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Installation: **Möbius room**

Topic: Art/Architecture

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References:
[1] Kiyosi Itô,"The encyclopedic dictionary of Mathematics", Year MIT Press, Cambridge,1993.

Abstract:
This installation is built using Möbius bands, an example of a non-orientable surface (with boundary) constructed as an identification space from a rectangle by twisting through 180" and identifying the opposite edges with one another [1]. The idea came from a very simple experiment using Möbius bands manipulation. When a single band is cut in half, its extension doubles and also the number of half twists. If the number of half twists is even, it does not keep the one-surface caractheristic of the band. So, it means the public will be able to touch the string and realize where in space there is a single-border experiment and when it is a simple double faced, which had been twisted.
The use of Möbius band and its geometrical properties enriches an artistic investigation field when art is supposed to experiment the space. As a non-orientable surface, the Möbius band permits a questioning of opposition binomials, which are caracteristic of the traditional space concepts - continuity and discontinuity, inside and outside, open and close, public and private, horizontal and vertical.
Firstly the observer might be puzzled by the geometry of it. How many strings compress the artwork? Are they double surfaced or single surfaced? That kind of generated art space leads the observer to question and review his or her position in this differential geometry space.While the public stretches, touches the strings all along its possible borders, they can eventually explore the whole room space.

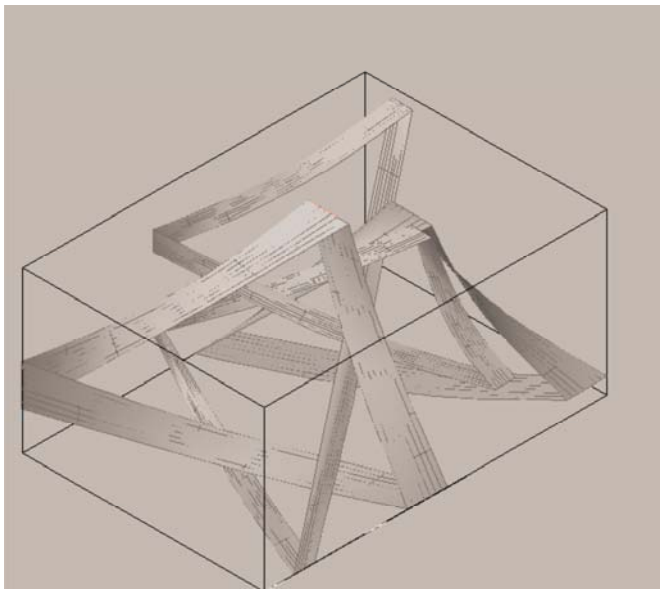

Image of Möbius room simulation

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Keywords:
Möbius band, spaciality, borders, surfaces.

Installation artwork: Möbius Room

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Abstract

This installation is built using Möbius bands, examples of single boundary non-orientable surfaces constructed as an identification space from a rectangle by twisting through 180" and identifying the opposite edges with one another. The idea came from a very simple experiment using Möbius bands manipulation. When a single band is cut in half, its extension doubles and also the number of half twists. If the number of half twists is even, it does not keep the one-surface feature of the band. So, it means the public will be able to touch the string and realize where in space there is a single-border experiment and when it is a simple double faced, which had been twisted. The use of Möbius band and its geometrical properties enriches an artistic field investigation when art is supposed to experiment the space. As a non-orientable surface, the Möbius band permits a questioning of opposition binomials, which are characteristic of the traditional space concepts - continuity and discontinuity, inside and outside, open and close, public and private, horizontal and vertical. Firstly the observer might be puzzled by the geometry of it. How many strings compress the artwork? Are they double surfaced or single surfaced? That kind of generated art space leads the observer to question and review his or her position in this differential geometry space. While the public touches and stretches the strings all along its possible borders, they can eventually explore the whole room space.

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1. Introduction

This installation artwork aims to generate some site of experimentation space with spectator participation from topological properties of the Möbius band – alternatively written “Moebius” as well as Möbius strip [1]. We have started from the transference of concepts from Mathematics to Art willing to cause a rupture with the passive position of the observer in front of the artwork, favouring the active spatial experience and actioning the body as perceptive tool. Here we understand the body according to the phenomenological study of Merleau-Ponty [2] about Perception – the phenomenological body expressed by the *body schema* as the main spatial subject reference, and from where the perception occurs.

2. Motivation

Dialogs between the art field and other knowledge areas are part of a historical process of majors approximation, which takes part specially in the contemporaneity. The incorporation of external concepts to the specific field of the artwork adds up to the material for discussion and investigation in the artistic field and ends up contributing for new perceptions, to instigate the creation and to enable new interpretations of the artistic object.

The contact with scientific innovations in Physics, Chemistry and Mathematics have opened more and more doors within the Visual Arts context, perhaps because science in the contemporaneity is validating a more complex reality conceptualization. In the regard of Quantum Physics, Chaos Theory, Fractals and Topology, in opposition to the linear causal schemes with which the Cartesian objectivity revolutionized the knowledge throughout the centuries, the reality shows up to us more and more complex and fascinating.

The artistic production as human and cultural product has always put itself in line with the scientific production and its timeline. Even without any intentions of the ineglectable “zeitgeist” reoccurrences, the contemporary artistic production before this new complex reality also retro-feeds and reverberates the concepts that come originally from the sciences.

Among the great mathematical developments of the XX century, one can mention those of topology. The study of topology offers for the installation artwork here proposed an extremely rich field with new possibilities of spatial relations, from the Möbius band (used in this work as our main reference for the space design) to the studies beyond fourth dimension, it lays in the topology the challenge of conceptions and limitations of the Euclidean geometry and the Cartesian plan.

3. Rubber-sheet features

Topology is in the field of the non-Euclidean geometries. Also known as “rubber-sheet geometry”, topology, roughly saying, does not worry about sizes and proportions, its objects can be imagined as those built with stretch performance materials, resulting in the verification of similarity between geometric forms considered distinct if thought in relation to axioms of Euclidean geometry [3]. It interests less to topology the shape though more the relations among comprehended points in that shape, so topology permits that deformations happen

altering the geometry or the shape of surfaces without their topological alteration, what makes possible two geometrically different surfaces to be considered equivalent. Stretching or shrinking, twisting or even cutting and pasting a surface if kept the same orientation are valid deformations in the topology field.

The topology with its study of surfaces transformations comprehends the geometric shapes as a phenomena, as something that develops along time [4], the rigid shapes themselves do not matter, a circle or a square if cut in a elastic and infinitely deformable matter acquire the property of assuming other configurations, and they are closer among themselves rather than traditional geometry would admit. In the words of Henri Poincaré, they permit the comprehension of this concept of shape transformation, in a more clear way exactly by the translation of the concept to the art field.

> "Let`s suppose any model and a copy of this model recopied by a clumsy designer. The proportions are changed, the lines traced by a trembling hand suffer unpleasant deviations and present disastrous curvatures. From the point of view of metric geometry the two figures are not equivalent, but they are, rather, from the standpoint of *Analysis situs"* [5].

For the installation artwork proposed here, we are interested especially in the study of the surfaces by topology, and above all, the properties and characteristics of the Möbius band, a single border non-orientable surface, and the reflections about space that it brings along. The study of surfaces, of transformations of a surface one another and their classifications occupy a very important part of topology investigation and it is extremely rich in the transference of concepts to the tridimentional art and the subject experience.

Surfaces, either in Euclidean geometry or in topology, are geometric objects whose dimensions of length and width are related to thickness, in other words, they only have dimensions x and y. Considering an inhabitant of a fictitious surface, he would only be able to move within two degrees of freedom, front-back, left-right, being unable to move up or down [6]. As examples of surfaces there are: spheres, cylinders or torus, the surface plane of Euclidean geometry or the surface of an air chamber, and beyond those, there are the main known topological surfaces: the Möbius band, the Klein bottle, the Boy surface and the projective plan.

4. History and curiosities

The Mobius strip, discovered independently by the German mathematicians August Ferdinand Möbius and Johann Benedict Listing in the nineteenth century, is one of the most basic topological surfaces, from which unfold many others. A model of the Mobius strip can be obtained from the rectangle of some paper, gluing the ends after a 180", i.e., a half-twist. The Möbius strip is classified by the topology as a non-orientable surface. The classification of a surface as non-orientable or orientable is based on the existence or absence of guidance on the inner and outer sides of a surface.

A surface is said to be orientable when it is possible to distinguish two sides, such as in a plane or a cylinder. Unlike the cylinder the Mobius strip does not have an inner nor an outer surface but a single surface, i.e., drawing a continuous line in the center of the tape measure you can get from one side to another on a single path

which reverses its orientation.

Two curiosities about the band lay on cuts that can be performed in their role model. The first is that, taking the midpoint of its width and cut a path across the extension of the length of the track, it will give way to a orientable band, twice longer and with four semi twists. The second is that taking 1/3 of the width and cutting a path across the span to find its beginning, the tape gives way to a orientable band, twice longer and with four semi twists, knotted with a Mobius strip of the same size than the original, only 2/3 narrower.

The Möbius band, due to its very specific topological properties, offers a both wide and rich field to think space. The Möbius band allows us to speculate new possibilities and to question opposition binomials, which are characteristic of the traditional space concepts - continuity and discontinuity, inside and outside, open and close, public and private, horizontal and vertical.

These binomials oppositions have always been used as spatial reference to the subject, in other words, the space was always conceived so that the subject would easily understand its position inside this space. The break with these binomials is a way of generating a new kind of space, a space that would dislocate, displace and disorient the subject and enrich the space experience. This hypothesis is brought up by the architect Peter Eisenman – “Suppose for a moment that architecture could be conceptualized as a Möbius strip, with an unbroken continuity between interior and exterior” [7], what would this mean in terms of the way we understand and apprehend the space?

5. Topology and Visual Arts

The topology and the Möbius band became famous in the Visual Arts by its use in the work of M.C. Escher, which showed exactly the possibility of disorientation and detachment from the space organized by the traditional perspective. In this work we take the Möbius band and take it to the real space fruition using a Möbius band with three half-twists. Because of its odd number of twists this band is also a non-orientable and continuous surface. This band is enlaced by another strip, also a three half-twist strip but cut in the middle along its width. However the result is a strip with six half twists because of its even twist numbers, transforming it into an orientable surface.

The point is that, in the processes of experiencing the work of art, the subject would try to understand those particular properties of the Möbius band above all by the means of experimenting, moving and acting in that given space limited by these fabric strips while he would be touching and twisting the band. At the same time we aim this subject to be impelled to understand his or her location in relation to the rest of the space, reflecting upon the idea of being inside or outside the band. How does s/he relate to this space?

Since the Minimalism and Post-Minimalism the realization of the tridimentional work has become more and more dynamical and active. In this moment sculpture and arts in general have begin a process of detachment from the representational space to get closer to the real space. This detachment is one of the ideas defended by Rosalind Krauss in *Passages of Modern Sculpture* [8].

From the renouncement of the representational space to the insertion in the real space, the tridimentional object was only one step away to become something that *generates* space instead of something that simply *lies* on space. Again is Krauss who reiterates this idea. In *Sculpture in the Expanded Field* [9] one of the reasons why the author points out a necessary review of what we call sculpture is actually this possibility of the sculpture to create or affect some space.

The approach of the tridimentional art work to the creation of space opens a possibility of reviewing the concept of meaning of the art work. The meaning shifts increasingly from the object to the experience, for the individual and unique moment in which the work stands in relation to the subject. The space of experience that Visual Arts and Installation Art can generate approaches what Eisenman [10] named “looking-back space”. The looking-back space means for the architect the possibility to modify the relationship of fruition between subject and artwork and transfers the subject's gaze into space to look to himself, in order to recognize himself in relation to space.

6. Space fruition

To achieve that kind of experiencing itself, this space is initially required to be somehow a disorientation space. It is this breaking with the traditional space that allows the possibility of the looking back - out of a space that is easily recognized, the subject needs to look at itself in relation to the spatial positioning, in order to understand this non-orientable spatiality.

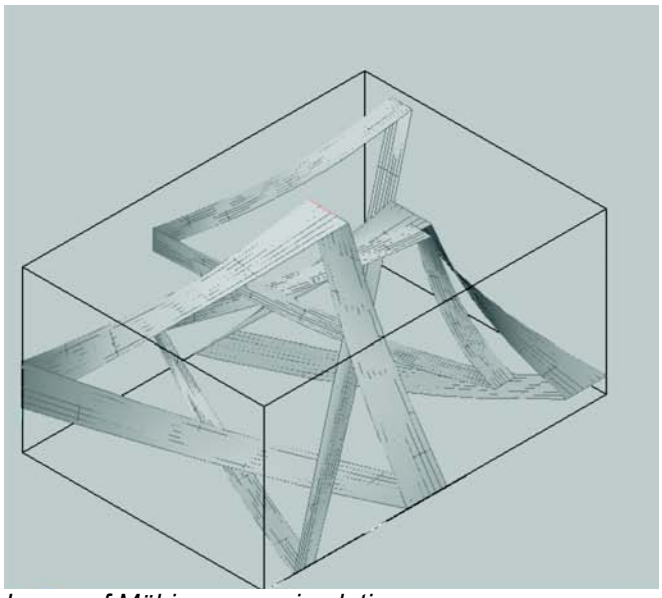

Image of Möbius room simulation

Therefore the choice of the Möbius band as a shape in this new form of experience of three-dimensional artwork happens both literally and metaphorically as a chosen figure. The aesthetic experience of this work requires a subject and a phenomenological body, insofar as the need for the observer to measure the space based on himself, on his own body and his position in this space, experiencing not only space but his own materiality in relation to space. The meaning of this experience depends, therefore, only on the relation with the subject. From this

discussion upon positioning of his body in space starts the understanding of situating this space in relation to himself. We end up coming to what Merleau-Ponty [11] named “general symbolism of the body”, where all the relations of the senses are established in a human context, from the human experience of the objective world.

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[10] EISENMAN *op.cit.*

[11] MERLEAU-PONTY. *op. cit.*