

# Uniqueness and Time

## Generative Art and Design, exploring poetics and dimensions in digital time

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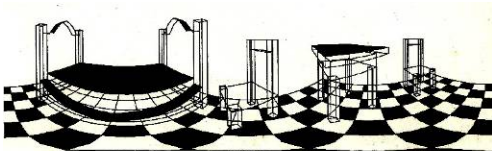
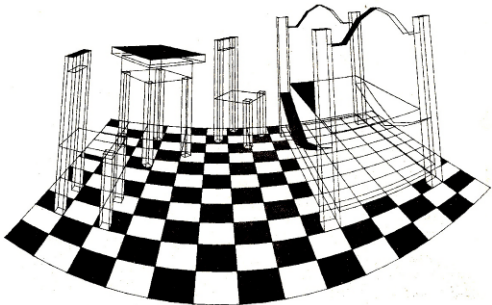
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At the end of the seventies, starting from some considerations on perspective representation as it had been systematized by Piero della Francesca invention, I identified a possible path of discovery where the **point of view** was able to build, at once, the uniqueness of the possible outcomes and the variations of the same. I experimented these possibilities working on some algorithms able to build, verify and probe various advanced perspective representations

investigating and trying to go beyond the borders of the one defined by Piero della Francesca. This was possible precisely because Piero della Francesca had defined a mathematical logic and a geometric process of perspective representation (see *Globet* by Paolo Uccello, recently attributed to Piero: C.Soddu, P.A.Rossi, "*Il calice di Paolo Uccello uno e senza limite*", (*the goblet of Paolo Uccello, one and without limit*) with a referee of C.L.Ragghianti, in "Critica d'arte" magazine n.8 1986.). Being a geometric and mathematical logic, it was possible to operate by constructing the related algorithms, bringing them to the limits of representation and varying them to access new possibilities.

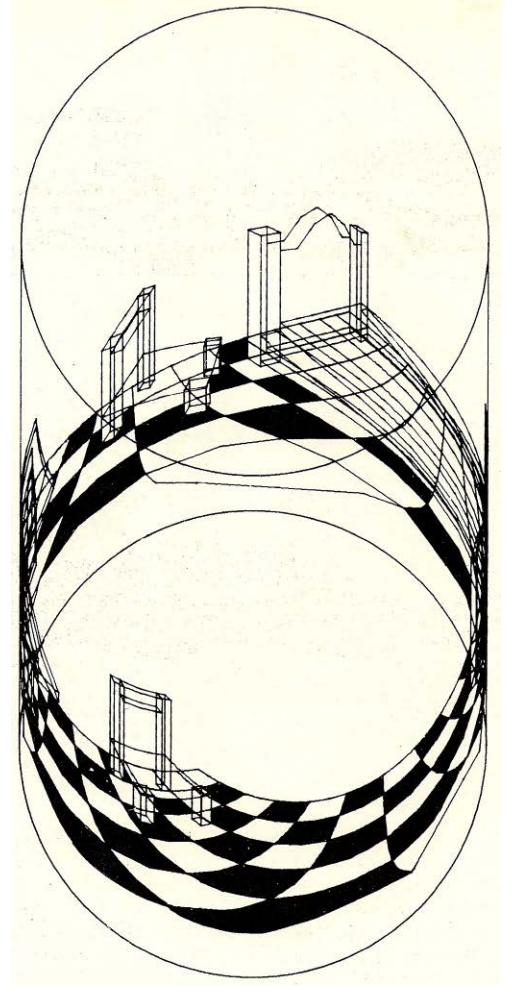
The basis of these experiments was the transition to non-Euclidean geometry, identifying as one of the fundamental elements the interface on which the drawing is drawn. A flat interface, like a sheet of paper, leads to Piero's perspective, with its deformations at the edges and progressive variations if the point of view approaches the interface or crosses it. But various other interfaces such as a curved surface, a cylinder or a sphere not only lead to drawing drawings that appear to be constructed with non-Euclidean geometry but also represent

the first step for an anamorphic perspective image.



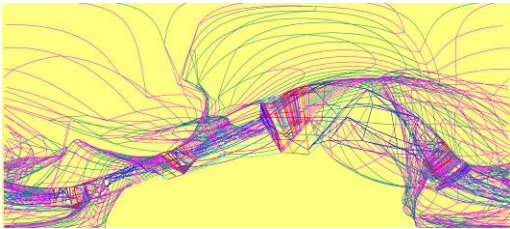
*Van Gogh's Room is a painting constructed as a curved perspective. In the second image the perspective reconstruction. In the third image two 360 degree anamorphic perspectives and in the final image a representation of the structure of the cylindrical interface, as it is organized to fit the anamorphism of the possible views with the sum of the curves of the representation and the interface*

*that cancel each other out.  
(C.Soddu, The not Euclidean image, 1986)*



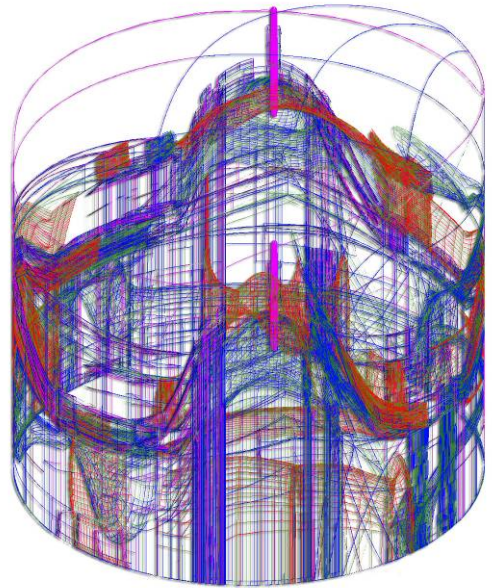
The anamorphism of these images becomes explicit when the double curvature, that of the interface surface and that of the drawn curved lines, cancel each other out. We look at a three-dimensional event from the point of view at the center of a cylinder and we trace in succession the points where a straight line starting from the point of

view towards the individual points of the three-dimensional event meets the interface of the surface of the cylinder (or sphere). These sequences trace curves even if, in the 3D model, they represent sequences of a straight segment. The anamorphosis happens when we realize that, looking from the defined point of view, the curvature of the cylinder and that of the drawn curve cancel each other out and the drawn segment appears straight at the sight.

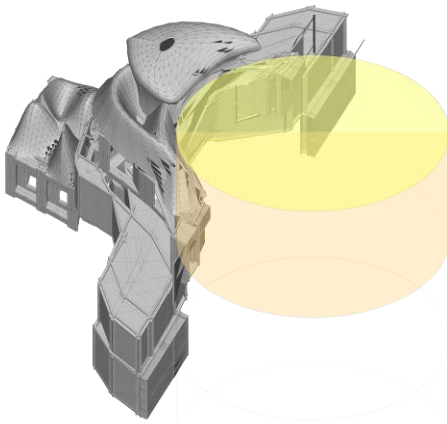


*Anamorphic 360 degrees perspective of a generated 3D model. The model is inclined by 30 degrees concerning the interface axis.*

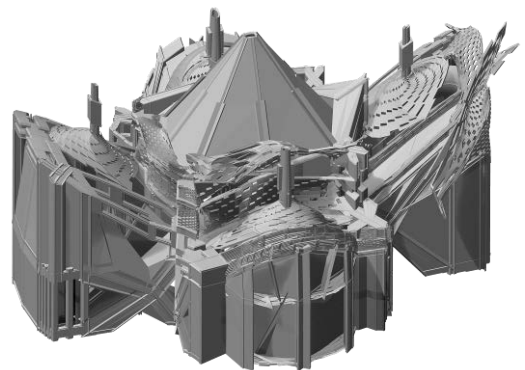
*could be used for transforming the 3D model into a not Euclidean space, or for using the 3D model in a bas-relief.*



*An axonometric representation of an anamorphic total perspective of a generated baroque castle. The image is in the cylindrical interface and the point of view is in the center of the cylinder. Following the 3D model of the castle.*

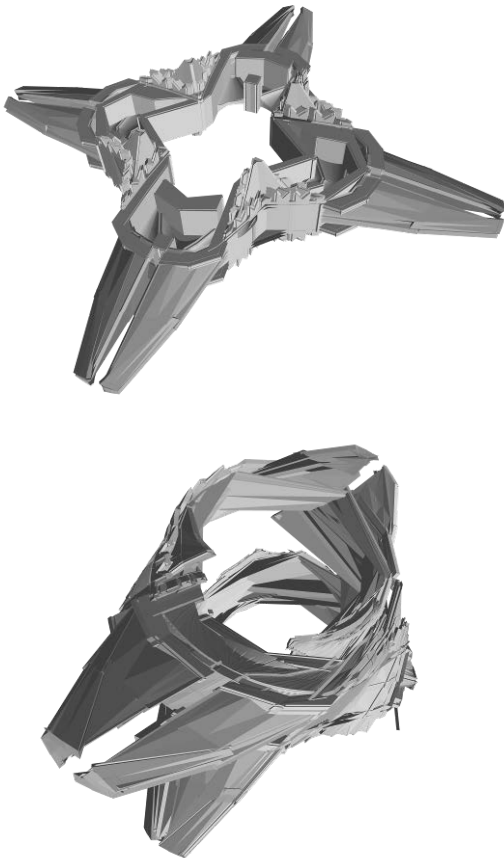


*An axonometric representation of half 3D model represented by using a cylinder interface in total hybrid perspective. The 3D result is a transformation of the original 3D model for fitting the cylindrical interface. The model extends its 3rd dimension outside of the cylinder. This*



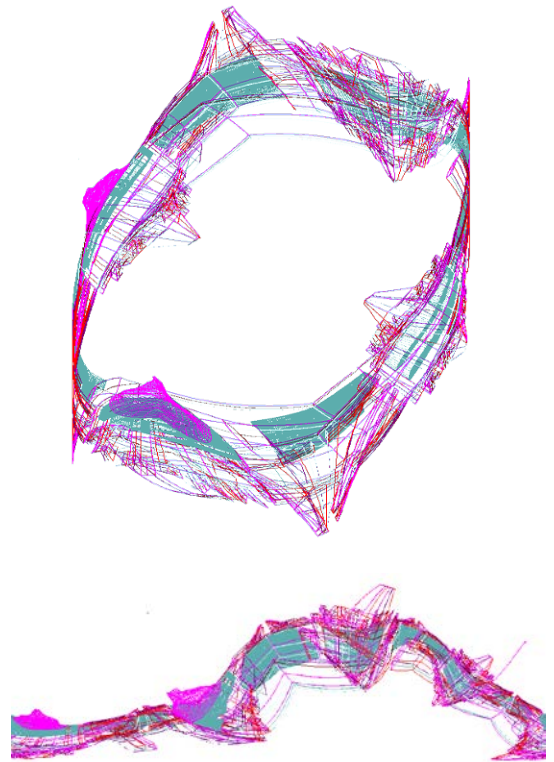


But this happens for only an instant vision. If we rotate our look, we find another perspective image where the same lines, due to anamorphism, move by rotating their arrangement. These keep the same straight configuration resulting from the mutual annulment of the two curves, the sphere or cylinder, and the drawn curve. This appears in the same way of the sequence of a film taken inside a parallelepiped space, where, as the camera moves rotating from one wall to the opposite one, the lines of the geometry of the space, for example, the lines of the walls meeting the ceiling, move to change their position.



*Four images of the same generated 3D model, a U.F.O model.*

*In the 1<sup>st</sup> one, a simple render of the model. In the 2<sup>nd</sup> one, an axonometric view of a hybrid anamorphic representation when the volume of the model exits from the cylinder interface reconstructing the model as not Euclidean volume. In the 3<sup>rd</sup> one an axonometric view of the anamorphic perspective of the model inclined of 30 degrees. The perspective images are written in the cylinder interface. In the 4<sup>th</sup> image, another anamorphic 360-degree cylinder perspective of the inclined 30-degree model is drawn in a plane sheet. (unwrapped cylinder).*



Precisely this consideration led me to identify, for each bundle of parallel lines, not one but two vanishing points. Between the two vanishing points can be represented as a straight line through a curve. In the cylinder-interface, the two vanishing points are the meeting of a straight line, which passes from the center of the cylinder at eye level, with the surface of the interface. The trace of the possible curves that join the two vanishing points represents the bundle of straight lines. This consideration led me to identify as non-Euclidean, the anamorphic cylindrical/spherical perspective representation.

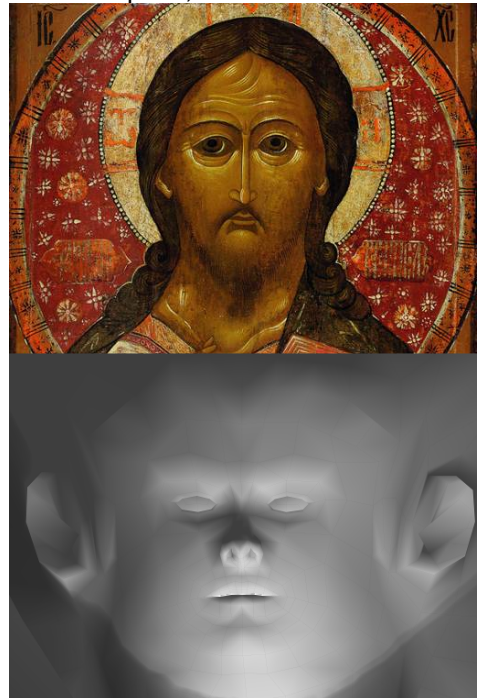
The sequence of perspective moments and the uniqueness of the 360-degree anamorphic perspective drawing defines the first relationship between uniqueness and time. **Uniqueness** because each perspective represented in an **instant** is unique but identifiable as one of the possible representations of the three-dimensional event. In this, **time**, as a factor that represents the uniqueness of an instant in the dynamics of the rotations of the look from the same point of view, becomes the generating element of the uniqueness of the generated image.

The uniqueness of each representation and the diversity concerning the others in the sequence is given precisely by anamorphism. It is not a sequence like the one that can be implemented by scrolling through the same flat image, as happens by filming a sequence of details of the same image. Anamorphism makes each perspective image, acquired by sight, profoundly different from the one that precedes it and from the one that follows it. It is not possible to approach them and reconstruct the total image, as happens with the filmed sequence of a

flat image, even of a traditional perspective image. Each perspective event is different and unique.

The correspondence between a perspective image and the temporal moment also happens in other perspective representations. The algorithmic reconstruction I made of the typical perspective of Russian icons, Florenskij's inverted perspective, led me to consider these perspective representations not as the reversal of canonical perspective but as the reversal of total anamorphic perspectives.

While anamorphic perspective considers one point of view, the center of the sphere, and infinite observed points, the inverted perspective of Russian icons has infinite points of view and only one observed point, the saint's face.



*A Russian Icon and a view from inside a 3D model of a head.*

To make all this clear, it is necessary to refer to some of Florensky's observations, first of all, the consideration that perspective vision involves only the surface of the represented object, in this case, the surface of the saint's face, but not the interior of the represented object. Consequently, this surface, being without thickness, is identical when considering the view from the inside of the face and the outside of the face.

We have therefore arrived at the nodal point of this representation. According to my logical reconstruction, the perspective reversal is also the reversal of the surface of the saint's face. We can imagine that the construction of Florenskij's inverted perspective is that of a view from the inside of the saint's head to the outside, and the surface of the face, even if it appears as seen from the outside, is represented as seen from the inside.

Moreover, one of the characteristics of these representations is, for example, to be able to see very clearly the saint's two ears, which would not be possible if the view is from the outside but extremely easy if the view is from the inside of the head.

The result is still a single perspective image that contains all the views from every possible angle, all the views of all the faithful looking at a single objective, the saint. Thus, different temporalities merge into one representation.

Later, in the mid-eighties, when I started building my first generative software, I started from this experience on possible non-Euclidean perspective representations. The purpose was in fact to define a logical process capable of generating different events, but all recognizable as belonging to a whole, or

better to an idea. Each event belonged to a different moment in time but all events, although different, were recognizable in the idea. In other words, I was defining a design process capable of building a species, an artificial species with the characteristics of natural species.

The recognizability of events belonging to the same species was structured in the logical process activated. The uniqueness of each event was due to time, to the instant in which the process was activated, to its birth. Since each instant is unique and unrepeatable, each event generated inherited this uniqueness and unrepeatability.

The generative process was built as an artificial DNA, as a system capable of performing the progressive construction of a complex event respecting, in every variation, the recognizability of the idea, the species. Genes were the multiple and parallel transformation logics that were selectively activated by the temporality of the moment of activation of the generative process. But all the transformation logics that could be activated were congruent to the subjective vision.

To manage the progressive construction of a complex event means building a logical process capable of performing by algorithms the design logic of architecture, a city, a piece of music.

It means defining a complex dynamic system with a structure that is not linear but adaptive to time. It is unthinkable that this system is born only reflecting an objective approach to problem-solving. This would lead to forgetting that every architect is a subject and that the uniqueness of each designer is the basis of the uniqueness of each designed event. It is no coincidence that all

architectures are different regardless of their quality. There is no concept of optimization of architecture to define the design logic. There is a quality in itself of each architecture that is born from the subjectivity of the designer and is made explicit through his subjective vision. The ability to make this vision explicit through the creation of works that can tell the character sought and that, of course, reaches the quality understood as the ability to respond to requests. Better, the objective of the design research is the ability to respond to the multiplicity of possible requests even of those that it is not possible to know before the design, since they could come from a possible user, indeed from the infinite possible users, also coming from a different time, of whom we do not know, and therefore it is not possible to objectively "analyze" their needs. On the other hand, working creatively to respond to infinite requests, also them that it is not possible to evaluable upstream, is the specificity of the designer, his creative ability.

I, therefore, built a complex and non-linear system that represented a design identity, a specific vision of the city and architecture, through algorithms capable of reflecting a subjective logic, an identifiable and recognizable poetics of space.

In this, my reference is once again Piero della Francesca who has modified the objective vision in the subjective one with the logical definition of perspective. The point of view, the subjectivity of the key to reading space, opens up a world in which, to the easy measurability, cataloging, and analysis of "objective" representations such as axonometry, is superimposed the possibility of logical management of complexity. This works up to the logical and interactive

management of the same concept and representation of the infinite. This is only possible with perspective.

The complex system of "subjective" management of the design process, as it is structured in my generative software, aims to generate events capable of achieving complexity and recognizability of species. Moreover, and this has been a surprising discovery, this tool of organization of the subjective design logic has configured an innovation in the way of teaching design.

Teaching design having as a particular interest the point of view of every single student-designer has been the aim of my courses of architectural design and design at the Politecnico di Milano which, in the last twenty years, has been called generative design courses, both in architecture, engineering and design. With this, founding a new discipline that has been called generative design. With Enrica Colabella, we developed this didactic approach and expanded the aspect of generative design as a teaching discipline of design. This does not deny the fact that each project has a theme and that the results must meet the client's requirements. But the identification of the theme and the requests is the work of the client. The work of the designer is to start from these "opportunities" of design to make explicit the architectural quality of each design vision, referring to its subjectivity and cultural references. Transforming the past into the future, performing the instant, is the aim of the design.

The logic of generative design is to propose endless possible paths that make explicit, in their multi-laterality, the subjectivity of each student, his or her architectural and design vision.

The novelty was to identify and structure a communicable logic inherent in every process of design discovery. The same logic that I had structured with algorithms in building my software. Being a logic, even if it involves the subjectivity of each student designer, it can be communicated, adopted, and discussed didactically as the structure of the progressive process of discovery and increase of complexity of the project. The outcomes of this project work, as well as the outcomes generated by the software, are multiple. The results are possible variations of the idea, born from the same paths but activated at different times, then using parallel logics of progressive transformation, logics that were chosen, among a set of logic congruent to the subjective vision, responding to different temporal moments. The similarity with the anamorphic perspective at 360 degrees is explicit.

Each variation in the set of possible outcomes was unique and unrepeatable, as time is unrepeatable. All variations, as a whole, were capable of representing the idea that had generated them. Noting that this idea was not representable with a single result, even if this will be chosen as the result to be realized. Each variation is only one of the possible representations of the idea, only one of the possible facets that, in its uniqueness, represents one of the possible "points of view".

After all, this is the role of every single project: to represent one of the possible temporal moments of who designed it, but able to be recognizable as belonging to the architect's vision.

Piero della Francesca, and the Italian Renaissance has opened this path based on subjective logics of transformation,

and not only on formal choices and their static re-propositions.

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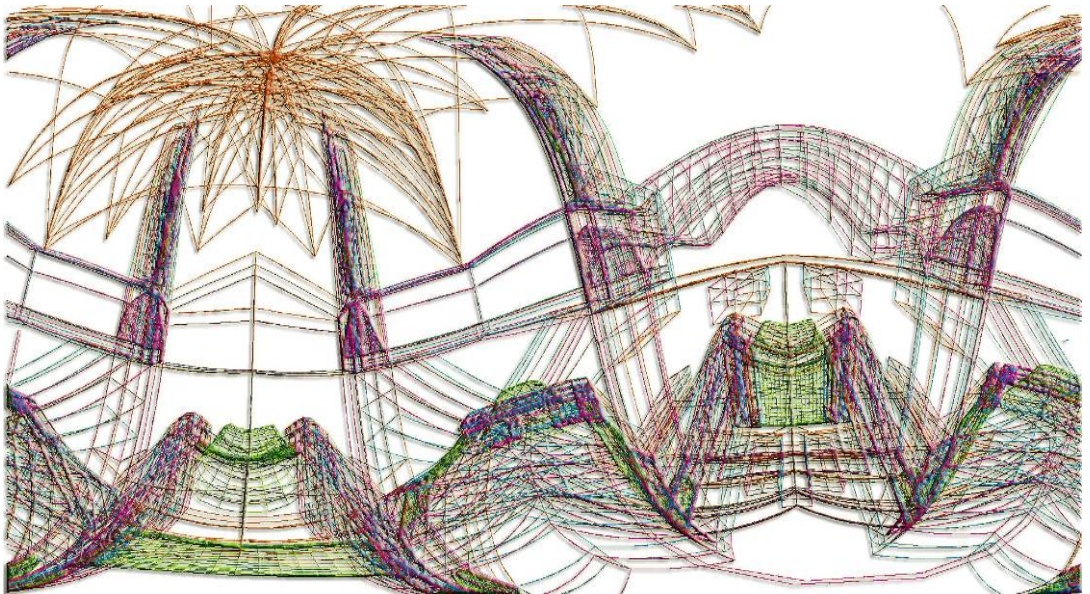
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*L'immagine non Euclidea (The not  
Euclidean image, Italian language)*