# XV: Reactive Spaces

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**This installation is the result of a collaborative effort in sound composition, computational art and mathematics. Using computer vision technologies and a nouvelle interface of Control Voltage audio synthesis (CV) and Bluetooth communication, XV expands on prior body of work in interactive visualization. The sonified and visualized installation demonstrates the aesthetic possibilities of a synesthetic experience.**

*Interactive art installation. Sonification. Synesthetic experience.*

## 1. INTRODUCTION

Fifteen points (XV) defines the role of cognitive dissonance in diverse reactive spaces. In an interactive floor projection, viewers are encouraged to move throughout the space and engage in the manipulation of the art piece. Detecting the body of the participant as well as the noise from the accompanying soundscape, the 3D shapes and textures within the installation bend and distort to the movement and sound interference accordingly. When a presence is no longer sensed, the shapes are autonomously restored with a burst of energy to their original state, while a generative, synth composition orchestrates the entire experience.

## 2. EMBODIED MODERNISM

A point of inspiration for our development was the Neo-Concrete movement, a short-lived group from Brazil in late 1950s. These artists departed from a systematic approach to geometric abstraction from the earlier “Concrete” movement, who focused on rationalizing form. The Neo-concretes did not completely reject geometry in their compositions, but rather incorporated it in a more playful way. One of the key elements of Neo-Concrete art was the belief that a piece can only be completed with the embodied participation of a viewer.
One example of such participation was “Bichos” by Lygia Clark. The “Bichos” are objects that can be manipulated by the viewer, moving corners and vertices to redefine the shape of the piece. In Parangolés, a Neo-Concrete happening by Helio Oiticica, there was live music involved to make more emphasis on an experiential and multi-sensory approach to art.

These ideas of the experiential with geometric spaces triggered our interest. New technologies have allowed us to create reactive and participative systems that integrate Neo-Concrete utopias further.

## 3. DESIGN AND IMPLEMENTATION

Our algorithm takes into consideration the position of the user in relation to the design. For the effective calculation of the position of the participant in relation within the geometric space, the shapes within the installation are defined geometrically as a set of irregular polygons. A “horizontal ray” is then traced in relation to the polygonal areas. This method is known as the IPT method and is described in a recent paper by Li, He and Tian [1]. For this project, we detected the location of the user as a vector in space. According to the IPT method, if the vector intersects the edge of the polygon an odd number of times, then it means that it is inside the polygon. Conversely, if the vector intersects an even number of times, then it means that it is outside the polygon (figure 1).

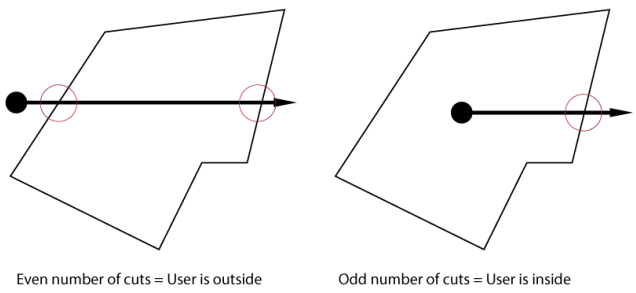


***Figure 1:*** *Illustration of the IPT method*

We used an infrared camera to find the position of the participant. The casted shadows are analyzed using OpenCV to track the position of the participants in diverse contexts. Since the areas of the video projection and the space the infrared camera is sensing may differ, we use simple linear interpolation to accurately map the position of the user in the projected space. The interdisciplinary efforts in generative sound composition, mathematics and interactive arts allow for a sensorially-rich and synesthetic experience.

### 3.1 Technical and logistic requirements

The space for the installation should meet the following specifications:

- A room with at least 30 x 30 ft. floor space
- Dim environment
- A projector and camera installed in the ceiling
- Room ceiling should be approximately 25 ft. tall.
- Sound system (amplification and speakers)

## 4. FUSION OF THE SENSES

The accompanying sound composition contributes greatly to the generative element of the system because it induces a form of auditory-visual synesthesia in participants. The installation features a newly developed protocol called Geometry Synth, developed by Minigorille [2]. This device communicates CV (modular sound synthesis) data to a remote computer via bluetooth communication. The sampled data is then visualized through a Processing application, and the sound variables are reinterpreted in the form of visual changes such as the amount of color or intensity of the experience. In this way, the soundscape is an integral part of the entire experience as it enables a relation to one sense by the stimulation of another sense.

## 5. CONCLUSION

By immersing the viewer in a full body experience of shifting compositions bred by human motion, this piece projects many diverse, retinal interpretations of space. XV challenges the senses and plays a crucial role as a generative system, giving insight to the prospect of inaccurate visual assumptions that can drive us to understand new possibilities. A piece with pleasing aesthetics, carefully planned architecture, algorithmically defined behaviors, and the ability to regenerate from disruptive energy, this work serves as a fusion point of art, design, mathematics and technology.

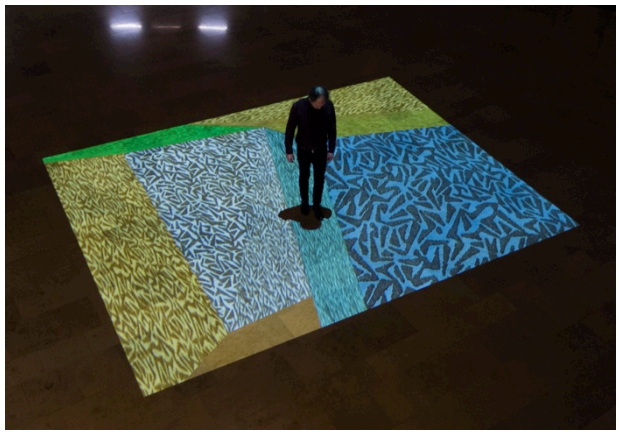

***Figure 2:*** *Image of the XV Installation.*

## 3. REFERENCES

Li, Z., He, Y., & Tian, Z. (2012). Overlapping Area Computation between Irregular Polygons for Its Evolutionary Layout Based on Convex Decomposition. *Journal Of Software*, 7(2), 485-492. doi:10.4304/jsw.7.2.485-492.

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