5-6-2016

Sonic Activation: a Multimedia Performance-Installation

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DOI: 10.25148/etd.FIDC000694

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SONIC ACTIVATION: A MULTIMEDIA PERFORMANCE-INSTALLATION

A thesis submitted in partial fulfillment of the

requirements for the degree of

MASTER OF MUSIC

by

Alex Joseph Lough

2016

To: Dean Brian Schriner
College of Architecture and the Arts

This thesis, written by Alex Joseph Lough, and entitled Sonic Activation: a Multimedia Performance-Installation, having been approved in respect to style and intellectual content, is referred to you for judgement.

We have read this thesis and recommend that it be approved.

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Date of Defense: May 6, 2016

The thesis of Alex Joseph Lough is approved.

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Florida International University, 2016

ACKNOWLEDGMENTS

I would like to thank my advisors Jacob Sudol and Juraj Kojs for their wonderful guidance, support, and friendship over the last two years. A very special thanks is owed to the performers who also helped me with produce this event: Laura Arevalo, Carlos Dominguez, Juraj Kojs, and Catalina Von Wrangell. This event would not have been possible without the support of Barry Fellman and the Center for Visual Communication, who generously offered their gallery space for this project. Finally, I would like to thank my loving family for their unrelenting support in my pursuit of art and music.

ABSTRACT OF THE THESIS

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by

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Florida International University, 2016

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Professor Juraj Kojs, Co-Major Professor

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Sonic Activation is a multimedia performance-installation featuring sound sculptures, video projections, and performance with live electronics for solo and mixed ensembles. The work aims to unpack the nature in which we hear and interact with sound, space, and gesture. It is a project that recontextualizes the typical practice of performance and installation modes of music and art. The event uses 12 loudspeakers spaced around a gallery to create a densely layered sonic atmosphere that gently fluctuates and slowly evolves. Throughout the event, the audience is encouraged to freely navigate the gallery and experience the subtle changes in sound as they manifest in the space.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

CHAPTER 1 – INTRODUCTION

sonic activation (stylized with lowercase letters on all the promotional material and throughout this paper) is a multimedia performance-installation that features custom-built sound sculptures, video projection, and live performance. I use the term “performance-installation” to refer to a newly evolving media form that is meant to be experienced in a particular location for a specific amount of time and contains live performers interacting with sounding structures or sonic environments.

The installation portion of the project consists of three sound sculptures and a generative video projection loop. While the compositions could theoretically exist separately from the installation, they are fundamentally intertwined in *sonic activation*. The compositions feature pieces for solo, duo, and trio performers. The instrumentation includes voice, guitar, transducers, laptop ensemble, cymbal, and a custom-built electronic game controller instrument. I will address the installation and performance aspects of the work both individually and how they function together to create a unified experience.

The title *sonic activation* is meant to elicit my aesthetic goals and themes present in the work. I use the term “sonic” as a means to focus attention on the physical nature of sound, as waves and changes in air pressure, perhaps to elicit a more scientific approach to sound. Similarly, “activation” contains more scientific connotations. In chemistry, “activation” refers to a reversible transitional state a molecule will enter that will increase its likelihood of transformation (IUPAC 2006). The prolonged drone in *sonic activation* can be thought of as the catalyst that allows the audience to enter into an altered state of listening. The title also points to the gestural elements in the work, calling into question how we sonically activate instruments in performance (the guitar is played with an eBow, while the gestural controller is plucked like a string, inverting what would normally be expected). Moreover, the title reinforces the other physical process at play, namely the transducers in the performance. Placing transducers on instruments causes them to sympathetically vibrate, thus sonically activating them.

The event is carefully structured in order to create a unique site-specific experience. The performance-installation form encourages active listening in which the audience members deliberately move around the space and thus experience the work. It is my desire to have the audience feel as if they are witnessing some sort of foreign ritual, prompting them to further investigate and question what is happening. At times, the performers make very little movement, suggesting the audience investigate elsewhere or listen more closely, while at other times the performers make large gestures that attract audience's attention.

My goals of the project are: (1) to explore the newly emerging performance-installation form, (2) to emphasize the physical nature of sound (perhaps more clearly, to emphasize the spatial component over the temporal), and (3) to explore how gesture plays a role in electronic and electroacoustic music.

1.1 – Terminology

Throughout this paper I will use the terms event, installation, and performance in reference to my project. *Event* in this this case is used to encompass the entire project. While there are a number of ways to interpret an "event,"[1] here it functions as a comprehensive descriptor referring to the specific realization of my project on March 18, 2016 at The Center for Visual Communication in the Wynwood Arts District of Miami. *Event* is used to broadly describe the entire experience of the performance-installation.

The term installation is used to describe "mixed media constructions or assemblages usually designed for a specific place and for a temporary period of time" (Tate Modern Glossary of Art Terms). In reference to *sonic activation*, the installation part of my work includes sound sculptures and video projection loops assembled in a particular spatial arrangement to create a site-specific sonic environment.

The installation elements in *sonic activation* are non-temporal in the sense that they do not develop formally or structurally throughout the experience, but rather change in the perception of the viewer as they navigate the space. Alan Licht argues that a sound installation "has no specified timeline; it can be experienced over a long or short period of time, without missing the beginning, middle or end" (2009, p. 3). In my project, I prefer the term installation because it focuses on the physicality and stasis of the sculptures and the sonic drone. The gestalt is instantly realized, the drone

[1] The term event has been used in reference to the performance art works associated with Fluxus (Friedman 1990). The Fluxus event scores have undoubtedly influenced my work, however the terminology in this paper is not used to necessarily draw a direct comparison.

persists throughout the work, the sculptures remain in a fixed position, and although the video loop is programed to generatively evolve, there is no "beginning, middle, and end." The evolution of the experience manifests itself as the audience moves throughout the space. The sounds of the various parts intermingle in particular temporal alignment.

The term performance in this paper generally refers to humans carrying out actions in a live setting. In *sonic activation*, the performance aspect of the work refers to five compositions created to sonically interact with the installation. These compositions are performed live and have more formal structures and temporal elements, some with graphic notation or text scores and others as structured improvisations. Performance in this case does not necessarily refer to performance art, but rather the focus is on live actions carried out by humans.

I explicitly choose to avoid the term concert or recital regarding this event because of their associated implications and expectations. Generally speaking, the term concert implies that a set of works takes place in a concert hall, a space in which the audience are seated in the same position. The audience face an area where musicians perform a series of compositions with applause or silence in between. This kind of environment is accompanied by a codified behavior and a set of value judgments assumed by the audience. I use the term performance-installation to undermine the established framework and encourage the audience to view the work in a new context, outside the institutionalized concert environment. I will discuss this in more detail later.

Many composers have challenged understanding of the formal concert experience and written at great length about broadening the concept. Max Neuhaus explicitly rejects the term sonic art as a "cowardly" lack of effort to expand the definition of music. He argues that "aesthetic experience lies in the area of fine distinctions, not in the destruction of distinctions for promotion of activities with their least common denominator, in this case sound" (2000). He also claims that "[i]n art, the medium is not often the message" (2000). I recognize the importance of Neuhaus' argument, especially with regard to my own work in which I avoided traditional nomenclature, however I disagree with the central focus of his opinion. I believe that using a new term can provide a different framework or context in which an audience can experience a work. To illustrate, Marshall McLuhan kept elaborating on his idea that "the medium is the message" (1964, 1967) in which the content of the art enables our understanding of it. This art-content relationship is particularly true in my work, in which the primary focus lies in exploration of sound and our interactions with it.

As a whole, my work uses creative techniques to explore psychoacoustic and physical properties of sound to provoke a fuller understanding of the sound itself. My aim is to create a framework that stimulates less restricted experiences. While the emotion and narrative are also investigated, the primary focus of inquiry is on sound as a medium.

1.2 – Realization of the event

The event took place at the Center for Visual Communication in the Wynwood Art District of Miami, which is a rather large and reverberant gallery space. Its rectangular architecture played a significant role in shaping the sound and providing ample space for the audience to move around.

As the audience arrived, they were restricted to the main lobby area until the event officially began. At this point, I instructed the audience to freely navigate the gallery, listen closely or at a distance, and stand, or be seated (although no chairs were provided in the space). I explained that the event would last for about one hour and the ending would be marked by me closing my laptop and bowing my head in silence. At that point, the other performers and audience could walk out of the space back into the main lobby. Strictly mediating the start and end, but allowing nearly complete freedom during the event fostered the most effective environment for engaging with the work.

The sculptures were already making sound and were audible immediately upon entering the main gallery space. In the corner, the live video projection was running and continued to run throughout the piece. During the event there were five main sections of performances occurring in three different zones as shown in Figure 1.

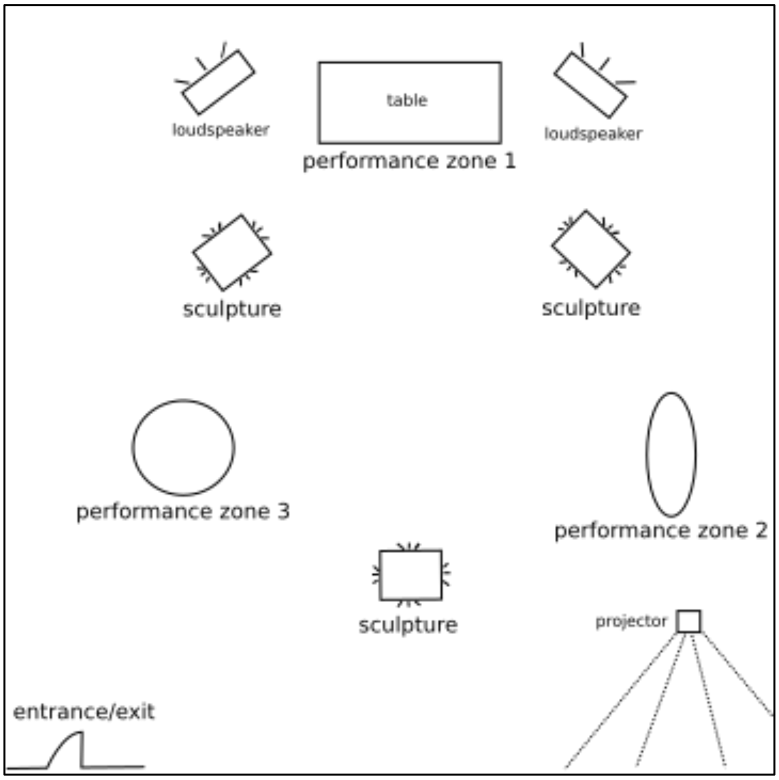


Figure 1 Approximate layout of the gallery space

The performers remained motionless at their stations the entire duration of the event until I journeyed to their zone to perform with them. The order of the performances is as follows: zone 1 → zone 2 → zone 1 → zone 3 → zone 1, in a triangular fashion moving in direct lines to and from each zone. Performance zone 1 contained a table with the main electronics and technical equipment (e.g. laptops, interface, mixer, microphones, gestural controller) where performers were seated on chairs. Performance zone 2 contained a guitar and transducer array on the floor with lights in front of the setup. Performance zone 3 consisted of a cymbal, stand, and electronics.

The performances consisted of works—in order—for voice and electronics (duo), guitar and transducer array (solo), laptop ensemble (trio), cymbal and transducer (duo), and gestural controller with electronics (solo). Individual performances lasted between 6.5 and 10 minutes each. I only left a few moments at the start and end of each piece before playing or leaving to the next station to keep the flow of the pieces.

When I arrived at each new performance zone, I changed not only location, but also my elevation, moving from sitting on a chair, to sitting on the floor, and finally to standing. My intention was to encourage the audience to view the works from all possible angles. I was pleased to see that they did in fact lie on floor, sit against walls, stand next to performers, and listen from across the gallery.

The event ended with a long phasing square wave drone that abruptly cut off when I closed my laptop. The audience was left with the unbroken drone as I sat head down in the center of performance zone 1. For the first time all the other performers stood up and quickly left the performance space guiding the audience to the main lobby where I met them a few moments later.

I felt that by bringing the audience into and out of the space was effective in creating an almost sacred and ritualistic space. They only had time to freely explore while I too was navigating the carefully planned sonic architecture of the room. By limiting their temporal engagement with *sonic activation*, site-specific nature of the work manifested itself, reinforcing the idea that this experience could only take place in this moment of time and space.

CHAPTER 2 – THE INSTALLATION

In referring to the installation half of my project, I will discuss the sound sculptures, including the hand molds, the speaker pedestals, and the circuitry involved, as well as the video projection loop. The common denominator of these elements is their static nature throughout the event. These elements remain unchanging while processes unfold around them. I will detail the construction of the materials, their aesthetic significance, and the inspiration behind them.

2.1 – Hand Molds and Resin Casting

The first part of the sound sculptures I created were the hand molds cast in polymer resin. I obtained a book titled *Body Casting Manual* (Duhamel 2010) that detailed the process behind making life size plaster sculptures of human models. Initially, I considered 3D printing models of my hands, but the material proved to be far too delicate to handle in an interactive setting. I discovered that resin was relatively inexpensive while extremely durable. The two-part liquid plastic could be cast in an alginate mold made by combining equal parts alginate and water forming a viscous gum. Once the alginate was mixed I submerged my hand into the mixture and posed considering different performance gestures (e.g. related to playing particular instruments like the guitar, violin, or piano). The entire process of casting a single hand could be done in about an hour. I made 16 of the resin hands and selected the best 12 for the installation as exemplified in Figure 2 and 3.

My decision to only focus on my hands had both practical and aesthetic significance. Since I was casting the sculptures myself, it was nearly impossible to apply the alginate to my own body. I discovered that reverse molding (pouring the alginate into a large container and submerging my hand) required significantly more alginate than the process of directly applying it to a model. It quickly became apparent that attempting to cast complete arms or even feet would require a substantial amount of alginate and resin, well outside my resources for the project. Instead, I focused on the hands and created them with striking detail and focused on poses with gestural significance the audience could identify.

Figure 2 Back of hand sculpture

Figure 3 Front of hand sculpture

2.2 – Construction of the Pedestals

The pedestals were made out of wood and neodymium magnets were embedded at the points where the hands attached. They also housed the speakers and the circuitry inside as shown in Figure 4. It was important to me that they did not have any nails showing, so I used wood glue to attach four 4-foot sections of pine together with a top and bottom section flush inside the square.

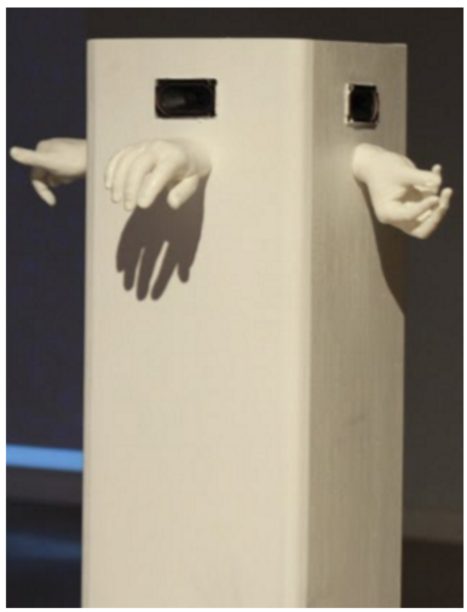


Figure 4 Picture of sound sculpture

I wanted to construct pedestals that resembled the traditional sculptural pedestals seen in most gallery settings, as well as use them as a traditional speaker-housing unit. Combining these two elements with the added display of the hands on the side of each pedestal recontextualized the traditional display of sculptural pedestal and speaker. I will go into this more later.

2.3 – Circuits and Electronics

The circuits housed in the pedestals are simple square wave oscillators made from a Hex Schmitt Trigger as detailed in Nicolas Collins' *Handmade Electronic Music.* It was important aesthetically that the sculptures had no cables or wires running to them, so I set out to design hardware that could be entirely battery operated. Inside each sculpture were a circuit with four oscillators, two amplifiers, four speakers and an additional amplifier/speaker and mp3 player.

In his book, *Handmade Electronic Music,* Collins details how to make a cheap square wave oscillator using Integrated Circuit (IC) units (p. 111). The basic principle of an IC is that it turns 1s into 0s and 0s into 1s. This process is useful as it models the behavior of a square wave as seen in Figure 5.

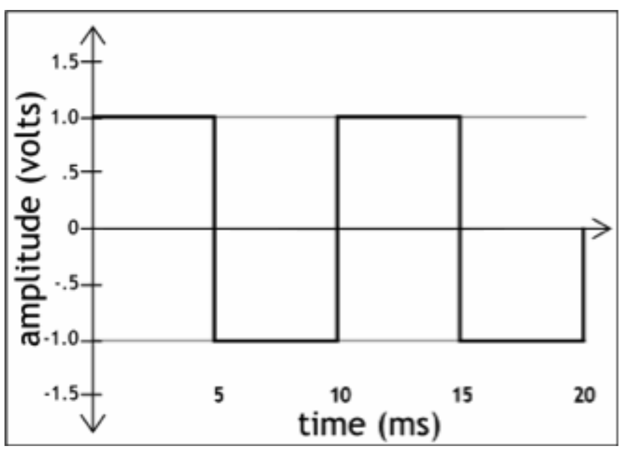


Figure 5 Square wave (recordingology.com)

The speed at which this process occurs determines the frequency of the oscillator (how many times per second it changes from 0 to 1 and back). In order to use a battery pack and get the Schmitt trigger to oscillate in the frequency range I desired I used a 4.7uF capacitor and a 1K Ohm resistor with a 10K Ohm pot in parallel[2]. Figure 6 is a circuit diagram illustrating the process.

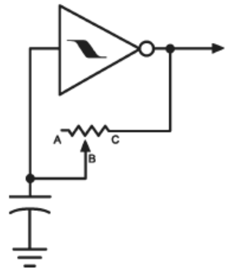


Figure 6 Circuit diagram (Collins 2006, p. 116)

Each circuit contains four of these oscillators running on the same IC unit, each with a different frequency. There are three of these circuits in the installation, one for each sound sculpture, resulting in twelve oscillators total.

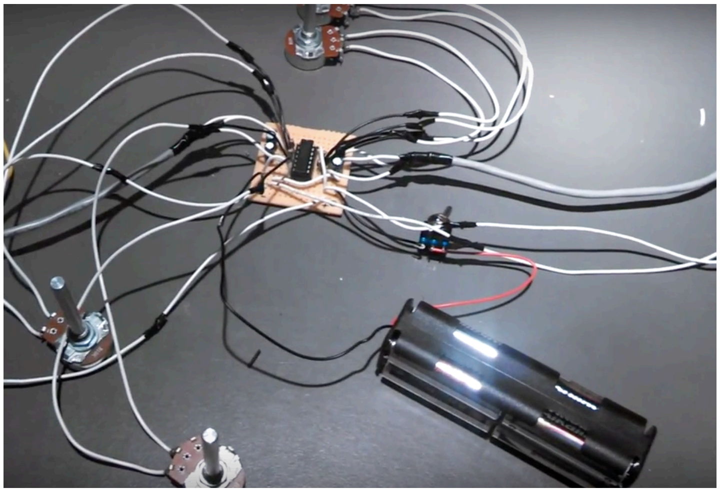


Figure 7 Circuit with potentiometers and battery pack

Each of the individual circuits is connected to two small DROK 10 Watt stereo amplifiers. All the power for the circuits and amplifiers are run from an 8 AA

[2] A few of the oscillators also used 5K Ohm potentiometers.

battery pack. The amplifiers send a stereo signal to two small pairs of 5 Watt speakers housed in the wooden pedestal with one speaker per side (see Figure 4).

The positive lead of the speaker cable is broken at the top of the pedestal and soldered to two neodymium magnets where the hands are attached to sculpture via a small zinc disc and an exposed nail head. When the zinc disc makes contact with the magnets the connection is bridged allowing electricity to flow from one magnet to other and send signal to the speaker.

The last component of the sound sculptures is an MP3 player connected to an additional small Radio Shack amplifier-speaker unit inside the pedestal. The MP3 and amp unit plays a 6-7 minute loop of one of three fixed media pieces I recorded using only sounds I created with my body. These sounds include whispers, vocalizations, bodily noises (burps, coughing, swallowing, etc) and breathing. The sounds were recorded as improvisations and then edited and processed in Ableton Live and Max/MSP.

The whispers and vocalizations were processed with munger1~, a granular synthesis external object created by Ivico Ico Bukvic as an enhancement to Dan Trueman's munger~. Granular synthesis is a DSP technique wherein a sound is broken into small fragments—on the order of ~1-100 milliseconds—called grains (Roads 1996, p. 168). These grains can then be resynthesized and transposed in both the pitch and time domain. Each sample I recorded was processed and transposed (and occasionally reversed) in several layers and then mixed back together in Ableton Live. I also applied reverb with long decay times to each track to create the illusion of a cavernous space inside the pedestals. The sounds were thus coming from *unimaginable* depths inside the sculptures.

2.4 – Tuning and Geometry

I have been particularly fond of using drones in my work. As a student at Wesleyan, much of my musical study focused on Indian classical music and some Indian classical dance. My exposure to Indian music left a significant impression on me as a composer and sound artist. Playing the tampura for my instructor and using the music for sonic meditation helped foster a sense of deep listening when creating and engaging with music. Much of my work has incorporated sustained tones/drones as a result.

In *sonic activation* I use the sound sculptures to create a drone that permeates the gallery. The three sound sculptures are arranged in the space with particular attention given to the tuning ratios and geometrical relationships. Given the combination of capacitors and resistors contained in my circuit the lowest producible frequency is 240 Hz (B3 -50 cents), which serves as the "fundamental" pitch in creating the drone in my sound sculptures. All the other pitches are derived from just intonation ratios above this partial (see Figure 8).

Frequency (Hz)	Ratio
240	1:1
320	4:3
360	3:2
420	7:4
480	2:1
540	9:4

Figure 8 Tuning and ratios of oscillators

In a just intonation tuning system, whole number ratios are used to derive pitch relationships. Perhaps the most famous composer to extensively explore just intonation is La Monte Young. His seminal work *The Well Tuned Piano* employs a seven-limit just intonation tuning system of his own invention (Gann 1993). In the opening chord of *The Well Tuned Piano* Young focuses on the ratios 1:1, 9:8, 3:2, and 7:4 (Gann 1993). Young's opening chord to *The Well Tuned Piano* became an inspiration for my drone. The chord has a "sweet and sour" quality to it, sounding simultaneously extremely consonant and yet somewhat dissonant.

Additionally, I slightly detuned the oscillators to create beating patterns throughout the space. Beating patterns occur when two frequencies are closely in tune with one another, typically between 1-15 Hz, and result in periodic phase cancellation and reinforcement (Roads p. 561). The beating patterns are evident not only in the fundamental, but also in the related overtones of each oscillator, creating a "chorus-like" effect.

The speakers are oriented such that different sections of the gallery space reinforce different parts of the chord and their overtone relationships (see Figure 9). The speaker configuration forms several layers of different triangles. In the center of the space speakers surround the audience, but when they journey outside this triangle, they hear the other side of the sculptures, subtly changing the perception of the chord quality and the beating patterns.

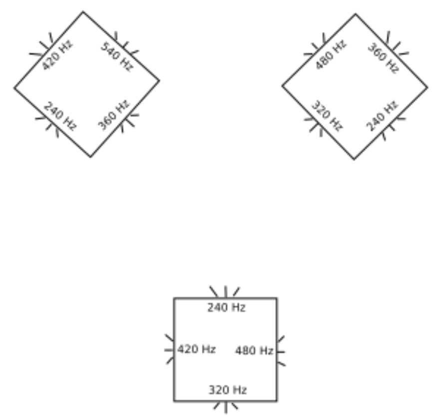


Figure 9 Speaker configuration with frequency values

The geometric placement of the speakers is also influenced by another work of Young's, *The Dream House.* This permanent sound and light installation in New York City was realized in collaboration with his partner Marian Zazeela in 1969, and it still exists today. The installation is a house filled with sustained tones, specific lighting created by Zazeela, and occasionally live performers (Young interview 2002). Visitors may walk through the house and experience the subtle chord changes form room to room. I find this concept fascinating because the way the audience must interpret the work functions like a sonic equivalent to sculpture. In the visual arts, sculpture is a static object; its dynamic nature comes into play as the viewer navigates around the object, viewing it from multiple angles and its new relationship with the space (and light, etc.). My installation draws on this technique by using physical sculptures as well as creating a sonic sculpture in the space.

2.5 – Transparency of Pedestals and Speakers

The definition of "sculpture" appears to be obvious at first thought, but becomes elusive upon further inspection. At what point do objects become sculpture? I offer two examples from art and music respectively: the sculptural pedestal and the speaker. The pedestal a sculpture rests upon is not perceived as part of the gestalt of the sculpture itself. Remove the sculpture and the entire gestalt goes with it. Similarly with speakers, they are not generally considered an inseparable element of a piece of music. It is fair to say that any pedestal holding a sculpture could be replaced by another pedestal of relatively equal size. It follows that any speaker could be replaced by one of a similar make and model. Their interchangeability is what perhaps relegates them as objects. They are not viewed as part of the art or music. Rather they remain in the background as functional devices. These objects are transparent in that the medium they project fundamentally define them.

I attempt to subvert these transparencies and fuse the two models in my project. The sound sculptures as a whole exist through the interaction between the white pedestal, the loudspeakers housed in them, and the attached hands. Nothing is placed on top of the pedestal, thus reinforcing its shape as the primary aesthetic focus. As for the loudspeakers, each one amplifies a single, sustained tone, giving the impression of specificity. The lack of cables running to the sculpture suggests autonomy from a separate master control. The tones are intertwined with the physical aspect of the sculpture as a whole.

2.6 – Video Projections

The last element of my installation is a video projection on loop throughout the event. To create the video I recorded several videos of gestural improvisations using only my hands and processed the video files in Jitter. These gestures are informed in part by musical gestures (like playing a particular instrument) and in part by Bharata Natyam mudras—South Indian dance hand gestures. Mudras can be used to communicate ideas and emotions in Bharata Natyam (O'Shea 2007, p. 199). While improvising I used elements I learned from this dance form to guide the hand movements.

I edited two six-minute video files together, one for each hand. The videos are imported to a custom Max/MSP/Jitter patch that uses video edge detection to outline the shape of the hands and remove most of the color. The files playback at predictably random variable rates using the drunk object in Max (see Figure 10).

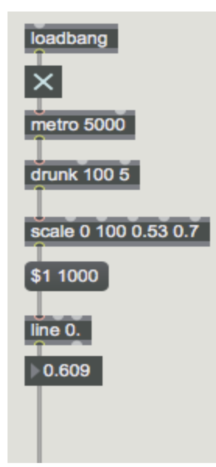


Figure 10 Sub-patch for predictively random playback speed

The drunk object in Max allows the user to create predictably random motion by stipulating a range and step size. I mapped the playback rate to change between 50-150% speed with a small step-size of 5% change every few seconds creating a slowly shifting speed that gives the file a more dynamic appearance, rather than a static video loop.

Using a similar sub-patch, the files crossfade between the left and right hands, the original, and a delayed signal inverted by 180 degrees. This process creates a generatively evolving video loop that contains recognizable gestures projected at variable speeds.

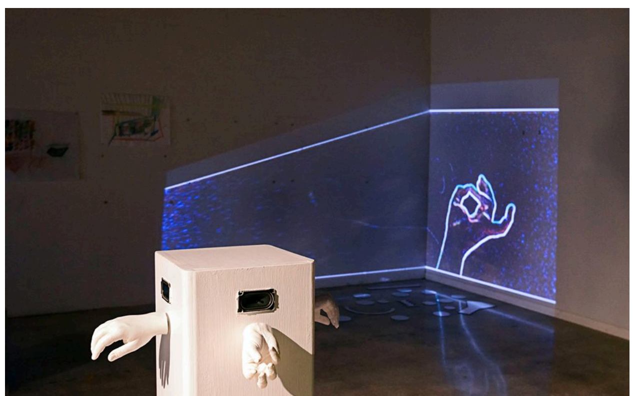


Figure 11 Sound sculpture and video projection

CHAPTER 3 – EVEN THE EARTH WILL GO

The first composition performed in *sonic activation* is a work for two performers and electronics. The piece is titled *even the earth will go* and has a duration of approximately 10 minutes. Each performer has a Sennheiser MD 421-II dynamic microphone for their voice and a homemade contact microphone fixed to the table underneath a black cloth. They read from a graphic score that indicates breath style and consonant articulations. The performers each also have one opportunity for a gestural improvisation they lead during the piece where they can act out a series of movement that the other performer responds to.

3.1 – Explanation of Graphic Notation

even the earth will go is realized using graphic notation that indicates relative breath styles and consonant articulations that are to be performed in a relative time space (see Appendix A). The particular style of the graphic notation draws heavily from John Cage's *Solo for Voice No.22* in which the composer parametrically notates breathing style ranging from nose to mouth and, as subcategories, regular to irregular with time on the x-axis. Lines drawn between points on the score indicate a transition from one mode of breathing to another.

My work incorporates this idea but with only two modes indicated on the y-axis, slow/steady and rapid/inconsistent. Additionally, I include points where percussive consonant sounds are made between two different modes of breathing. The performers assume the responsibility of interpreting the relative points on the graph between in the spectrum of breath modes and how to creatively improvise with the percussive consonants. The performers have some freedom in interpreting the timeline, though each system should take approximately 60-90 seconds to complete. FIG 12 reference missing.

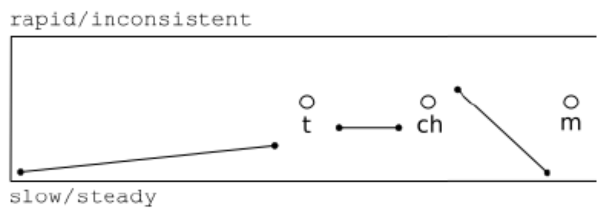


Figure 12 Sample of graphic notation for *even the earth will go*

While this is going on each performer is also tapping out a heartbeat-like rhythm with one hand on the table that is amplified through the loudspeakers. This pulse remains constant during the performers' vocalizations. With the other hand, the performers draw out the shape of each consonant sound as they improvise with it. At first, in the air in front of them, then in air above the table, and finally scratching it out onto the table itself. This process serves to draw a connection between the physical gesture, the shape of the letter, and the sound of the letter.

3.2 – Electronics and Technical Setup

This work contains both live processing and fixed media that is altered by live input. The performers' voices are amplified and processed in Ableton Live and the signal is sent to two loudspeakers placed reflectively (facing the walls) on either end of the table in performance zone 1 (see Figure 1).

Each individual voice track is sent to a separate return track in Ableton that processes the vocalizations two ways. The first is a "glitch" effect created with Ableton's Beat Repeat. An envelope follower tracks the loudness of the performers' voice and when it crosses above a given amplitude threshold (typically only on the articulated sounds) the signal is sent to the Beat Repeat effect, which creates a rapid succession of pitch shifted delays. A low frequency oscillator (LFO) controls how low the original sample is transposed by the pitch shifter. The effect enhances the percussive quality of the consonant sounds and transforms them into sharp textural attacks. These processed sounds are sent to a Looper effect that continuously records about a minute of sound, thus accumulating density as the piece progresses by layering many transposed samples on top of one another.

Figure 13 Ableton's Beat Repeat effect

A sound file of a processed cello sample is heard as a low drone. To create the processed cello sound, I imported a cello sample into SPEAR, a digital resynthesis application, and removed most of the spectral content, leaving behind only the strongest partials. The file was then frequency shifted to match the drone created by the sound sculptures. Each of the two performers in *even the earth will go* has a version of the sample that starts at 90 Hz and is frequency shifted up 30 Hz for one and down 30 Hz for the other, ending the piece with a 60 Hz and 120 Hz drone. The two drones are side-chained to the contact microphone signal on the table, resulting in an audible ducking effect when the players tap out their heartbeat-like rhythms. Side-chain compression is when an input signal is used to control the output gain of another signal (Colletti 2013). Ducking is simply another term used for lowering the volume of a signal. This effect creates a pumping sound that pulsates through the speakers.

Lastly, the signal from the two drones is sent to a tapped delay line with a series of formant filters(Smith 2007). Formants are resonant bands of frequencies found in speech. These acoustic properties can be modeled using the digital signal processing (DSP) technique formant filtering, which highlights particular frequency bands. Given that I stripped the Whitman text of all the vowels, I used vowel formant frequency filtering to replace this spectral content. Each return track is controlled by a LFO to create sweeping A's, E's, I's, O's, and U's.

3.3 – Gesture and Meaning

The gestures in *even the earth will go* can be categorized as: (1) related-unsounding gestures, (2) related-sounding gestures, and (3) unrelated-unsounding gestures. The first category of gestures is performed during the second and third systems of the piece. Starting in the second system the performer traces out the consonant letter in the air in front of him as he says them. In the third system the performer traces the letter above the surface of the table, still without the action itself making a sound. Though this is an unsounding gesture, the action is related to the sound. It reinforces what the sound looks like as it is said. The audience can draw a relationship between the action and the sound. When they hear a "t" or an "m" for example, they see the shape drawn out in front of the performer.

In the second category, the gesture becomes a sounding action. The performers trace the letter onto the table and the contact microphone amplifies the action. The audience hears the letter, sees the gesture, and hears a secondary sound related to the inherent gesture in the letter. There is an innate rhythm to tracing each letter and as well as a specific envelope unique to almost each letter, with perhaps the exception of p, b, and d which will sound similar due to their shape.

The third category occurs during one short improvisation per performer. At any point in the piece either performer may signal to the other that they would like to lead a short gestural improvisation. Each solo is a 20-30 second unsounding gestural improvisation that deviates from whatever they are currently performing. The gesture can be anything so long as the performer does not intentionally make any sound and it does not relate to any previous gestures in the piece. While one performer leads, the other follows, responding to the gesture with similar or contrary motion, so long as it directly responds to the leader. Because much of the piece requires the performers to be acting out multiple focused tasks at their own rate (breathing, tapping, and tracing) the solo sections act as a burst of energy to wake the performers from their concentration and briefly improvise together before returning to their tasks.

CHAPTER 4 – AS IF ONCE BEFORE

In order to further explain the second piece, I will need to spend some time elaborating on my research with transducer technology. I will detail how the technology functions, reference historical and contemporary works that implement the technology, and categorize the performance possibilities with transducers. This section will serve as an explanation for the cymbal and transducer piece I will discuss later as well.

4.1 – Transducers

To put it simply, transducers are the vibrating half of a speaker without the cone. More broadly the term transducer refers to a device that converts energy into a different kind of energy (Agarwal 2005, p. 43). I will be addressing a specific kind of transducer, one that is used to convert electrical signals into vibrations (sometimes known as an actuator). Audio transducers use magnets and electricity to create an electromagnetic field that causes vibrations depending on how much current is flowing through it, which in turn creates changes in air pressure that we can perceive as sound (Storr 2016). Since an audio transducer is missing the cone normally used on a loudspeaker to direct the sound, it must be placed on an object to clearly hear the amplified signal.

Transducers have been used in experimental and electronic music since the latter half of the 20th century. Possibly the earliest and most well known example is

David Tudor’s *Rainforest* in which objects are affixed with transducers and contact microphones and sound is transmitted through the objects and amplified back into the space. The piece had several incarnations, but *Rainforest (IV)* (1973) exists conceptually as a single circuit diagram (see Figure 14).

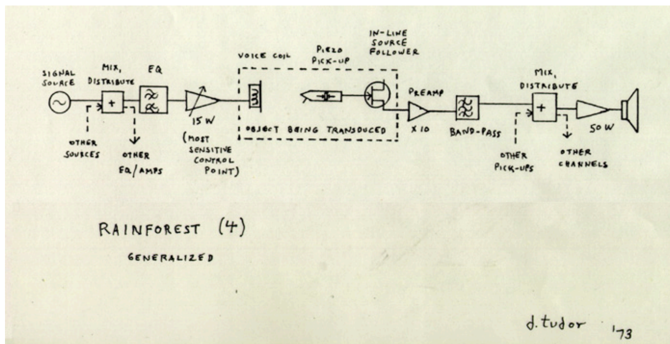


Figure 14 *Rainforest (IV)* circuit diagram (davidtudor.org)

The above figure simply indicates the technical process behind the installation, and yet provides so much possibility for creative realization. It allows an artist or group of musicians the freedom to curate the objects, determine how to position them in a space, and what sounds to play through them. Each realization is unique yet remarkably familiar. The objects color and distort the sounds completely differently and always come together to create a rich sound environment.

Composer Alvin Lucier implements transducers in several of his works as well. His groundbreaking work *Music for Solo Performer* (1965) uses alpha brain waves as control signals that vibrate transducers attached to drums heads (Collins 2006, p. 44). In his work *Risonanza* (1982) Lucier attaches a transducer to a cymbal and plays tones through the cymbal to create harmonic resonances that are accompanied by a flute, oboe, and clarinet.

More recently, composer Alex Sigman uses transducers attached to both objects and instruments in his work. *le jardin des supplices* (2012) calls for transducers attached to the body of a violin and cello to use as resonating surfaces. His work *fcremaperc* (2014) for solo percussion and live electronics instructs the performer to attach transducers to a thunder sheet, a snare drum, and a zither.

Jacob Sudol, has worked extensively with transducers in his series *…spaces to listen to from within (i-v).* In the second installation of the series, *...spaces to listen to from within (ii)* (2014) performers use a 4-chanel transducer array to play a fixed media composition onto various objects. There is no score to the work, but there is an implicit trajectory in each performance. Since the fixed media playback file is the same from one performance to another, the realization of the piece manifests itself in the selection and exploration of objects being transduced.

I have performed this piece three times, all with different realizations. In the first instance, two performers each hold a stereo pair of transducers and perform on a large architectural installation, slowly exploring the large surface fixed to the wall. Here, both performers face the same direction—the audience behind them—and navigate the surface of the object on one plane (against the wall). The second instance included four performers with one transducer each, navigating through five different objects placed around the stage. In this case the performers not only changed objects but also moved in three spatial planes. Finally, the third realization of the project was again with four performers and on a 3-D printed architectural installation of a building in downtown Miami. This time, performers changed surfaces once and moved on one plane each, but faced one another on the edges of a square, with the audience surrounding them. This is one of the few works that uses transducers as a performative tool rather than a fixed sonic activator. Allowing the performers to fully explore the surfaces of the objects introduces a much more dynamic performance model and uses the more expressive potential of the technology.

I propose that there are four models for implementing transducers in electronic music: (1) fixed-position/fixed-media, (2) fixed-position/live-input, (3) moveable-position/fixed-media, and (4) moveable-position/live-input. As the names imply, fixed-position is when the transducer is attached to an object and remains stationary, while moveable-position allows performers to modify the location of the transducer during a performance. Fixed-media refers to a pre-recorded file (or possibly a preprogrammed circuit/sequence) as the input source of the transducer array. Live-input has a broad scope of realizations, but generally refers to any input system where a performer changes or controls the sound in some way via instrument, live processing, feedback loops, etc. The key difference being that there are dynamic processes at play that the composer or performer can influence during the piece.

Most work with transducers falls into the second category. With regard to the earlier examples I mentioned, *Rainforest (IV)* is fixed-position/live-input (FPLI) as the transducers are attached to objects in a space, but performers may introduce sound into the system. In addition, much of Alex Sigman's work uses the sound from processed instruments to transduce objects with a fixed-position transducer. The FPLI model is perhaps the most convenient for live performance with transducers because the transducers are simply used as "special effect speakers." The composer needs only to indicate how and where the transducers are attached and the rest of the mechanics of the piece function independently.

The first category, fixed-position/fixed media (FPFM) would most likely function in an installation setting, as is the case of my own work *Other Voices* (2015). The project was installed at the Bakehouse Arts Complex in an old electrical cellar where I attached transducers into the A/C vents and circuit boxes and used small MP3 devices to play a 4-chanel audio loop. The FPFM model allows for the creation of a completely autonomous system, absent of performers or composer input. In the case of *Other Voices*, I carefully placed the transducers and electronics out of sight so that it appears the room is creating the sounds on its own.

As described earlier, *...spaces to listen to from within (ii)* fits into the moveable-position/fixed-media model (MPFM). The moveable-position model demands the composer address the problem of how the transducers are moved, which is why categories 3 and 4 are not as common. In Sudol's case, the composer gives oral directions to the performers and the work is choreographed like a dance, with each realization presenting alternate possibilities for choreography. In chapter 6 I will discuss a system of graphic notation I devised to indicate transducer motion.

The last model of performance, moveable-position/live-input (MPLI), is certainly the least common. I became most interested in this performance model because it requires the composer and performer to treat the transducer as an instrument, not simply an extension of a speaker. There are several MPLI systems I found to work in a live performance setting. In the rest of this chapter I will discuss a feedback performance system and in a later section I will discuss a controller-based system.

4.2 – Feedback and Improvisation

The second composition in *sonic activation* is for amplified 12-string guitar with eBow and a mono transducer array. An eBow is a small electromagnet that causes metal strings to sympathetically vibrate (creating the effect of an infinitely sustained sound). The top two courses of the guitar, the unison B string, are tuned down to 240 Hz (-50 cents below B3), the fundamental of the installation drone. A small clip-on microphone is inserted into the body of the guitar and the signal sent to a mixer and amplifier. With the guitar laid flat on the ground, the performer places the eBow on the second course of strings and allows them to freely vibrate. The performer then places a transducer that plays the amplified guitar signal back into the body of the guitar. By moving the transducer around the body of the guitar he explores the natural resonances of the instrument and creates slowly undulating feedback loops. The work is called *as if once before.*

Creating a feedback loop with a transducer is very straightforward. The signal chain is simply: microphone → mixer → amplifier → transducer. Contact microphones generally are the most effective way to create feedback loops on the surface of an object (Collins 2006, p. 41). Through my own experience however, I found that inserting a microphone into a resonant body and placing a transducer on the surface will create excellent navigable feedback.

In *as if once before* the performer is tasked with navigating the surface of the guitar with a transducer searching for resonances that verge on the edge of uncontrolled feedback. This piece uses the MPLI model with live feedback as the input source.

The moment the system begins to produce feedback, beautiful resonances emerge and interact with the drone produced by the eBow. There are "sweet spots" on the body of the guitar that will produce low-frequency feedback that activate the lower strings on the guitar. A few times throughout the piece, the performer slightly detunes one of the 240 Hz B strings creating beating patterns that interact with the feedback loops resulting in quiet polyrhythms.

There are several modes of control in this piece. Using the left hand, the performer can simply make volume and EQ adjustments to enhance or attenuate particular frequencies. Also using the left hand the performer can dampen different areas on the surface of the instrument, which alters the feedback. The performer can move the transducer to different areas along the surface of the instrument as well as apply different levels of pressure with the transducer. Perhaps counter-intuitively, less pressure on the transducer can actually cause more feedback, especially in high frequency bands. These possibilities come together to form a sort of improvisational map (or feedback minefield if you will) that guides the performance. A successful performance will explore a diverse and rich collection of resonances without any "feedback explosions."

CHAPTER 5 – SLOWLY IN BLOSSOMS

The third piece is titled *slowly in blossoms.* The work is for laptop ensemble and uses controlled feedback loops, room resonance, and performer vocalizations to create a gradually expanding and contracting drone. Each performer runs a Max/MSP patch on their laptop that uses the internal microphone and built-in tilt sensor to create and control the sound in the piece. Performers are seated in a semi-circle in performance zone 1 and are connected to the reflective stereo loudspeakers on either end of the table (see Figure 1).

The score, a set of text instructions written directly in the patch, indicates time and actions. In the first minute of the piece the performers breathe into the microphone in various ways. Then, the performers sing a series of quiet, sustained tones, just loud enough so that each performer can barely hear the others. Throughout the piece the performers tilt their laptops in various directions (in-sync and then freely), which changes the transposition of the feedback loops.

5.1 – Electronics and Technical Setup

I created *slowly in blossoms* with the intention of designing a simple interface and minimal technical setup for a live laptop ensemble performance. The Max/MSP performance patch used for the piece is almost entirely automated and uses the built in microphone and headphone output. To set up the patch the user interface directs the performer to draw in two curves to a filter bank. Once they have done that, the rest of the patch runs without user input. As a result of automating the processes in the patch, the performer may focus solely on the breath sounds, vocalizations, and laptop orientation. This also prevents unnecessary sounds such as keyboard and mouse clicks from being introduced into the delay lines.

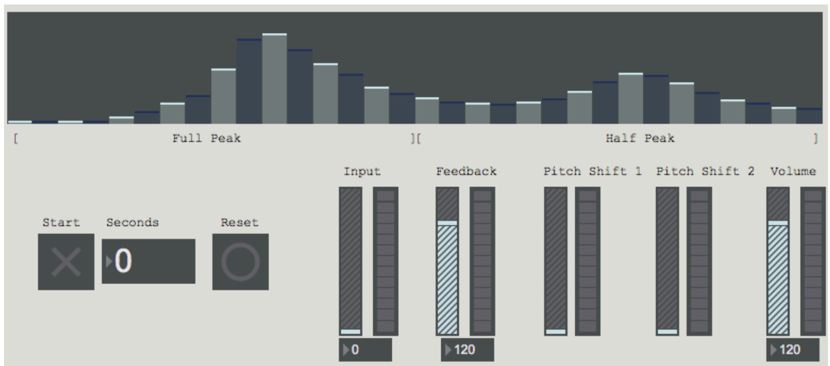


Figure 15 Max/MSP Performance Patch for *slowly in blossoms*

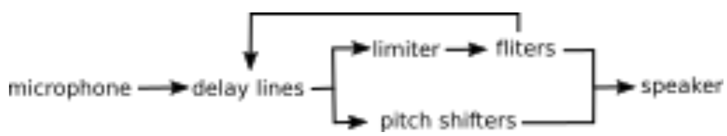


Figure 16 Signal chain for *slowly in blossoms*

The signal from the microphone input and is sent to a series of delay lines processing the sound. From there the signal is sent to a limiter and a bank of filters, then sent back into the delay line, creating a feedback loop. Both the original and delayed signal is sent to two pitch shifters that are controlled by the computer's built in tilt sensor (see Figure 16).

I am using the object fffb~ to create a fast fixed filter bank, a process also known as 1/3 octave filtering (Elsea 2010). As the name suggests, 1/3 octave filtering splits the signal into narrow frequency bands spaced 1/3 of an octave apart (Elsea 2010). In my patch I give the fffb~ object arguments to create 32 bands of frequency starting at 63.5 Hz spaced apart at ratios of the cube root of two (see Figure 17). The filters are given the argument 40 to create a very high Q (bandwidth), this gives a "chordal" effect when the players breathe into the microphone. The signal of all the filters is summed and sent back into the delay line to be reprocessed.

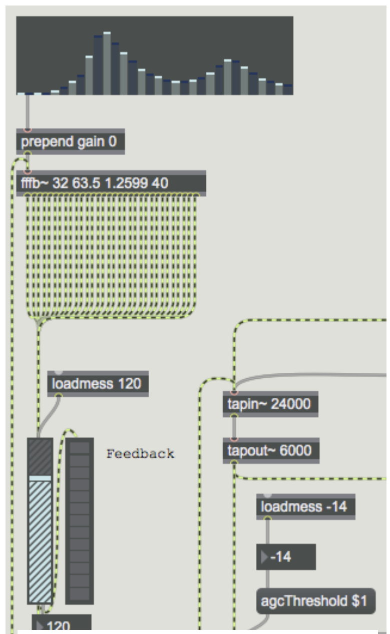


Figure 17 Fast fixed filter bank

The 1/3 octave filtering is used to remove large bands of frequencies on the incoming signal and the feedback loops. If left running, the loop will continue to filter down to a single tone (or two), which is how the piece ends.

The other process I implement in the patch is pitch shifting controlled by the sudden motion sensor using the external object aka.bookmotion (Akamatsu). As the performers hum tones into their microphones, they gently tilt their laptops in different directions, causing subtle transpositions in the two pitch shifters. By adding these extra pitch deviations in the feedback loop the system can prevent any particular frequencies from distorting. The sounding result is a swirling effect between the speakers.

5.2 – Resonance and Feedback

The primary goal of *slowly in blossoms* is to interact with the resonant architectural qualities of the performance space through vocalizations and feedback loops. One of the most influential inspirations for this work is Alvin Lucier's *I am sitting in a room* (1969). Lucier uses the recorded sound of his voice to discover the constructive and destructive interference patterns of a room (Lucier 2012, p. 90). Each time he plays the recording back into the room the latent architectural sounds begin to manifest themselves. The room becomes the catalyst for transforming natural speech into a slowly unfolding rich harmonic texture.

The other work that inspired my piece is Nicolas Collins' *Pea Soup* (1974). In his work, Collins uses envelope followers with voltage controlled phase shifters that create stable feedback patterns (Collins 1976). When the envelope followers receive signal (created by feedback), they send changes in voltage to the short delay lines that alter the phase of the incoming signal. The system uses "automatic negative feedback…to control audible positive feedback" (Collins 2011, p. 4). Collins himself describes the process as a "site-specific raga" (2014, p.1).

In *slowly in blossoms* I borrow elements from the above pieces and put them in the context of a laptop ensemble performance. The performers use a mix of breath sounds and humming to start the long delay lines that are similar to the process in Lucier's *I am sitting in a room.* By moving the orientation of their computer the performers adjust the pitch directly in the software and their relative distance to the speakers, similar to the process in Collins' *Pea Soup.* As the piece develops, the system fluctuates between the strong room tones reinforced by the feedback and the overtones present in the sound sculptures.

CHAPTER 6 – BETWEEN US THE AIR ENCIRCLES

The fourth piece in my project is a work for two performers with transducers on cymbal. A fixed media file plays sine tones that are transduced on the cymbal, exciting the latent harmonic qualities of the metal. Each performer has a transducer in their right hand and is connected to one half of an open circuit (using the Makey Makey microcontroller), so that the transducer only makes sound when the performer is touching the cymbal with the left hand. The Makey Makey is a microcontroller that allows the user to create open circuits that, once the connection is bridged, sends ASCII information (keyboard data) to the user's computer. The performers follow a graphic score that indicates direction of motion and pressure with the transducer, as well as left hand movement and muting. The title of the work is *between us the air encircles* and is 7 minutes and 15 seconds long.

6.1 – Electronics and Technical Setup

I use a Max/MSP patch to play a fixed media sound file of pre-recorded sine tones as the input source for the transducers. The output volume of the patch is controlled using a Makey Makey. In *between us the air encircles*, each performer is connected to a separate lead and the cymbal is connected to the ground of the circuit (see Figure 18). This allows the performer to control when their transducer makes sound by touching the cymbal. When they make contact with the surface of the cymbal their transducer will start making sound and when they release contact with the cymbal the signal is cut off.

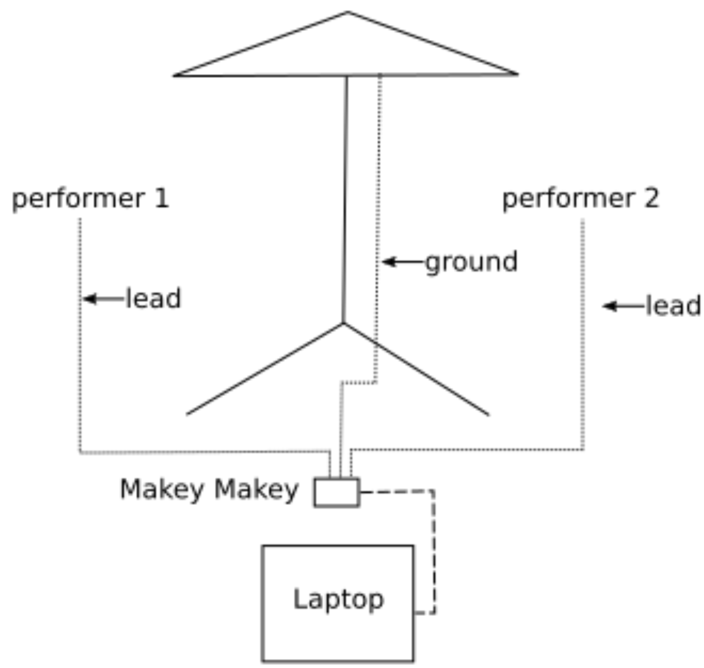


Figure 18 Makey Makey setup for *between us the air encircles*

Though this system falls into the moveable-position/fixed-media (MPFM) model I described in Chapter 4, the addition of the volume control makes it a more dynamic performance model. Adding this feature gives the performer the ability to exert more control over the system and create rhythmic effects that are otherwise not possible with a normal MPFM setup.

The signal flow for the piece is as follows: computer (stereo sound file) → amplifier → (stereo out) transducers. A small wire is attached to the performer as the lead for the Makey Makey and both this wire and the speaker cable running to the transducer are held back with a small sweatband on the forearm to prevent interference with the cymbal (see Figure 19).

Figure 19 Performance setup of *between us the air encircles*

The sine tones used in the piece are selected in part to relate to the installation's drone and in part after extensive resonance testing with the cymbal while searching for sympathetic frequencies. To test which frequencies would excite the cymbal most, I ran sine wave sweeps from 60 Hz to 600 Hz on many locations across the surface. The cymbal is a large 24-inch ride, so high frequencies, above 300 Hz, had little effect in vibrating it. I took notes as to which frequencies the cymbal most actively responded to and cross-referenced them with a list of just intonation ratios related to the chord in the drone and selected the ten frequencies that best fit these two categories. In two instances, at the beginning and end of the piece, there is a sweep from one frequency to another. In all other cases only one tone per player is produced during each phrase.

6.2 – Explanation of Graphic Notation

Earlier I mentioned that one of the problems with moveable-position performance models is that the composer needs to communicate to the performers how to move the transducers. Since no such standardized notation system exists, I devised a system of graphic notation that includes the necessary information to perform with moveable-position transducers (see Appendix B). After some careful thought I realized the performance elements I needed to include are: time, location on the cymbal, direction of movement, pressure of transducer, and different modes for muting the cymbal.

Right hand movements, with the transducer, would effect which overtones were brought out, while pressure would change the timbre. High pressure resulted in less volume, but more emphasis on low partials. Low pressure resulted in a saw-like sound, emphasizing the high partials and causing an extreme ringing when played on the edges. Left hand muting was most noticeable with low pressure.

Any left hand movements are essential in turning on the system, as contact with the left hand is what bridges the electrical circuit and sends signal to the transducer. The left hand could also be used to mute overtones in interesting ways, especially by expanding and contracting the fingertips. Also, the performers can create rhythmic phrases by brushing their fingers tips across the surface of the cymbal.

The page is divided into two parts horizontally, one for each player, with time indication in the center. Each page is broken into three gestural cells, which display the surface of the cymbal. As a courtesy, the frequency of the sine tone during each cell is indicated for the performer. The gestures are to be completed within the time indication, but pacing within each cell is left up to the player. Since the performers stand opposite one another, the score displays the performers half of the cymbal from their perspective, in reality creating a mirror image. The cymbal is further divided into left and right quadrants for left and right hand gestures respectively. Figure 20 and 21 are samples from the score.

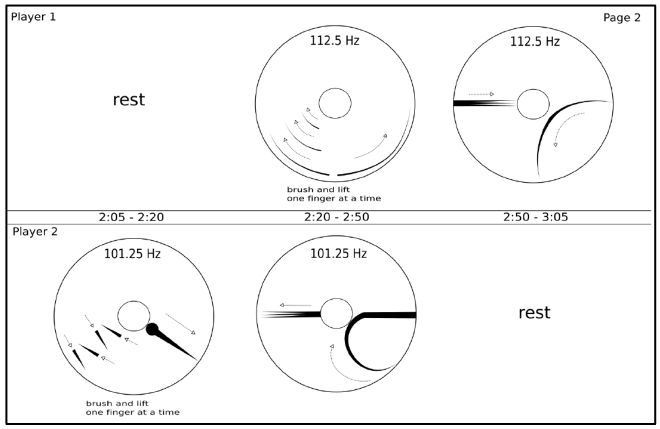


Figure 20 Sample page from *between us the air encircles* score

For right hand gestures, the thickness of the line indicates the amount of pressure. A solid circle signifies leaving the transducer in that position with full pressure for more time. A dotted arrow shows the direction of movement. All right hand movements with the transducer are continuous, unbroken gestures; the transducer stays on the surface of the cymbal for the entire duration of the gestural cell. The last location of the transducer on each gestural cell is usually the first location on the subsequent cell, implying that the performer need not lift the transducer.

For left hand gestures, thickness of the line suggests the amount of flesh touching the cymbal (not necessarily the amount pressure). Again, a dotted arrow shows the direction of movement. However, left hand gestures are not all continuous, some are broken or rhythmic in nature. The performance order of broken left hand gestures is left up to the performer, but the pacing is implied with the physical length of each gesture (longer lines will take more time to complete). Occasionally text is given underneath a gestural cell to explain the left hand gesture.

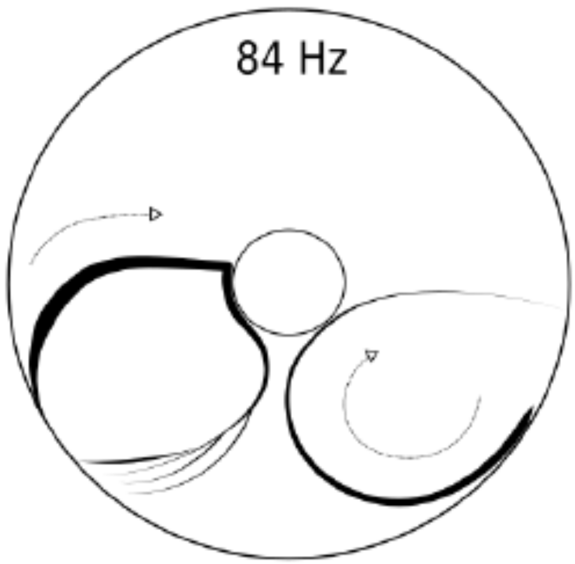


Figure 21 Sample gestural cell from *between us the air encircles* score

CHAPTER 7 – GAMETRAK GESTURAL CONTROLLER IMPROVISATION

The final section of the performance is an improvisation using a repurposed video game controller with custom-built software designed in Max/MSP. The hardware device is a GameTrak controller, originally intended for use with a virtual golf game. The improvisation occurs in two parts, one focused on playing the controller like an electronic stringed instrument and the other as a gestural controller to interact with the laptop physically.

7.1 – Hardware and Software

The GameTrak is a three-dimensional game controller that uses a pair of joysticks and retractable cables to track x, y, and z coordinates of real time movement (Myers 2002). At the ends of the cables there are clips where the user can attach a set of gloves. There is also a footswitch that can be used as a toggle. The device connects to a laptop via USB.

Figure 22 GameTrak Controller (image from ign.com)

I programmed a Max/MSP patch that will recognize the GameTrak data using the “hi” object. This object allows for the input of data from gaming device and human interfaces. Once the data is in Max, it can be mapped to control any parameters within the patch.

I wanted to figure out a way to program the patch to recognize a plucking gesture because the GameTrak has an actual plastic string that comes out of the device. The physical process of plucking the GameTrak cable is essentially a sudden negative change in the z plane (i.e. moving from a higher point to a lower point very quickly). The following sub-patch recognizes sudden changes in downward motion from the cable’s z coordinates (see Figure 23).

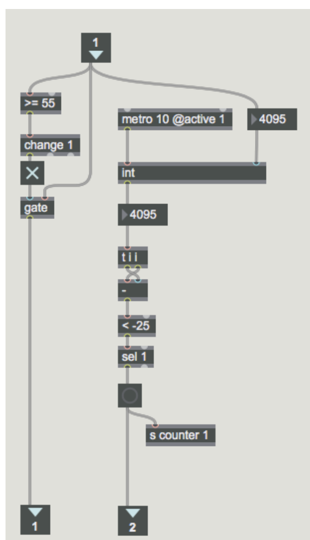


Figure 23 GameTrak plucking sub-patch

The first section of the improvisation implements Karplus-Strong synthesis algorithm that is used to simulate a string model. Karplus-Strong synthesis uses a noise generator and a short delay line to create the decaying timbre of a plucked string (Roads p. 294). The onset of the sound is triggered by the sub-patch shown in

Figure 23 and the length of the cable in the left hand controls the "pitch". Pitch in this sense refers to the delay time of a comb~ object (comb filter) that filters a noise burst, giving the impression of relative pitch between higher and lower positions of the cable. The right hand controls a set of continuously variable delays that will alter the timbre and stereo distribution of the sound.

The second part of the improvisation features a modified "chorus" effect that transforms the signal received from the computer microphone. A chorus effect is simply "a combination of delay and phase shifting" (Roads p. 419). As a side effect of using the computer microphone, feedback is easily introduced into the signal chain. As mentioned earlier, Nicolas Collins discussed the implementation phase shifters to control feedback signals. Using the GameTrak controller, I can change the delay time, rate, and depth of the chorus effect to shift the incoming feedback frequencies and generate a dense and unpredictable soundscape (see Figure 24). I can also use this technique to process tapping, scratching, and other percussive sounds on the computer and keyboard that are picked up through the internal microphone.

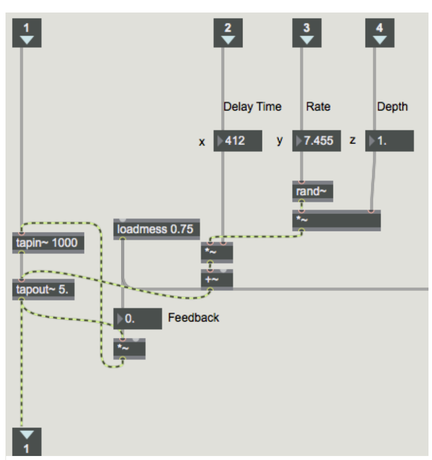


Figure 24 Sub-patch for one channel of the chorus effect

7.2 – Guidelines for Improvisation

During the first part of the improvisation—with the synthesized plucked string sounds—the performer is searching for pitches and timbres that create strong room resonances and, when possible, are in tune with the drone of the installation. The placement of the left hand in the z plane (up and down motion) is the first exploration. The performer plucks the string with the right hand a few times to test the relative response of a few lengths of the cable. Once some positions have been established that function within the above guidelines, the performer adds more motion to the release of the plucked gesture in the left hand, further altering the timbre. These two gestures are developed and used in combination several times until the performer finds some combinations that work.

Once this is accomplished, the performer can use the footswitch to activate a kind of "bowing" or sustained excitation mechanism that will allow for longer gestural explorations (~15 seconds at a time). The patch is programmed to introduce some rhythmic effects, like amplitude modulation, that will inform the pacing of the improvised gestures.

In the second half of the improvisation, the performer is searching for different gestures to alter feedback loops and introduce percussive sounds into the system. Similar to the programming in the plucked string, a sudden change in up/down motion will trigger an amplitude envelope to turn on the computer microphone. Feedback almost instantly occurs and the performer must adjust the position of his or her hands to continuously alter the signal and prevent any frequencies from completely overloading the system. The performer can also tap, scratch, or type out on the keyboard to create percussive sounds that interrupt the feedback. The system is intentionally difficult to tame and requires significantly more movement than the first half of the improvisation.

CHAPTER 8 – CONCLUSION

As I described in this paper, my intention of *sonic activation* is to create an experimental audiovisual experience that guides the audience toward an active role in listening and viewing. By shifting between various modes of spatial performance juxtaposed against a static installation, the event recontextualizes the modes of engagement between the sound and gesture. Gesture plays an important role in offering exact clues in the processes at play, while at times obfuscating the direct interaction. Investigation and understanding of how the sounds are generated in the space, their relationship to one another, and their function in the experience as a whole can be all explored via gestures. In the future, I plan to continue my research into transducer technology and performance and expand on the concept I addressed in this work.

Additionally, I have planned to realize another version of *sonic activation* at the Bakehouse Art Complex in the Wynwood Arts District of Miami. A different site-specific installation will allow me to explore the expanded possibilities of audience interaction with the work. In this second iteration my goal is to allow the audience to remove, attach, and reconfigure the hands on the sound sculptures. They will have the opportunity to alter the drone in the space and become part of the performance in *sonic activation*.

Moreover, *sonic activation* has a degree of modularity and possibility for independent performance/realization of its constituent elements. Each composition has the potential to be performed as an independent work in a concert setting. I have performed *slowly in blossoms* and *between us the air encircles* as independent works since the initial realization of *sonic activation*. However, because the works were composed specifically in relationship to one another I have found that they may require slight adjustments depending on the concert space. For example, in *between us the air encircles,* the cymbal and transducer system needed to be amplified and diffused throughout the concert space as the seated audience did not have the same freedom in spatial proximity to the performance space. In the future, I plan to realize each individual component of *sonic activation* either as performed works in a concert or recorded in a studio setting.

Finally, I have submitted an article to the 2016 Sound and Music Computing Conference in Hamburg, Germany that further develops and unifies the conceptual guidelines present in the performance-installation model. Using my experience in *sonic activation* and similar collaborative projects I created in the past I will provide a functional definition of the performance-installation model and detail how it can be used to explore new technology-driven media in art and music. I am committed to continue developing and refining the performance-installation model and thus enabling new contexts for expanded creativity.

BIBLIOGRAPHY

Agarwal, Anant, and Jeffrey Lang. *Foundations of Analog & Digital Electronic Circuits*. Amsterdam: Elsevier, 2005. Print.

Akamatsu, Masayuki. "Aka.objects." *Aka.objects*. N.p., n.d. Web. <http://www.iamas.ac.jp/~aka/max/>.

"American Mavericks: An Interview with La Monte Young and Marian Zazeela." Interview by Gabrielle Zuckerman. *American Mavericks: An Interview with La Monte Young and Marian Zazeela*. American Public Media, July 2002. Web.

Block, Gerry. "Exclusive GameTrak Interview with Developer In2Games - IGN." *IGN*. Ziff Davis, LLC, 14 Apr. 2006. Web. <http://www.ign.com/articles/2006/04/14/exclusive-gametrak-interview-with-developer-in2games>.

Cage, John. "Solo for Voice No.22." *Songbooks, Volume I: Solos for Voice 3-58*. New York: Henmar, 1970. N. pag. Print.

Colletti, Justin. "Beyond The Basics: Sidechain Compression - SonicScoop." *SonicScoop*. SonicScoop, 27 June 2013. Web. <http://www.sonicscoop.com/2013/06/27/beyond-the-basics-sidechain-compression/>.

Collins, Nicolas. *Experimental Music*. Thesis. Wesleyan University, 1976. Middletown: Wesleyan UP, CT. *Nicolascollins.com*. Web. <http://www.nicolascollins.com/texts/Collins_BA_thesis.pdf>.

Collins, Nicolas. *Handmade Electronic Music: The Art of Hardware Hacking*. New York: Routledge, 2006. Print.

Collins, Nicolas. *Handmade Electronic Music: The Art of Hardware Hacking*. N.p.: n.p., n.d. Print.

Collins, Nicolas. "Nicolas Collins: About Pea Soup." *Nicolas Collins: About Pea Soup*. N.p., n.d. Web. <http://www.nicolascollins.com/aboutpeasoup.htm>.

Collins, Nicolas. "'Pea Soup' - A History." (2011): n. pag. Web. <http://www.nicolascollins.com/aboutpeasoup.htm>.

Collins, Nicolas. "Technical Instructions and Score." *Pea Soup* (2014): n. pag. Web. <http://www.nicolascollins.com/texts/PeaSoup2014.pdf>.

Duhamel, Olivier O. *Body Casting Manual*. Waiheke Island, N.Z.: O. Duhamel, 2010. Print.

Edward, Myers Elliot. A Transducer for Detecting the Position of a Mobile Unit. Patent GB2373039 (A). 11 Sept. 2002. Print.

Elsea, Peter. "1/3 Octave Filters." *Max Tutorials* (n.d.): n. pag. *Peterelsea.com*. Web. <http://peterelsea.com/Maxtuts_msp/ThirdOct.pdf>.

Friedman, Ken. *Fluxus Performance Workbook*. Trondheim, Norway: Guttorm Nordø, 1990. Web.

Gann, Kyle. "La Monte Young's The Well-Tuned Piano." *Perspectives of New Music* 31.1 (1993): 134-62. *JSTOR*. Perspectives of New Music. Web. <www.jstor.org/stable/833045>.

"Installation Art." *Glossary of Art Terms*. Tate Modern, n.d. Web. <http://www.tate.org.uk/learn/online-resources/glossary/i/installation-art>.

Jirat, J. "Activation." Comp. A.D. McNaught, A. Wilkinson, and A. Jenkins. *Compendium of Chemical Terminology, 2nd Ed. (the "Gold Book")*. By Bedrich Kosata, IUPAC, and M. Nic. Prague: ICT, 2006. N. pag. *The Gold Book*. Blackwell Scientific Publications, 2006. Web. <http://goldbook.iupac.org>.

Licht, Alan. "Sound Art: Origins, Development and Ambiguities." *Organised Sound Org. Sound* 14.01 (2009): 3. Web.

Lucier, Alvin. *Music 109: Notes on Experimental Music*. N.p.: Wesleyan UP, 2012. Print.

Lucier, Alvin. *Risonanza*. Nexus Trio. 1982. MP3.

McLuhan, Marshall, Quentin Fiore, and Jerome Agel. *The Medium Is the Massage*. New York: Bantam, 1967. Print.

McLuhan, Marshall. *Understanding Media: The Extensions of Man*. N.p.: n.p., n.d. Print.

Neuhaus, Max. "Liner Notes for Volume: Bed Of Sound." *Discogs*. N.p., n.d. Web. <http://www.max-neuhaus.info/soundworks/soundart/SoundArt.htm>.

O'Shea, Janet. *At Home in the World: Bharata Natyam on the Global Stage*. Middletown, CT: Wesleyan UP, 2007. Print.

Roads, Curtis, and John Strawn. *The Computer Music Tutorial*. Cambridge, MA: MIT, 1996. Print.

Sigman, Alexander. "Alexander Sigman | Composer." *Audio and Scores*. N.p., n.d. Web. <http://www.lxsigman.com/media/audio.htm>.

Smith, Julius O., III. "INTRODUCTION TO DIGITAL FILTERS WITH AUDIO APPLICATIONS." *Ccrma.stanford.edu*. Center for Computer Research in Music and Acoustics, Stanford University, Sept. 2007. Web. <https://ccrma.stanford.edu/~jos/filters/>.

Storr, Wayne. "Sound Transducer for Sensing and Generating Sounds." *Basic Electronics Tutorials*. N.p., 18 Aug. 2013. Web. <http://www.electronics-tutorials.ws/io/io_8.html>.

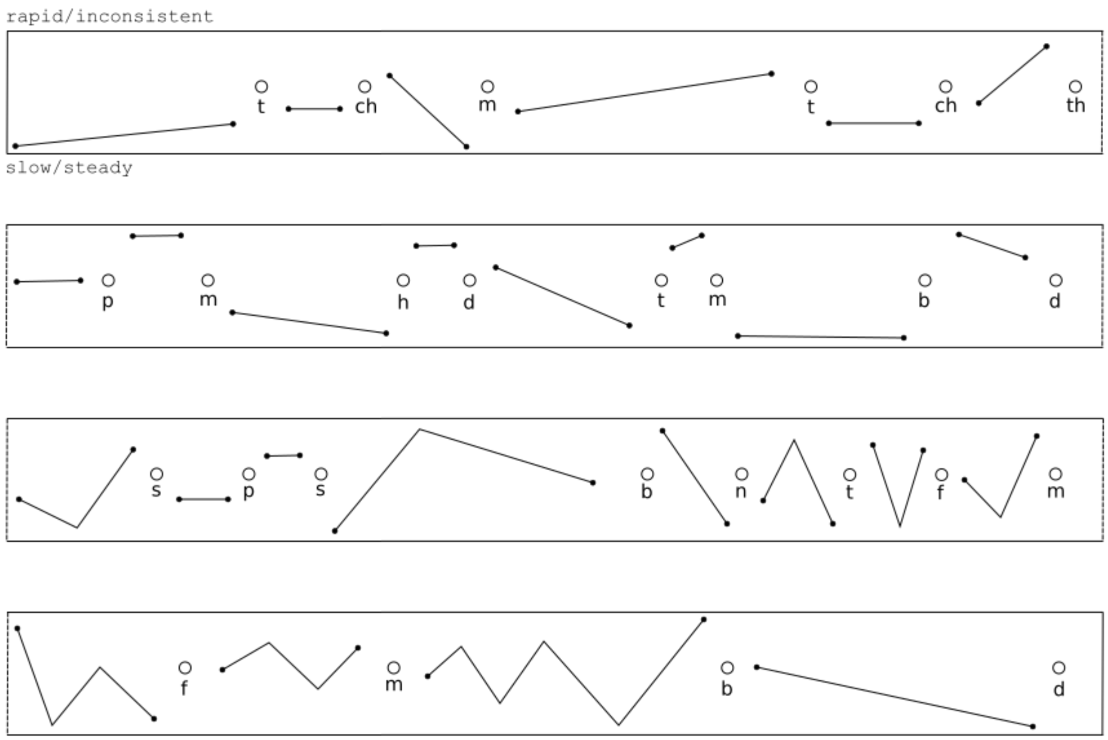
Tudor, David. "Rainforest Diagram 73." *Rainforest Diagram 73*. Electronic Music Foundation, Aug. 1997. Web. <http://davidtudor.org/Electronics/rfDiagram73.html>.

Whitman, Walt. *Leaves of Grass.* Philadelphia: David McKay, [c1900]; Bartleby.com, 1999. <www.bartleby.com/142/>.

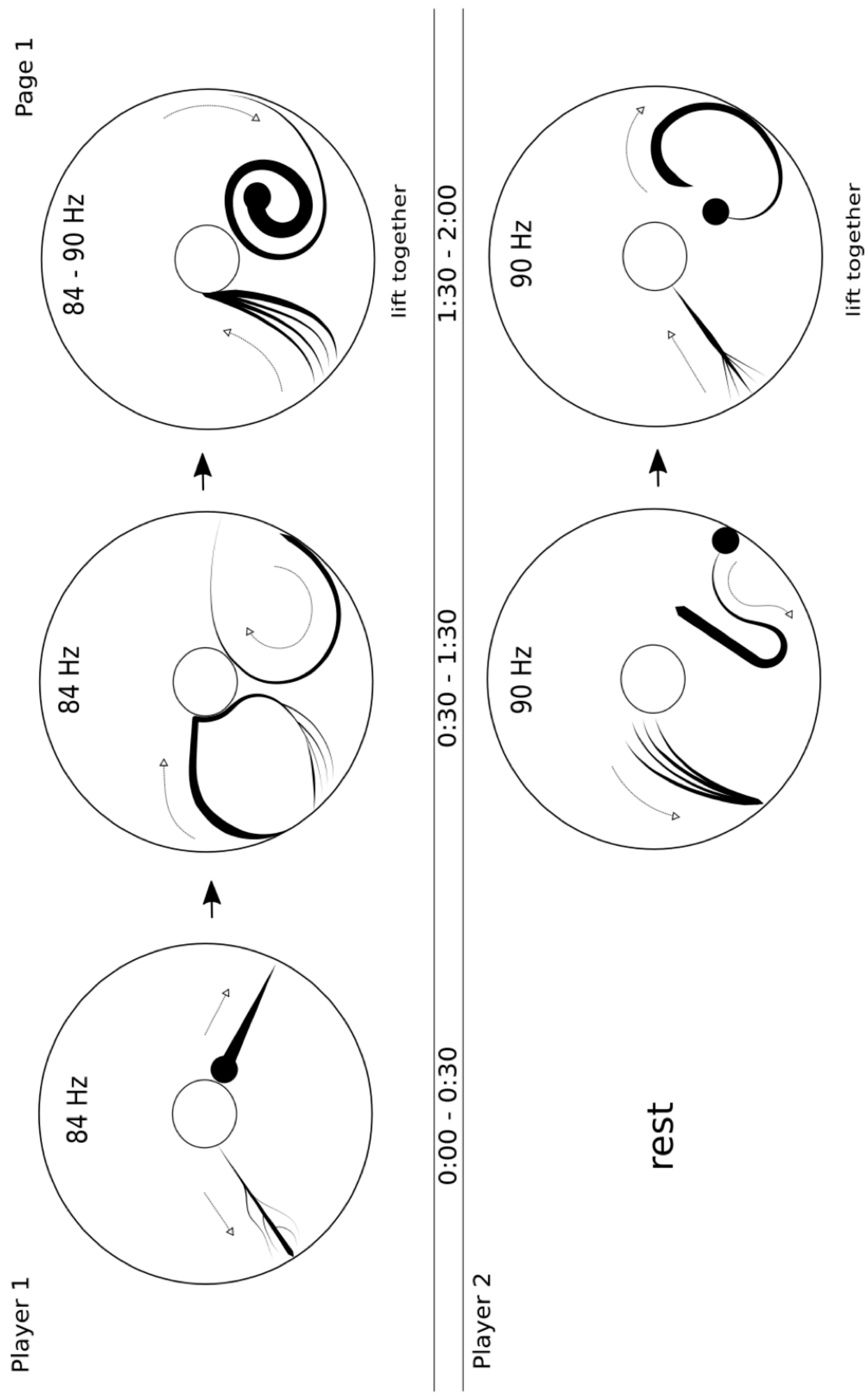
Wishart, Trevor, and Simon Emmerson. *On Sonic Art*. Amsterdam: Harwood Academic, 1996. Print.

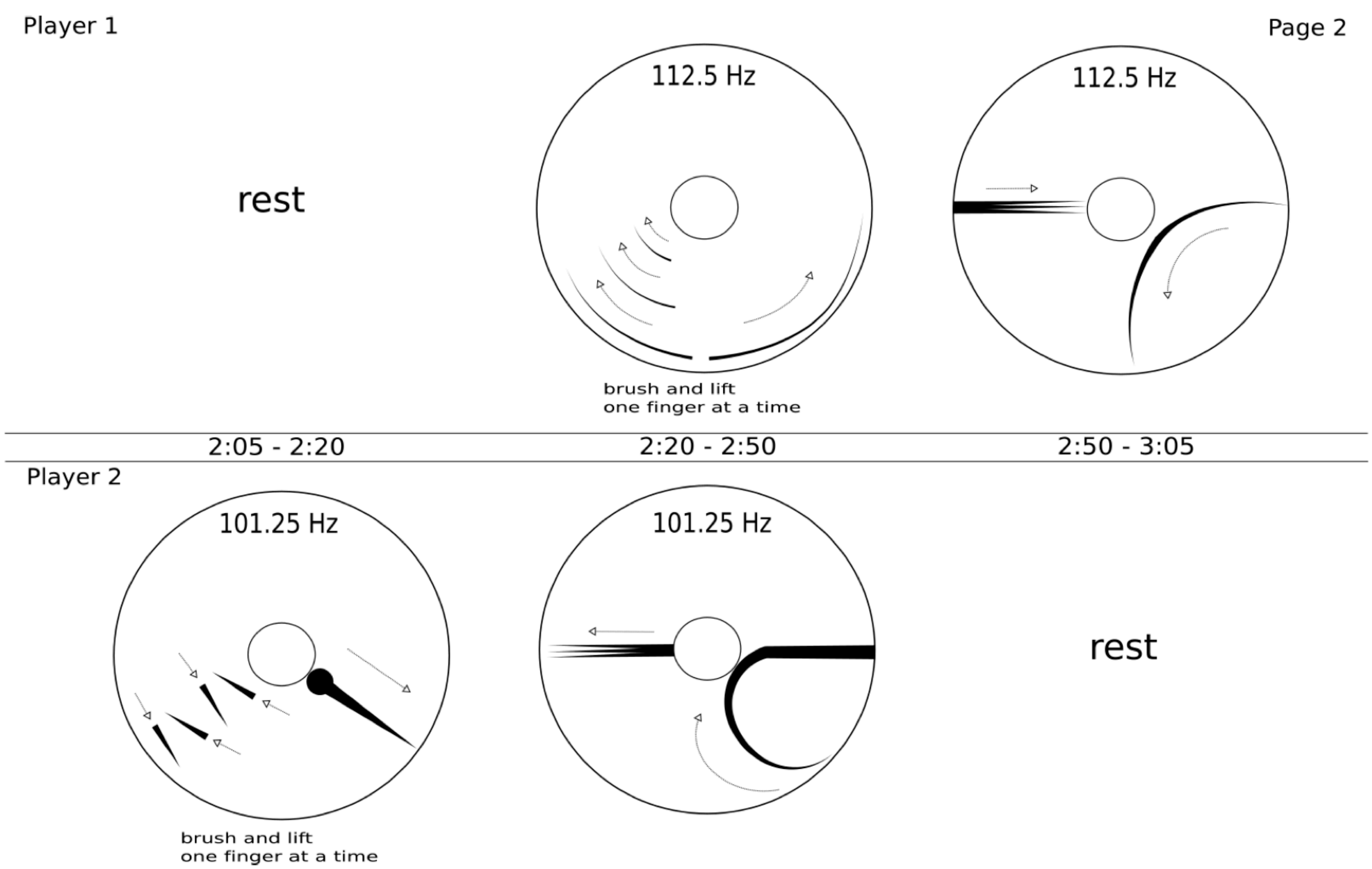
Young, LaMonte. *The Well Tuned Piano*. La Monte Young. Gramavision, 1987. Web.

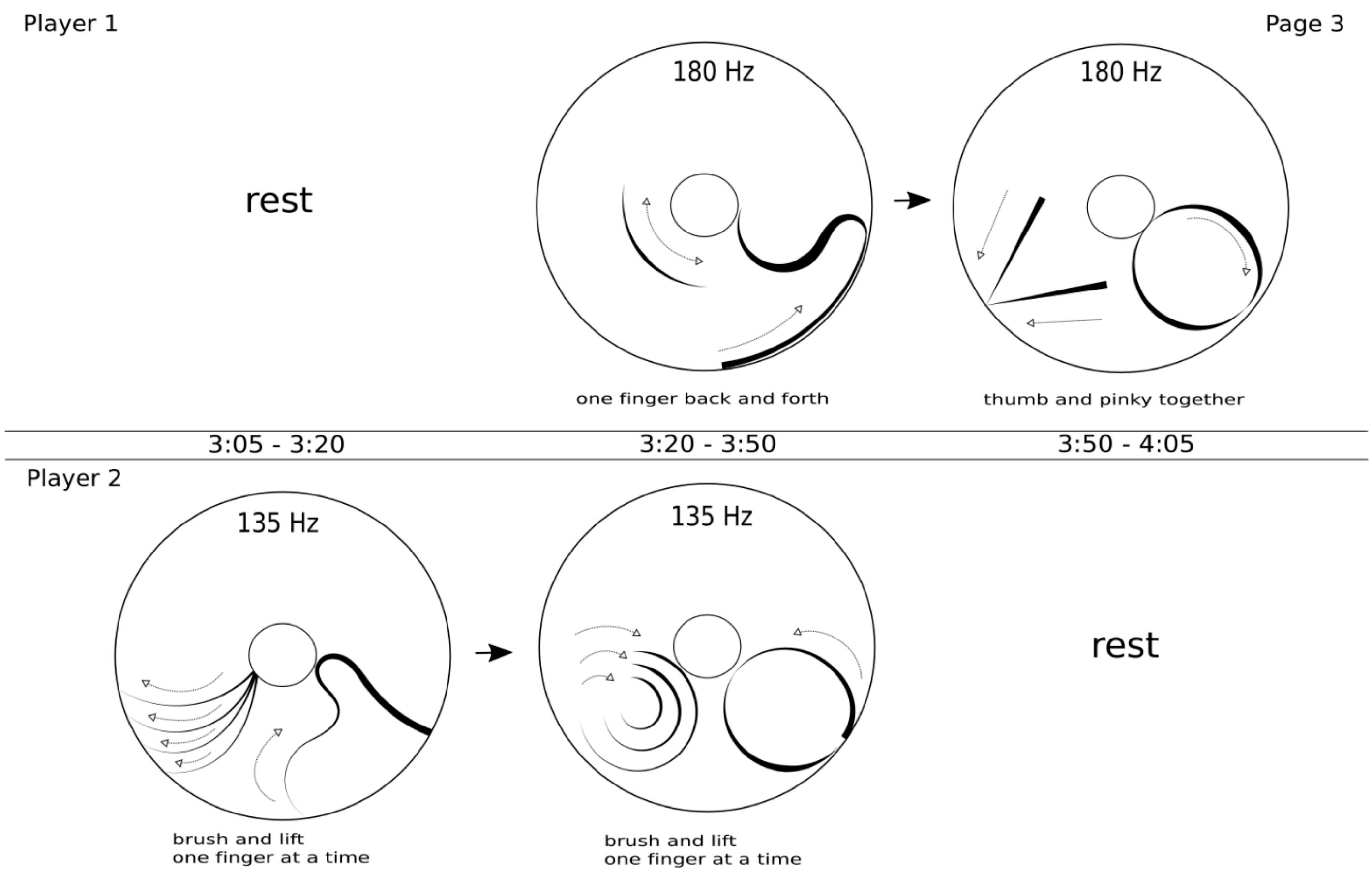
Appendix A: ***even the earth will go*** **score (scaled)**

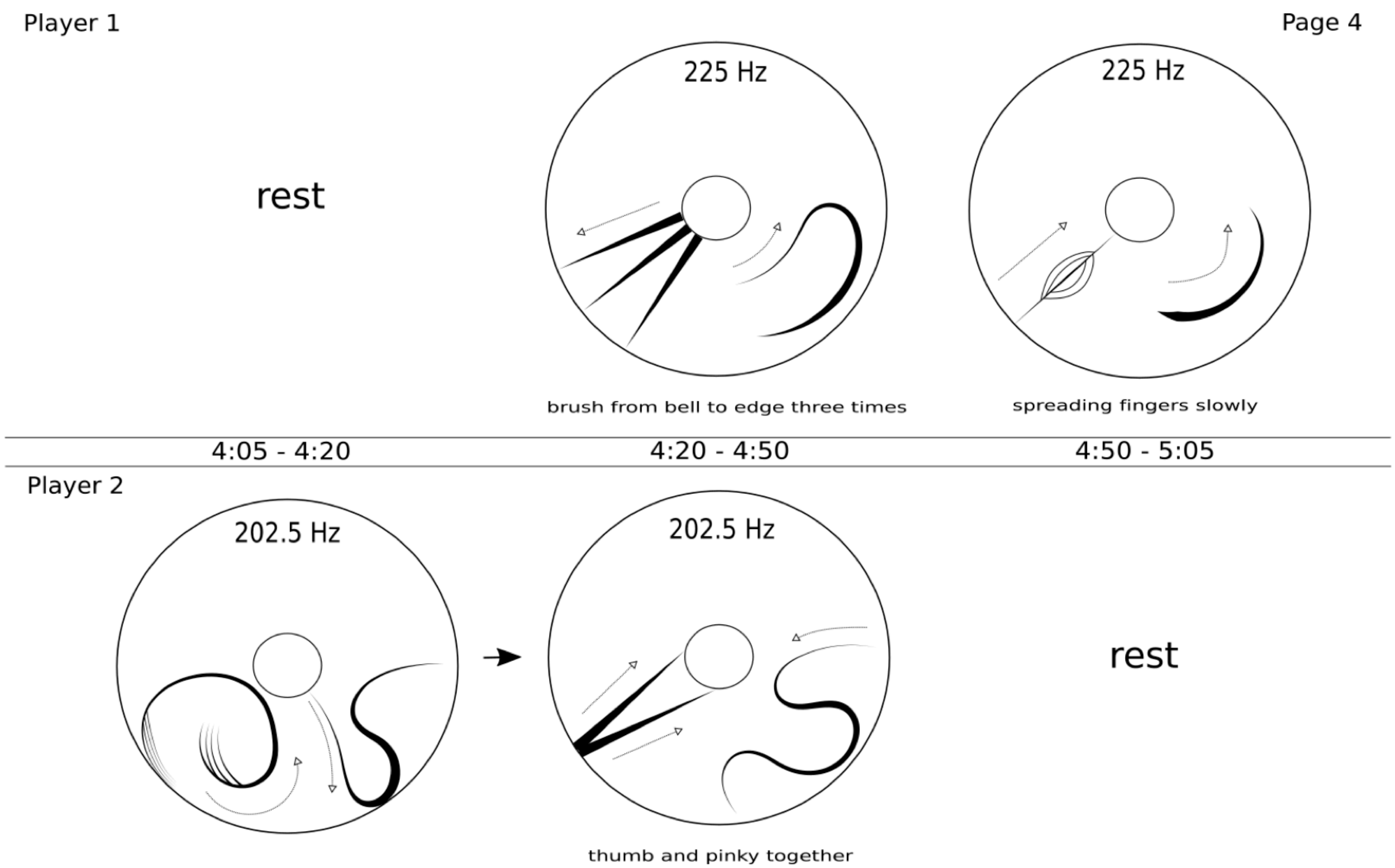


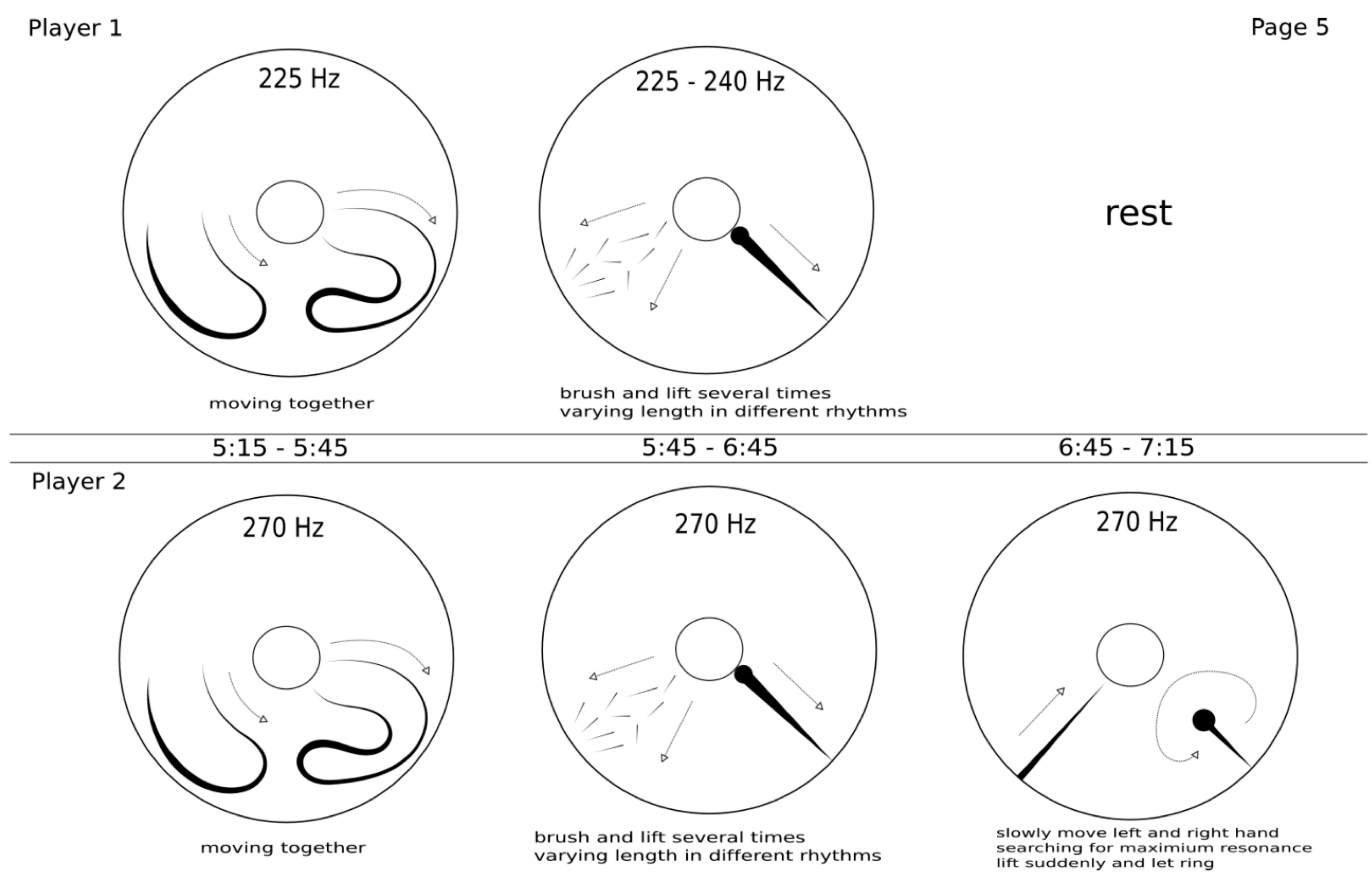
Appendix B: ***between us the air encircles*** **score (scaled)**




Player 1
Page 2
rest
112.5 Hz
brush and lift
one finger at a time
112.5 Hz
2:05 - 2:20
2:20 - 2:50
2:50 - 3:05
Player 2
101.25 Hz
brush and lift
one finger at a time
101.25 Hz
rest


Player 1
Page 3
rest
180 Hz
one finger back and forth
180 Hz
thumb and pinky together
3:05 - 3:20
3:20 - 3:50
3:50 - 4:05
Player 2
135 Hz
brush and lift
one finger at a time
135 Hz
brush and lift
one finger at a time
rest


Player 1
Page 4
rest
225 Hz
brush from bell to edge three times
225 Hz
spreading fingers slowly
4:05 - 4:20
4:20 - 4:50
4:50 - 5:05
Player 2
202.5 Hz
202.5 Hz
thumb and pinky together
rest


Player 1
Page 5
225 Hz
225 - 240 Hz
rest
moving together
brush and lift several times
varying length in different rhythms
5:15 - 5:45
5:45 - 6:45
6:45 - 7:15
Player 2
270 Hz
270 Hz
270 Hz
moving together
brush and lift several times
varying length in different rhythms
slowly move left and right hand
searching for maximium resonance
lift suddenly and let ring