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# Distractions: Interactive Visualizations on a Kinetic Sculpture Using Infrasound Vibrations

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## Abstract

*Distractions* is a kinetic sculpture that brings together sonification and visualization in a single physical artifact. It utilizes inaudible frequencies to visualize invisible electromagnetic signals, such as those from cellphone, Wi-Fi and radio communications, that surround us in daily life. This way, the piece highlights some of our routine sources of distraction in their raw forms. By picking up the electromagnetic signals in the exhibition space, the sculpture visualizes the signals to and from the mobile devices that are brought into this space by the visitors. The sub frequency vibrations, which oscillate the structure according to these intentional or unintentional communications, not only represent the distractions the artist faces on a regular basis, but also intercept the dialogue between the audience and the inert steady state of the sculpture. The piece therefore interacts with the audience through the distractions that draw them away from the experience of the artwork.

## Author Keywords

Kinetic sculpture; sonification; depth image; radio frequency data; visualization; CNC

## ACM Classification Keywords

H.5.1 [Information interfaces and presentation (e.g., HCI)]:  
Multimedia Information Systems

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## Introduction

The amount of radio-frequency data that permeate our daily lives is overwhelming. Cellphone communication, Wi-Fi transmission, and FM broadcast are some of the better known components of a broad spectrum of signals transmitted electromagnetically. These signals are invisible to the human eye unless they are interpreted, demodulated or decoded by machines that are tuned to pick them up.

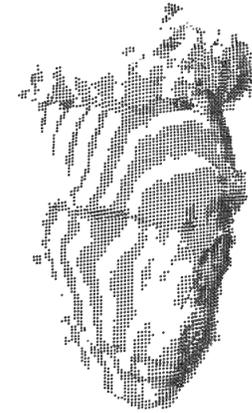
When visitors bring their mobile communication devices to an exhibition space, they also introduce a range of electromagnetic signals that carry a significant amount of data into this space. These data might involve phone calls, text messages, or emails, which would distract the visitor from his or her experience of an artwork. *Distractions* relies on such data to become activated as a kinetic sculpture.

*Distractions* utilizes oscillations that are below the limits of auditory perception to visualize oscillations that are above these limits. By mapping a spectrum of radio frequencies that range between 20 MHz and 6 GHz to sinusoidal oscillations between 10 Hz and 20 Hz, the sculpture translates invisible electromagnetic signals into changes in air pressure. These oscillations vibrate the transparency sheets that are printed with point clouds of the artist's head in 9 layers as seen in Fig. 1.

## Related Work

Several previous projects have dealt with the visualization of electromagnetic signals. In his piece *Immaterials*, the artist Timo Arnall uses custom LED lights to visualize the strength of Wi-Fi signals in outdoor spaces. By using long-exposure photography to capture these visualizations, he creates "light paintings" of Wi-Fi networks in urban spaces [1].

In his *A Noospheric Atlas of the United States*, the artist



**Figure 1:** A depth image of the artist's head segmented into 9 layers.

Brett Balogh uses the geospatial data provided by the FCC to render translucent shapes that represent a variety of common utility signals populating the Hertzian space. The artist describes the resulting visualizations as "a landscape formed by our collective communications" [2].

The use of layered translucent material to create the illusion of depth in painting has also been practiced by many artists. Notably, the artist Xia Xiaowan creates 3D paintings by layering sheets of glass that are individually painted with depth portions of 3D objects, and most commonly human bodies. The artist describes his method as an association of painting with the theory of CAT scans [3].

In his sculpture series *Transparency Report*, the visual artist David Spriggs creates sculptures by printing X-ray images from airport surveillance systems onto hundreds of tempered glass sheets. The work therefore utilizes transparency "both as the subject and as the medium" [4].

## Components

*Distractions* makes use of a variety of computational media as listed below:

- A Microsoft KINECT sensor is used to capture a depth image of the artist's head, which is then processed using the C++ toolkit openFrameworks<sup>1</sup> to create point clouds of this image in depth layers, as seen in Fig. 1.
- These depth layers are then printed onto 9 sheets of transparency paper, which are propped together as seen in Fig. 2. This custom structure is 3D-modeled using Rhino<sup>2</sup>. It is then milled from MDF panels using a Computerized Numeric Control (CNC) machine. Finishing and assembly are done by hand.
- A Keysight N6841A wide-band radio frequency sensor is utilized to detect a broad spectrum of electromagnetic signals including, radio, Wi-Fi, and cell-phone transmissions. A middleware interprets electromagnetic events picked-up from mobile devices, such as smartphones and tablets.
- A software designed using the multimedia programming language Max<sup>3</sup> receives and maps electromagnetic activities to low frequency oscillations. The structure is then placed on a subwoofer, which outputs these oscillations. The events detected in the RF spectrum activate the sculpture with the resulting infrasound vibrations.

## Project Team

Anıl Çamcı developed, fabricated and implemented *Distractions* as the lead artist.

<sup>1</sup><http://www.openframeworks.cc/>

<sup>2</sup><https://www.rhino3d.com/>

<sup>3</sup><http://cycling74.com>



**Figure 2:** Two images of the fabricated sculpture.



**Figure 3:** The MDF framework of the sculpture being milled with a CNC machine.

Brett Balogh designed the middleware that interprets the data stream from the Keysight N6841A sensor. The middleware filters the data to report specific events pertaining to cellphone activity.

An earlier project, which involved acquiring and utilizing this sensor, was lead by Angus Forbes at the University of Illinois at Chicago. A collection of data visualizations created during this project was exhibited as part of the IEEE VIS Arts Program in 2015 at the School of the Arts Institute of Chicago.

Matt Brett assisted with the 3D modeling and the milling, as seen in Fig. 3, of the framework that holds up the transparency sheets in place.

## Conclusion

*Distractions* brings invisible and inaudible signals into the kinetic domain. Such signals, which would go unnoticed by the human perceptual systems, represent some of the most prevalent sources of distraction in our everyday lives. *Distractions* comments not only on the artist's process, which is inherently plagued with such distractions, but also on the relationship between modern audiences and exhibition spaces. Relying exclusively on digital computing techniques, such as depth imaging, signal processing, audio synthesis and numeric milling, *Distractions* visualizes data, without using computer displays, through infrasound vibrations.

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