, done on the occasion of my visit to India. Increasing just a bit the parameter of control of the possible fractal event repetitions had brought to a meaningful increase of the "Indian" identity in my generated events.



Fig. Futuring Past generating architecture in Delhi, 2006, and referring to the topology of the Ideal City by Piero della Francesca, 2004.

Going ahead, I have constructed the "DNA" of the city of Lucca in the same way. I operated on the topological structure and managed, with small variations, the previous "medieval" algorithms. I have generated a series of variations of possible Lucca cities that I have used for personalizing the covers of the proceedings of GA2012.

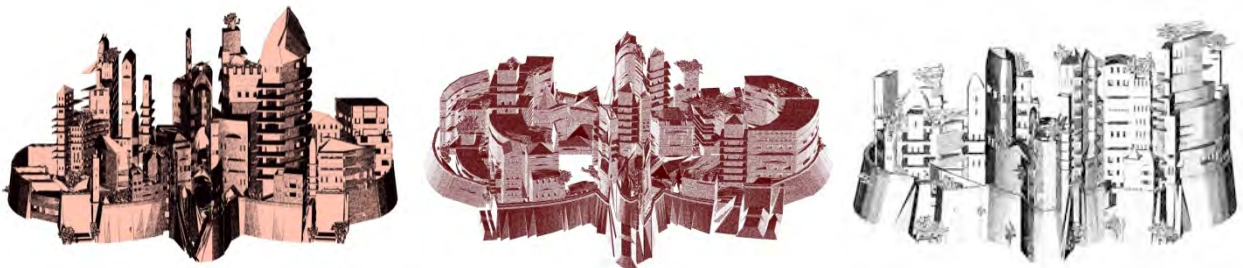


Fig. Futuring Past of Lucca by generating city variations, 2012.

My experimentation of Generative Futuring of the work of Gaudi, that is one of my masters, was longer and harder. Operational references to the catenary curve as geometry able to build the structures proper of Gaudi appeared too much obvious and too much simplified: not

able to bring to the complexity that is one of the characters of this architecture. So I have re-read some aspects of his work through progressive disequilibrium due to progressive variations of the verticality but, in the same time, by maintaining the topological structure of the connections among events. A hardly predictable generative structure was born, but full of charm. A charm that was not due to random, that I don't like in my works, but was due to the unpredictable emerging of formalized relationships among parts when these were transformed changing their progressive order. The results are recognizable architectural variations as interpretations of Gaudi, as an homage to this great master. But also as pushing his works to Future



Fig. Futuring Past Gaudi (2003) and a generated architecture for a museum in Milan used for the cover of Blueprint magazine (1999)

For Milan, in 2004 when, in Hong Kong, has been asked me to prepare an exhibition on Futuring Milan, I have decided to undertake an experience that can seem different but, for many reasons, it is not different from the previous ones. I decided to give back to Milan what Milan had lost as an essential component of its own identity. Milan has been the home of Futurism, but Milan has subsequently forgotten this component of its history and, today, few events remember this cultural past. I proposed this lost identity in about thirty new architectures generated for Milan; grafting on the consolidated components of Milan Identity the seeds of the Futurism. A "new DNA" of Milan was born, able to rediscover the potentialities of Futurist fever but, in the same moment, finding again, in a possible future, the progression of this lost identity. My aim was to bait a new futurist disequilibrium for the future in Milan, but it is not easy. (C.Soddu, Milan Visionary Variations. Futuristic Meta-Codes for Milan's Identity 2005)



Fig. Futuring Milan, Futurism museum variations, 2004

Visual Artworks are certainly a field in which the ability of Generative Art to communicate the progressive passage from the past to future seems to be immediate and extremely strong. I experimented that by interpreting the portraits by Picasso and Francis Bacon. These artists were experimenters of the Futuring Past too, working by interpreting Velasquez and Van Gogh.

Doing that I had a very important advantage. My main interest and acquired knowledge is the three-dimensional space. The main logical geometrical interpretation that I adopted has been the passage through different dimensions. In fact, I interpreted the works of Picasso and Francis Bacon reading them as 3D models. With this approach, I succeed in activating in the space some topological structures and relationships that I had identified as interesting in their bi-dimensional paintings. Moving from 2-dimensional events to those in 3D has meant to have to insert my own vision because, as it clear appears, it is not possible to increase the dimension from 2 to 3 without operating a subjective interpretation, without inserting further relationships among events and building new geometries. Therefore, the results have been 3D artworks, sculptures that I directly printed with the first 3D printers.

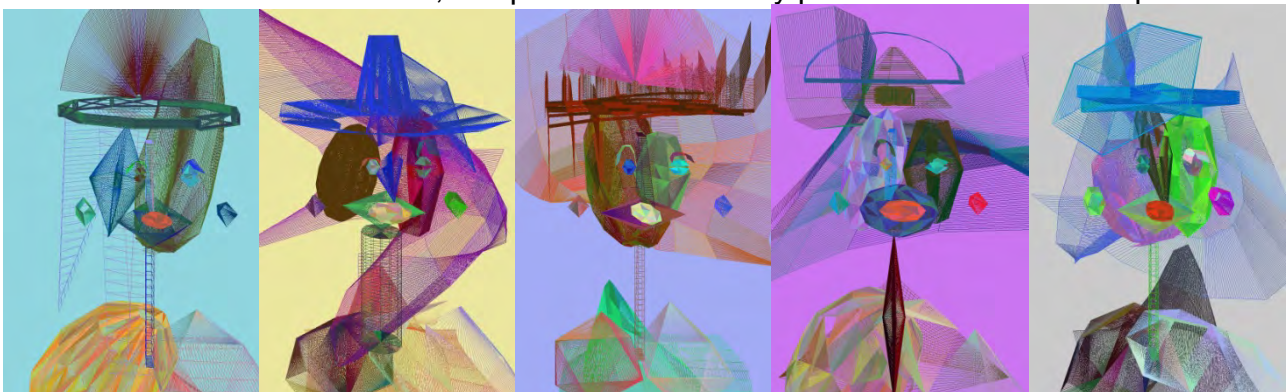


Fig. Futuring Picasso, Generated woman portraits, 1997.

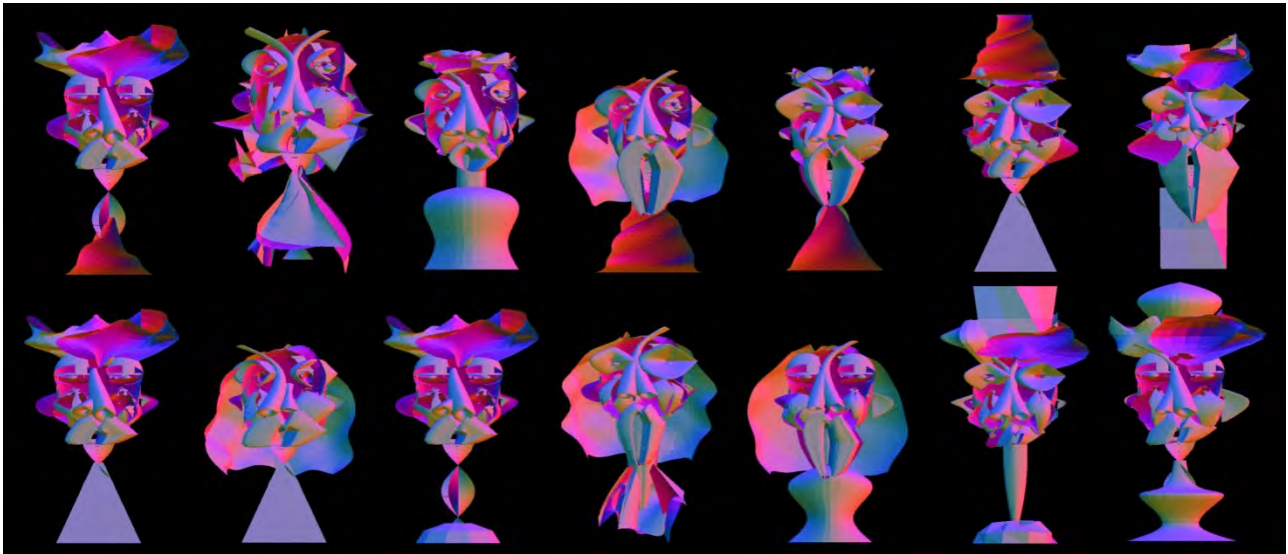


Fig. Futuring Francis Bacon, 2013

The most interesting discovery has been the practical verification that different identities don't annihilate one each other. The possibility to recognize past and future persists and it's stratified in the complexity of the results. The artworks still have two different identities: not only Picasso or Bacon but they have also assumed a clear possibility to recognize them as my artworks. The bridge between past and future has been created without copying the past but only with the increase of significance due to the interpretation. As it happens when in a strongly characterized city a new architecture is built. If the new architecture is not a copy but a subjective interpretation of the existing city made by a good architect, the identity of the city grows through this new facet of sense. This is the charm of ancient cities, but also of cities, like NYC or Hong Kong where the love to own city is strong and each possible interpretation is full of sense.

In all these works the starting point of creative acts is gathering the disequilibrium of the past. That is considering the past as alive. This is a generative approach: identifying the character of the "species" and increasing it with subsequent possible interpretations for performing further possible qualities. In fact, the results are variations, nearly endless, of three-dimensional portraits. Them, in my intentions, could increase the complexity of the memory and appreciation of the works by building further disequilibrium for a "progressive memory", consolidating a bridge between past and future.

In the engravings of Piranesi, especially in those representing the ancient Rome, the progression is explicit. The progressive disequilibrium is appreciable both in the content (Rome with an explicit "time patina") than in its structure. Piranesi operated in the time with progressive incisions on the plate, one after the other. Besides, in these progressive stratifications of contents, the perspective structure was slightly varied so that the vision of the work was "dynamic", asking the observer to virtually move when he considers a detail of the work. In 2008, I have tried "to continue" one of the works of Piranesi following this process of progressive stratification. I have in fact inserted in one engraving of Piranesi a series of variations of an architecture generated by me, a "Babel Tower". The result has been a series of prints that I have used as different unique covers for the proceedings of Generative Art conference of that year, dedicating every cover to one of the participants. Just this multiplicity of variations shaped a further and explicit disequilibrium dynamically connecting the past with the future.



Fig. *Futuring Piranesi: Generating Babel Towers*, 2008

Always using the engravings of Piranesi as an environment for my new architectures in Rome, I have tried to find again the contemporary sense of the Baroque architecture. More specifically of the architecture of Francesco Borromini. Here the generative approach has been focused on the geometries trying to dynamically read the complex geometries of the Baroc. In other terms, I have tried to read the geometries as generative geometries (V. paper GA2014). The most difficult moment has been when I needed to make dynamic the "perfection" of Sant'Ivo alla Sapienza, based on the equilateral triangles. It strongly appeared as static in its "perfection" as if it were impossible to push this geometry inside a progressive path able to produce variations. The attempt has been done by performing the possible dynamics of this geometry through an interactive transposition of the topological relationships among different geometric models. Following this approach, I succeeded in finding again a lost disequilibrium in the apparent fixity of the equilateral triangle (v. my paper GA2013).

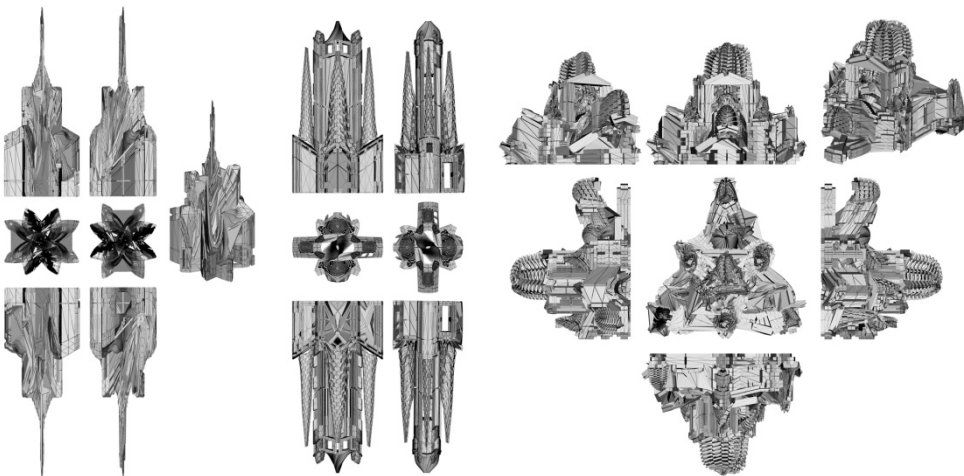


Fig. *Generated Baroque Architectures, redefining baroque identity with generative geometric systems*



Fig. Futuring Baroc and Rome Identity. Generated baroque architectures interpreting Borromini in Piranesi engravings, 2013.

Finally, the experimentation that I have done for Venice on the occasion of this conference. I would want to call it "Futuring Canaletto" for the reason why, as I have always done when I designed virtual DNA of cities, I didn't use as reference the physical city, analyzing single parts and aspects of it, but I have "progressively" interpreted the works of an artist that represented Venice by interpreting this "Ideal City": Canaletto. I have not only abducted from Canaletto the progressive geometric structure of the architectural and urban events but I have also interpreted his so important feeling for this city, that is a way to look at the future. More, Decio Gioseffi, the great expert on geometries and art history, said me twenty-five years ago, that my artworks remember him, Canaletto. I always asked myself why and, finally, I assumed that it was because of continuous progressive perspective, from the whole city to details. And I followed his indication. The architectures that I generated for these Venetian variations, as the urban orders, the bridges and so on, are not present in Venice. No copy or repetition of existing events, and not even a formal or deconstructive analysis. I also inserted, like Canaletto with daily Venetian events, a fashion generation for showing a typical contemporary event. The results would like to be, in my intentions, as an expression of the identity in the progress of Venice, of its recognizable DNA. Breaking, in this way, the static approach to Venice and giving back to this city a small engine to glimpse its Venetian future and the pride of a city that it is not only the static analysis of what is present, not only a museum, but a way to think progressive, a way to think generative.

Fig. Futuring Canaletto, variations #1 and #2

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Celestino Soddu

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His first Generative project, a software able to generate endless 3D models of typical Italian Medieval towns, 1987, was published in his book "Citta' Aleatorie" 1989. Together with E.Colabella he founded the Generative Design Lab at Politecnico di Milano in 1992 and, in 1998 they used for the first time the term Generative Art as chair of the annual Generative Art Conference, until now the leading international meetings on Generative approach, www.generativeart.com In 2011 they established the international journal GASATHJ, Generative Art Science and Technology hard Journal.

In 2002, he established the international network of Generative Design Labs as coordinator of an European Commission program with Milan, Eindhoven, Kassel, Shanghai and Tianjin.

He presented his generative projects and artworks in many lectures, conferences and personal exhibitions, including exhibits at Hong Kong Museum, IDB Cultural Center in Washington DC, Pacific Design Center in Los Angeles, Italian Embassy in Beijing, International Financial Center in Hong Kong and at Giureconsulti Palace in Milan. He is author of numerous books and papers in Italian and English. Video interviews and programs for international televisions were created about his generative research. More information in his website www.generativedesign.com

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