After the reception of enigmatic radio signals in 1899, Tesla began work for many years to perfect the receiving and transmitting equipment that was needed to better pick-up and translate his aural discoveries. In 1925, Tesla wrote: “The sounds I am listening to every night at first appear to be human voices conversing back and forth in a language I cannot understand. I find it difficult to imagine that I am actually hearing real voices from people not of this planet. There must be a more simple explanation that has so far eluded me.” Tesla developed an antithesis to Einstein’s Special Theory in The Dynamic Theory of Gravity and The Environmental Energy. In the text “Voices in the Aether,” Tesla proposed there is no energy in matter other than energy received from its environment.

*Stoicheia*, is a dynamic soundscape installation dedicated to Tesla’s “Voices in the Aether” postulate. This sound architecture project relies on both a dynamic merger and progressive modulation of two complementary data sources:

1. The robotic and optical scanning of four fossilized objects, embodying the classical states of matter: solid, liquid, gas and plasma

2. The sensing of local electromagnetic fields with EMF sensors and local geologic seismic activity feed.
The two data sources converge through real-time computing and unfold a spatialized soundscape made of dynamic sound signals transgressing through their origins. The robotic scanning path of the four elements is computationally controlled, self-regulating system that continuously re-evaluates and varies in order to sustain a balanced sound ecology in sound architecture. Stoicheia draws an experience of immediacy, and ephemeral interplay between the agencies that maintain a continuously self-adaptive sonic and physical environment. As Tesla hypothesized, Stoicheia absorbs sound energy from its environment and projects it through the movement of the four elementary stages.

INSTALLATION EXPERIENCE

The installation takes place within an enclosed space, approximately 30'(w) x 30'(d) x 15'(h). A five-axis robot arm with a 3D scanner attached moves through four suspended multi-material objects that represent the four elements. Combined with an array of four EMF antennas that monitor local EM modulation and the local seismic activity via XML feed, these scanning sources provide qualitative data about the represented elemental flux. The connected data is analyzed and sonified using 3D, 3rd order ambisonic algorithms that spatialize the audio through 16.4 system. There are four hue-variable spotlights that illuminate the suspended objects creating low ambient pulsing patterns that are composed with the sound. The installation is composed of four object and process components:

- Elementary Objects: Four fossilized objects, embodying the classical States
- Scanning Process: The robotic scanning of the four elementary objects.
- SoundScape: An evolving ambisonic spatial sound ecology.
- Drawings: Drawings of the each object: scanned, construction

ELEMENTARY OBJECTS

Four object elements are suspended in the space. Each Elementary model is a different multi-material model, composed of multiple 3D printed materials along with scale model fabricated pieces and connection elements. These are each suspended by electro-illuminate surrounded wire and illuminated by a parametrically controlled low ambient light source located within reach of a robotic arm.

SCANNING PROCESS

A computer controlled robot arm sits on a pedestal in the center of the room and scans and analyzes the elemental objects (see Analysis section).

SOUNDSCAPE

The Soundscape will be created using a series of physical and virtual components. Consisting of a 16.4 Channel surround sound system and a virtual sounds generation controlled by software the scanned and collected data will be aurally spatialized.

- Sixteen Channels are arranged equidistantly along the room periphery (above and below) along with four sub-woofers located in each room corner.
- Ambisonics: A full-sphere surround sound technique, which triangulates the sound source amongst a spatial sound array.
- Spatial Sound Array: Stoicheia will feature two Octophonic sound arrays. An Octophonic system is a form of audio reproduction that presents eight discrete audio channels using eight speakers arranged in a circle within the space with azimuths of negative forty-five and forty-five degrees.
- Quasar: Quasar was a previous project at the SCI-Arc Gallery which experimented with synthetic environmental ecologies.

DRAWINGS

A series of drawings will be produced using the scanned data, oriented path data, collected intensity data; these are all overlaid and illustrated through time (see Analysis Section) of each element object. These drawings are exhibited next to the elemental construction drawing.

ANALYSIS AND GENERATION

DATA-SENSING

The project ecology supports three data sources:

- Four local EMF Electro-Magnetic Field sensors that detect the modulated EMF field of the space.
- One robotic operated IR optical 3D scanner head that scans the four elementary objects.
- One real-time data feed from USGS, which denotes seismic activity for the surrounding area.

DATA ANALYSIS

The analysis is done in real-time, at frame-rate and consists of the following processes:

- The compiled sensor data taken from the EMF, Robotic scanner and Seismic data feed is transcribed into a virtual field of forces.
- The virtual field of forces is scanned to determine intensities that are translated into a map of matrices and analyzed for the following geometric and texture characteristics: Resolution Displacement Mesh Continuity Mesh Contrast

The resulting matrix is fed-back into the robotic control path parameters and alters the direction and speed that changes the overall visual and sonic and visual resolution.
DATA TRANSLATION

The resulting data analysis will translate the resolution characteristics into sound and light through four-scaled structures:

- **Micro-Structure = Timbre (Grains)**
- **Mini-Structure = Note (Seconds)**
- **Meso-Structure = Polyrhythm, Scale (10’s Seconds)**
- **Macro-Structure = Global Evolution (10’s Minutes)**

Installation Equipment:

**Processing:**
- Computer: two Mac Mini’s - Analysis, Rendering, Sound

**Sonic:**
- Subs - four Anthony Gallo Subs
- Interface - one Motu 828 MK3
- Monitors - sixteen Anthony Gallo Satellites

**Robotics:**
- Robot Arm - one Strobotics R14 five-axis Arm

**Visual:**
- Interface - one DMX box
- Lights - three DMX spots
- Scanner - one ASUS Depth Sensor

**Sensor:**
- EMF - four Antennas
- Seismic - one USGS Real-Time Feed

Venue Requirements:

Requested conditions from conference facilities:

- **Size:** 30’w x 30’d x 15’h
- The USC Arch Clipper Lab or similar would be ideal.

Location Conditions:
- Low Ambient Light (The darker the better)
- Low Ambient Sound (The quieter the better)

System Diagram:

Interaction diagram illustrating the information flow

Network and Power:
- four outlets i fifteen amp outlets
- IFI - Internet connection

Notes: Structure suitable for hardware

NOTES

Ambisonics: A spatial sound algorithm

Optical Scanning: Using scanning light to illuminate scanned area

Sound System: 16.2 Anthony Gallo Sound System

Kinect: Structured Light sensor for gathering depth information

Robotic Arm: five-axis robotic arm to implement the scanning devices
Stoicheia: A graphic collage Representative of the installation components
Stoicheia Sketches: Intensities translated into isosurface symmetry
Element Sketches: Illustrating the various components and assemblages of one of the four elements
Stoicheia Elemental Elevation: A concept illustrating the four Elemental objects
Drawings and Models: A relationship between the physical model and the drawing offer different modalities to understand the elemental objects

COLLABORATORS
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IMAGE CREDITS
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