

Endless interpretations, infinite in the mirror

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Abstract

Inquire about problems of design in our time of globalization, mainly the loosing 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.

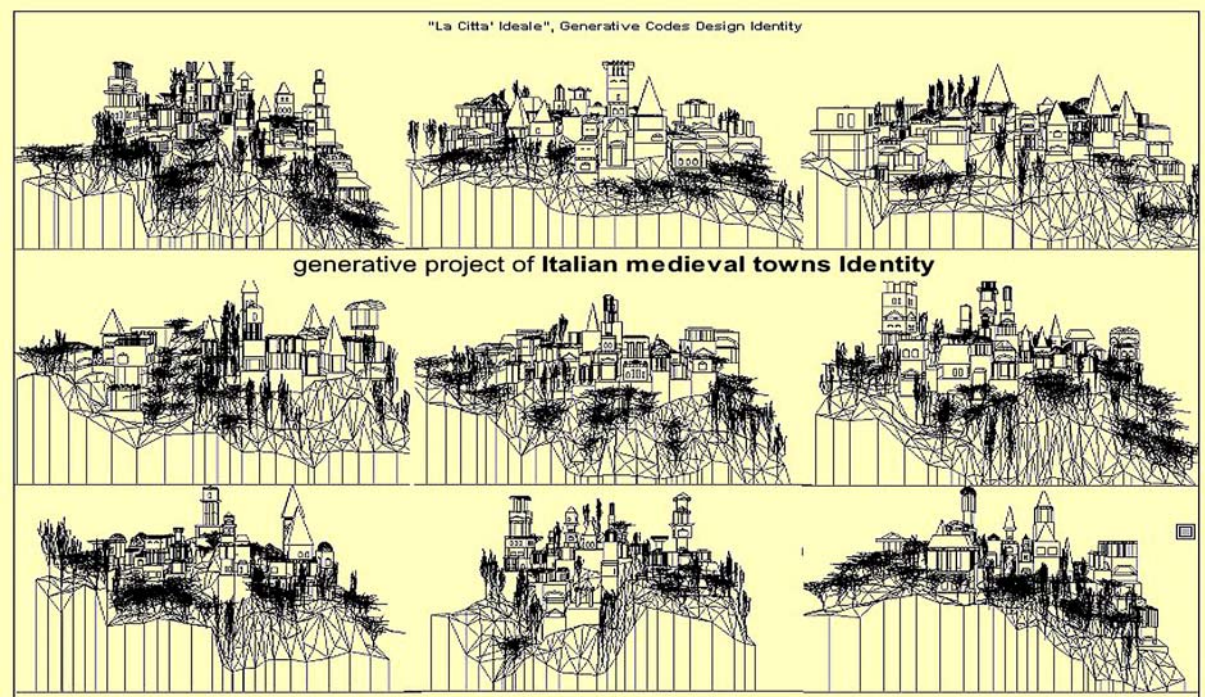


Fig.1. First Argenia. Generative design of Italian medieval towns. 1987. The main reference was Giotto's frescos.

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 a 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 this starting point is considered in Argenia?
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 aesthetical needs? how we can 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 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 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 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 environment, the insertion of the new individual will also increase (or decrease) the environmental identity. The increasing identity come 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 create 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 not-linear system.

This stratified mix of architectures have set up the uniqueness and unrepeteability 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 unrepeteable.

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 axes.

Representing the space could mean, as 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 cancelled 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 it 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 effected transformations.

The initial sketch has a marginal role in the final result, or it could have the role to differentiate each some possible results that appear as variations of a 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 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 the 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 tassellation 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 start 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 tetraedro to a cube to one of the solid traced by Luca Pacioli and Leonardo.

If the algorithm expresses formalities in 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 choosing 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 ad 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.

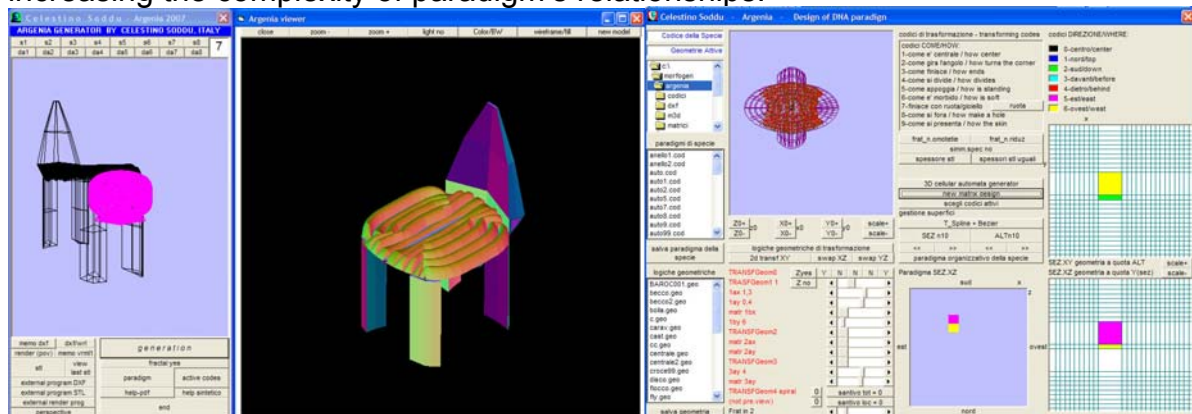


Fig.2 Screen dumps of last Argenia software. 1st version 1987, last version 2007.

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 creates inurement that 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 an habit that risks to create 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 Velsquez. This interpretation supported him in constructing his own work, using his peculiar artist's identity.

But he reached also another goal. The result, being a 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 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.

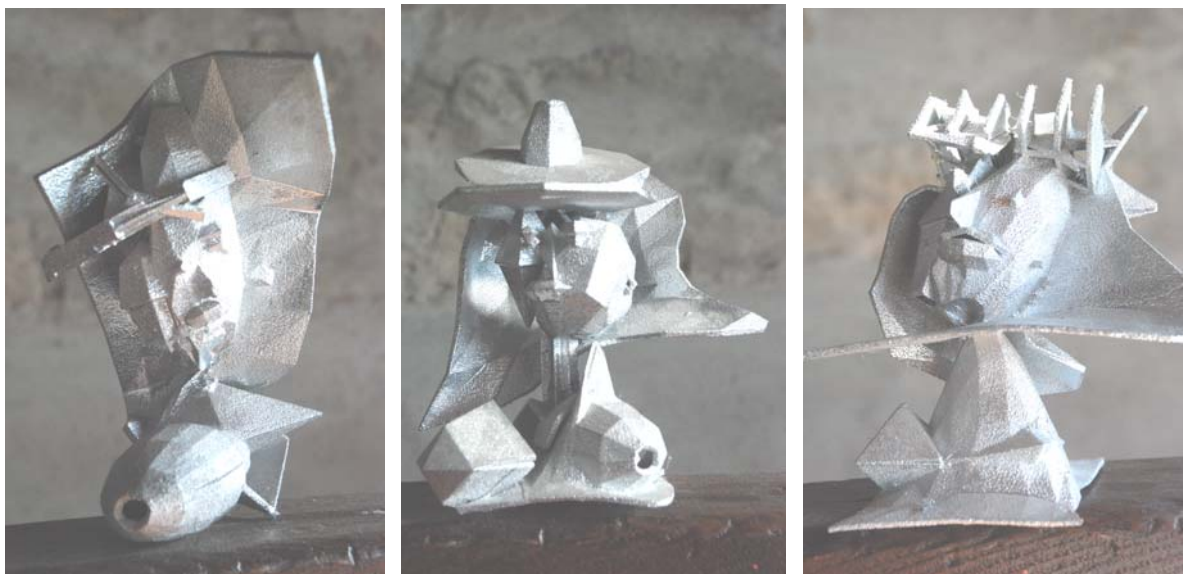


Fig.3 Woman Portraits from Picasso realized with rapid prototyping equipment using STL files directly generated by Argenia.

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 dimension (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.

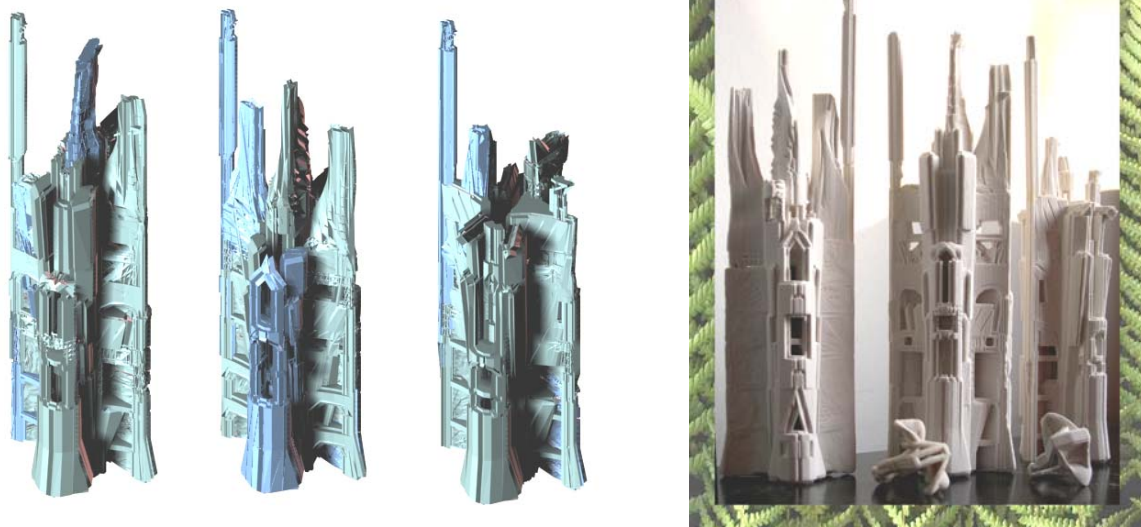


Fig.4 "Homage to Gaudì", generated variation of towers with codes fitting my interpretation of Gaudì. Realized with rapid prototyping equipment using the STL files generated by Argenia.

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 from 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 possible variations belonging to a species and every species is one of 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 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 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.

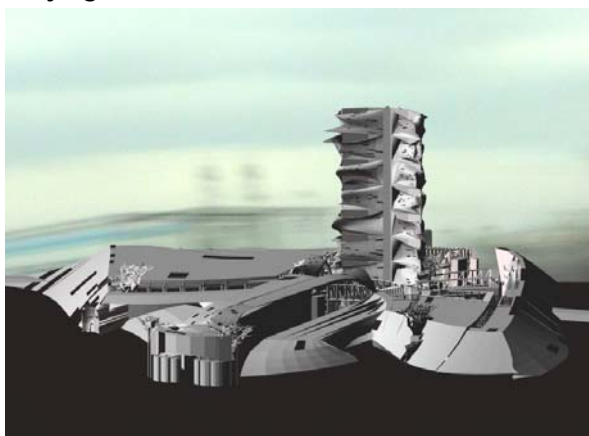


Fig.8 Cities Identities and Argenia. Generated architecture for Milan interland, 2001 and Tianjin, 2003.

Travelling 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 un-repeatable 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 on 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

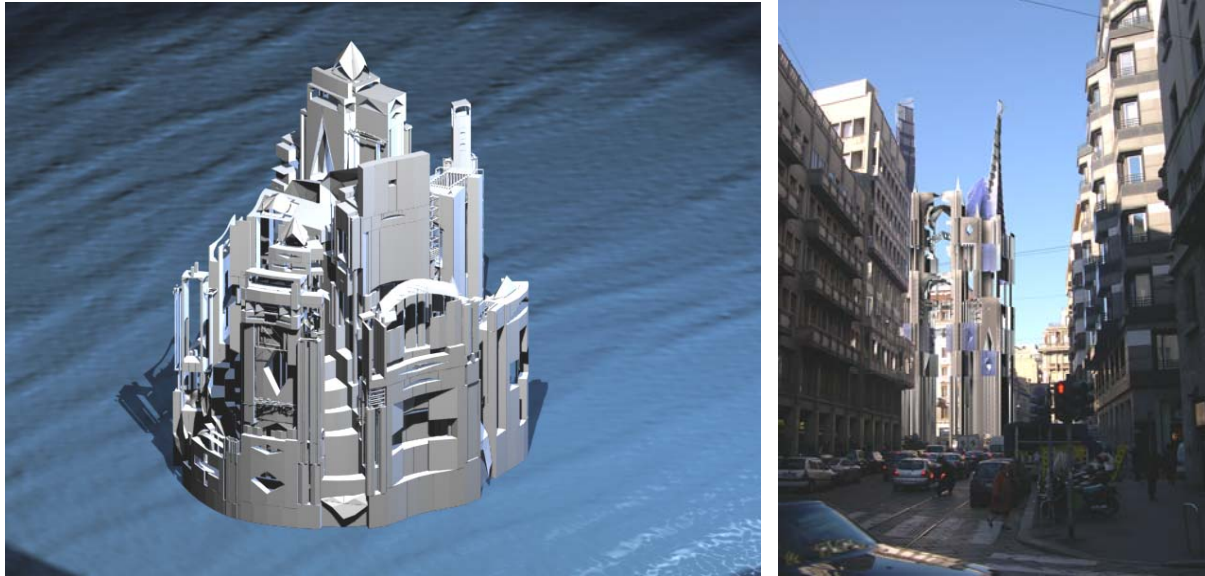


Fig.11 City on the water for Macau earth's recovery from the sea, 2004, and New Gallery in Milan, 2004.

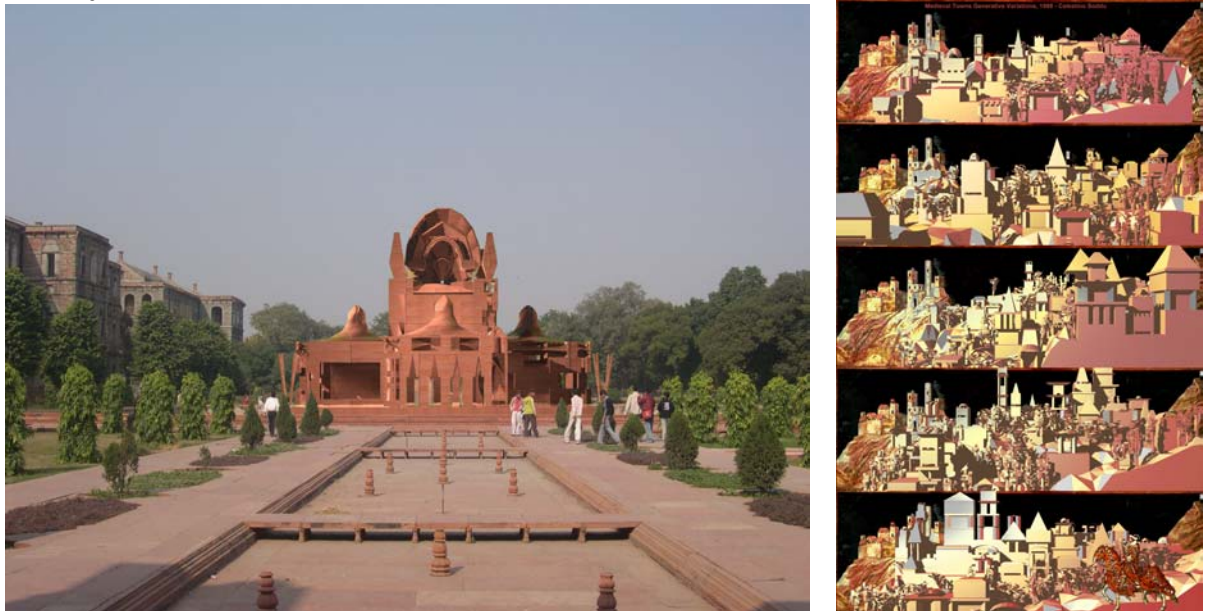


Fig.11 Indian Taj generated by Argenia, 2006, increasing the fractal iterative sequences of transformations for reaching "Delhi Identity" and Medieval towns, 1987.

More, each new generative project, through the plurality of algorithms set in every different occasion, can supports 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 have manifold interpretations is a city that has its own identity. It has an history.

The variations of Bach don't destroy the identity of its work, but they consolidate rendering more clear 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 an 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.

References

Websites:

www.argenia.it

www.generativeart.com

Main Books about Argenia:

Celestino Soddu, "Città Aleatorie" (aleatory cities), Masson Publisher, 1989

Enrica Colabella, Celestino Soddu, "Il progetto ambientale di morfogenesi" (environmental morphogenetic design), Esculapio Publisher, 1992

Celestino Soddu, "Milan visionary variations, Futuristic Meta codes for Milan's Identity", Gangemi publisher, 2005 (in english and Italian)

Celestino Soddu (edited by), "Generative Art Conference", proceedings of annual GA conferences 1998-2006.

Some articles:

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, "变化多端的建筑生成设计法" (Generative Design), article in the magazine "Architect", December 2004, China

C. Soddu, "Generative Art in Visionary Variations", in *Art+Math=X* proceedings, University of Colorado Boulder, 2005.

C. Soddu, "Visionary Variations in Generative Architectural Design", article in *Chepos* magazine n.003, TU/e, Eindhoven 2005.

C. Soddu, E. Colabella, "A Universal Mother Tongue", *Leonardo Electronic Almanac* Volume 13, Number 8, August 2005

C. Soddu, "Argenia, Artificial DNA and Visionary variations", *The Journal of designing in China*, summer 2005, Hong Kong