STORYTELLING:

THE

HUMAN EXPERIENCE

THROUGH

DATA-DRIVEN INSTRUMENTS

by

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A DISSERTATION

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and the Division of Graduate Studies of the University of Oregon
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DISSERTATION ABSTRACT

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This Digital Portfolio Dissertation is a collection of seven original real-time, interactive, multichannel compositions featuring data-driven instruments. This dissertation includes video recordings of seven individual performances, associated files needed for the performance of each work, and a descriptive text document for each of the seven compositions. The text document in this digital portfolio dissertation describes the storytelling components and the musical ideas and compositional structure of each composition, the design and implementation of each data-driven instrument, the sonic materials and data mapping strategies, as well as other extra-musical elements associated with each composition.

ACKNOWLEDGMENTS

I wish to express sincerest gratitude to my committee: Professors Jeffrey Stolet, Akiko Hatakeyama, David Crumb, and Steven Brown, who generously shared their thoughts, expertise, and knowledge to help me accomplish this goal.

I would also like to thank Sandra Honda for helping edit my writing.

I wish my mother-in-law was still in this world so that we could have a glass of wine together to celebrate my accomplishment. She showed me how wonderful this world can be if you are willing to change your mind.

One of the most influential persons in my life during my time at the University of Oregon, Professor Stolet, has shown me the power of music and given me a glimpse of what the future of music may be. From him I learned that composing music is more than just seeking inspiration to find sounds and melodies to put together; rather, it is a voyage of understanding your inner self, a process of a lifetime of discipline, and an ongoing desire for love and generosity towards all humanity.

DEDICATION

This work is dedicated to my dearest husband, Jefferson Goolsby, for his endless support and love.

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SUPPLEMENTAL FILES

The supplemental material takes three forms: digital videos of performances of the portfolio compositions, the custom software used to perform the works, and all affiliated files necessary to perform the works.

Video of performance of *Giant Dipper*

Video of performance of *Farewell*

Video of performance of *The Lighted Windows*

Video of performance of *MG-She is Such a Wonderful Person to Know*

Video of performance of *Summoner*

Video of performance of *Golden Slumbers*

Video of performance of *21C*

Custom software and affiliated files required to perform *Giant Dipper*

Custom software and affiliated files required to perform *Farewell*

Custom software and affiliated files required to perform *The Lighted Windows*

Custom software and affiliated files required to perform *MG-She is Such a Wonderful Person to Know*

Custom software and affiliated files required to perform *Summoner*

Custom software and affiliated files required to perform *Golden Slumbers*

Custom software and affiliated files required to perform *21C*

CHAPTER I

INTRODUCTION

Through language, art, music, and literature, humans pass down experiences from generation to generation. This long-standing tradition of transgenerational and community sharing facilitates understanding, interpretation, and transmission of the experiences of our lives and our communities. Throughout history music has played an essential role in this process. Religious ceremonies in ancient Greece were inextricably linked to music.[1] Italian madrigals were sung at a variety of aristocratic social gatherings of the 16th century.[2] More recently, electronic dance music has served as a significant social-defining element for the millennial generation.[3] Now we are witnessing the impacts of the computer and the myriad modern technologies on the process of music making. From simple MIDI keyboards to alternative electronic music controllers, technological developments in data-driven instruments are expanding and even driving the potential for interpreting and expressing aspects of lived human experiences. Composing music with data-driven instruments opens up tremendous opportunities and possibilities for expression via new musical tools and languages, as well as new avenues for communicating to the world in diverse and in previously unimaginable ways.

As a composer, I believe that music has the capacity to comment on the human condition and the potential to change the world for the better. One of my deep desires in making music is to honestly explore my experiences in the world and use both process and findings of my explorations to express a view of the world. These explorations have led to my initial concepts

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[1] Donald Jay Grout, Claude V. Palisca, *A History of Western Music* (W.W. Norton & Company, 2001), 3.

[2] Grout, Palisca, *A History of Western Music*, 184.

[3] Michaelangelo Matos, *The Underground is Massive* (Harper Collins, 2015).

for the seven compositions in this dissertation, all inspired and created from my personal experiences, which I transmit through both music and the ancient art form of storytelling.

My dissertation is based on seven musical compositions presented in counterpoint to and alignment with personal narratives. These seven musical compositions serve as *containers* for seven very distinct stories. All are related to conveyances about essential human experiences. I do not focus on a single issue or topic. For instance, *Giant Dipper, The Lighted Windows,* and *MG-She was such a wonderful person to know* touch on issues of family across generations. *Farewell* deals with friendships. *Summoner* explores the sounds of animals in nature. *Golden Slumbers* and *21C* examine the experiences and existential nature of our social beings.

Though all seven compositions are stories, I do not simply perform recordings of a narrator reciting a text; instead, I employ various tactics, often multiple and overlapping in a single composition. For instance, in two of my compositions, *Farewell* and *Golden Slumbers,* I borrow pre-existing texts as the primary vehicles for corresponding narratives. In other compositions, such as *Golden Slumbers* and *MG-She was such a wonderful person to know,* historical events of personal significance become the source of story. In some, as in *The Lighted Windows*, I collaborate with an author to construct a text. In *Giant Dipper*, field recordings form the basis for composition built around stories drawn directly from my life. Sometimes, the story is not told by a human. In *Summoner*, I use the sounds of animals in nature to tell a story. In other cases, as in *21C*, the text does not aspire to tell a literal story but rather exists as a modern poem with sets of symbols collectively constructed into a narrative experience.

The seven compositions are real-time interactive multichannel works, created using Cycling '74's Max[4] as the programming language and Symbolic Sound's Kyma[5] as the primary sound creation environment. The titles, performance interfaces, and sound synthesis engines of each composition are:

1. *Giant Dipper,* created using Kyma by Symbolic Sound Corporation, Max software by Cycling '74, and a Gametrak controller by Atomic Planet
2. *Farewell,* created using Kyma by Symbolic Sound Corporation, and Intuos Pro Tablet by Wacom
3. *The Lighted Windows,* created using Kyma by Symbolic Sound Corporation, and two Wii Remote controllers by Nintendo
4. *MG-She was such a wonderful person to know,* created using Kyma by Symbolic Sound Corporation, and Seaboard RISE 49 by ROLI
5. *Summoner,* created using Kyma by Symbolic Sound Corporation, Max software by Cycling '74, and Leap Motion Controller by Ultraleap
6. *Golden Slumbers,* created using Kyma by Symbolic Sound Corporation, Max software by Cycling '74, voice, and custom sensor-based interface
7. *21C,* created using Kyma by Symbolic Sound Corporation, iPhone by Apple Inc, voice, telegraph sounder, and computer keyboard

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[4] Created by Miller Puckette at IRCAM, Max is an object-oriented programming language for the production of music and multimedia. Additional information can be found about Max at https://cycling74.com/products/max.

[5] Kyma is a domain-specific programming language that includes a software component created by Carla Scaletti and a hardware component created by Kurt Hebel. The complete Kyma system is dedicated to synthesizing, modifying, exploring, and constructing sound, and to the creation and performance of musical compositions. Additional information about Kyma can be found in Carla Scaletti, *Kyma X Revealed! Secrets of the Kyma Sound Design Language*. Champaign: Symbolic Sound Corporation. 2004, at https://kyma.symbolicsound.com, and in Jeffrey Stolet, *Kyma and the SumOfSines Disco Club* (Morrisville: Lulu Press, 2012).

CHAPTER II

CONCEPTUAL BACKGROUND AND THEORETICAL FRAMEWORKS

Many concepts and techniques are involved in creating electronic music compositions for data-driven instruments. In this chapter, I provide an overview of the most essential concepts and techniques important to my seven portfolio dissertation compositions. These concepts and techniques, which occur in multiple compositions, include: 1) the structure of data-driven instruments; 2) instrumental modularity; 3) instrumental mutability; 4) data mapping; and 5) recurrent synthesis techniques employed in and among the seven compositions.

The Unique Structure of Data-driven Instruments

While great variety exists among possible data-driven instruments, the basic structure of data-driven instruments can be explained in three parts: data acquired by operating an interface, data mapping and routing, and sound-producing algorithms.[6] When playing traditional instruments, such as piano or violin, we exert force into their physical systems to create a sound. However, when working with data-driven instruments, a performer first operates an interface to generate the data. The data function as a replacement for energy within the traditional performance model. The data are then sent to a software layer for mapping. During this phase, the data will be analyzed and recalculated, then mapped to an appropriate assigned range. This

[6] Jeffrey Stolet, *"Twenty-three and a Half Things about Musical Interfaces,"* Kyma International Sound Symposium Keynote Address, Brussels, Belgium, September 14, 2013.

new data stream will be routed to the sound-producing algorithm for generating sound. The data-driven instrumental architecture is shown in Figure 1.

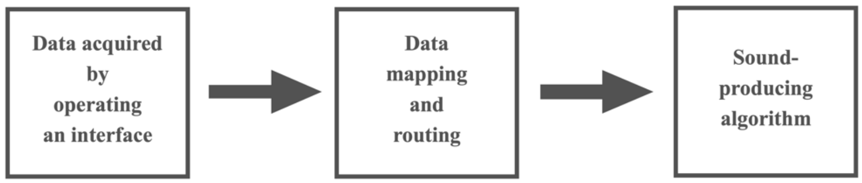

Figure 1. The unique structure of data-driven instruments

One common misinterpretation of data-driven instruments lies in the concept of tracking and the notion of gesture control. In performing with data-driven instruments, the interface itself is not tracking the performer's movements, but is instead reporting the data stream related to the current status of the performance interface. Physical "gestures" do not create or control sounds; however, during a data-driven musical performance, *performance actions* produces data that then can be used to control the sound-producing mechanism of the instrument.

Instrumental Modularity

Modularity is the foundation upon which almost all things are built.[7] Instrumental modularity is also a key feature of the data-driven instrument. The concept of modularity centers on the idea of combining and connecting smaller and simpler things to construct larger and complex things. For most traditional instruments, the entire instrument is housed in one physical body. The piano, which is comprised of keys, pedals, hammers, and a soundboard, is an example where all the instrumental components are assembled into a singular physical structure. However, each component of a data-driven instrument may be conceived as an independent element or as a

[7] Jeffrey Stolet. *Do: Notes about Action in the Creation of Musical Performance with Data-driven Instruments* (Lulu Press, 2021), 25-27.

component of a data-driven instrument. The interface, the mapping mechanism, and the sound-producing algorithm components are each conceptually its own module and separate from other parts. For example, we can use a Gametrak[8] as the interface for a data-driven instrument, then use Max as the data mapping area of our instrument. Max then sends the newly mapped data to Kyma, the sound-production mechanism. Furthermore, we can take the same Gametrak as the performance interface to create another composition and route the data for sound production to Logic Pro instead of Kyma as shown in Figure 2.

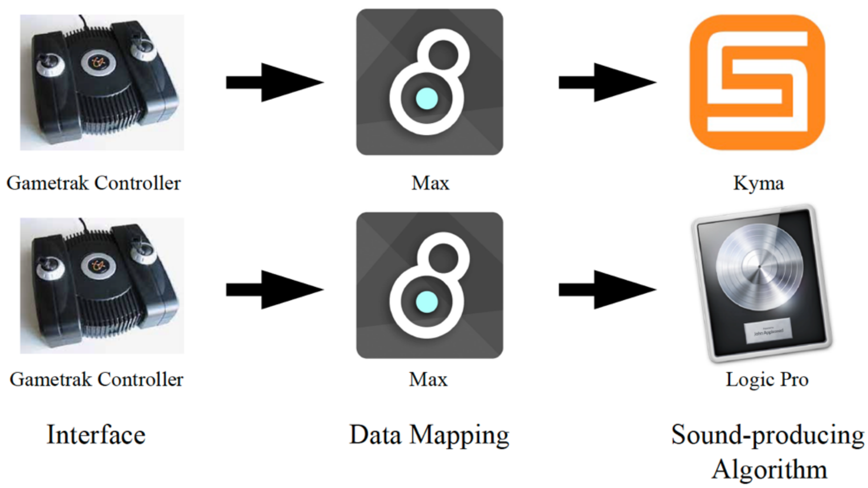

Figure 2. Modularity features on data-driven instruments

Through the multitude of combinatorial possibilities, modularity provides data-driven instruments with great musical flexibility and allows one to create unlimited instrumental variations.

[8] The Gametrak is originally designed for a virtual golf video game, based on a 3-dimensional position tracking game control system.

Mutability

One of the main features of a data-driven instrument is its mutability,[9] which allows the instrument to change its sound significantly during a performance. Traditional instruments have a more bounded capability to change their sound during the performance. Mutes on trumpets and stringed instruments, damper pedals on pianos, and different mallets for percussion instruments are examples of mechanisms for mutability of traditional instruments. For data-driven instruments, however, the ability to mutate is expanded dramatically. Unlike traditional instruments in which mutability happens in the physical hardware of the instrument, mutability of data-driven instruments predominantly occurs at the software layers through data mapping, routing, and sound production.

Data Mapping and Mapping

One of the essential processes in data-driven instruments is data mapping.[10] This process converts each data value generated by the interface into a new output value. Data mapping is crucial in the design of data-driven instruments because it transforms the range of data that an interface naturally produces to one that controls a musical parameter effectively making it possible to connect almost any interface to any sound-producing algorithm.

When performing with a data-driven instrument, the data are created then acquired by a performer operating the interface. Most typically, the raw data acquired from operating the interface may not be effective if sent directly to a sound-producing element of the data-driven instrument. For example, we may receive a data stream from a MIDI controller with a data range from 0 to 127. We want to use this data stream to generate some MIDI notes. However, if we use

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[9] Stolet, *Do,* 81.

[10] Stolet, *Do,* 67-76.

these raw data directly, we are likely to produce notes that are pitched too low and produce undesirable musical consequences. To address this problem, we need a data mapping process to convert the data from its original range to a new range to achieve the desired musical result. During the data mapping process, data are sent to the software layers, where the data are converted to a more useful range more appropriate for the sound-producing algorithm.

In my compositions, there are a few basic types of data mapping techniques – scaling and offsetting. The scaling technique is used to remap the data that exists in one range to another range to serve the intended musical result more precisely. Offsetting is a technique to shift a data range, while still maintaining the same range size.

Within my compositions, I discuss data mapping within my composition, in addition to the concept of mapping as applied to a broader scheme. I also use the term "mapping" to describe how a performative action culminates with a sonic result. Unlike data mapping

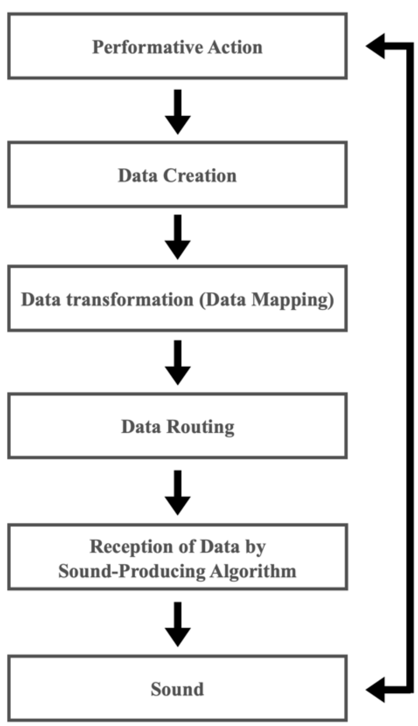

Figure 3. Broader conception of the notion of mapping

techniques that transform the range of data, this conceptually broader idea of mapping commences with a performative action that produces data that is subsequently transformed through a data mapping process and routed to a sound-producing algorithm that outputs a digital representation of sound. This conceptual version of mapping is shown in Figure 3.

Synthesis Techniques

In my seven compositions in this portfolio I use a variety of sound synthesis techniques. These techniques include sampling, additive, subtractive, and granular synthesis, as well as analysis and re-synthesis, and Kyma's Time Alignment Utility (TAU) algorithm.

Sampling synthesis techniques appear in all seven compositions.[11] Sampling synthesis includes playback of the original audio sound source into a digital medium and applies various audio editing techniques to transform the recording such as looping and pitch-shifting.

Additive synthesis involves combining simple waveforms at various frequencies, amplitudes, and phases to create more complex waveforms. While additive synthesis involves combining frequencies, subtractive synthesis shapes the sound by removing or attenuating frequencies of a waveform by applying various types of filters. Granular synthesis is another important synthesis technique I used in my compositions. Based on sample manipulation, granular synthesis provides a method to manipulate sound by breaking down the sample into tiny sonic particles, usually 5-100 ms, called "grains." We can then generate extraordinary evolving soundscapes using granular techniques by controlling the parameters such as grain duration, overall texture density, and spatialization. Analysis and resynthesis is a process that starts with

[11] For additional information about sampling synthesis, see Curtis Road, *The Computer Music Tutorial* (Cambridge: The MIT Press, 1996), 117-133.

analyzing a recorded sound, and continues with using that analysis data to control a synthesis process - the re-synthesis.[12]

Another important sound design tool I use inside Kyma is the TAU algorithm. TAU provides ways to modify, morph, and resynthesize sounds, allowing sounds to be mixed or morphed between amplitudes, frequencies, formats, and bandwidths. For example, one can combine the amplitude characteristics of a sound with the frequency characteristics of another sound, then mix in the formant characteristics of the third sound, to create a unique sound result.[13]

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[12] Road, 144.

[13] Jeffrey Stolet, *Kyma and the SumOfSines Disco Club* (Morrisville: Lulu Press, 2021). 169.

CHAPTER III

PORTFOLIO COMPOSITIONS

GIANT DIPPER

Storytelling Components

Music and art can reflect who we are and what we are in the current time through unique lenses. As a creative artist, I look for ways to preserve what is happening around us in the present, while using art as a lasting medium through which current and future generations can experience our contemporary culture. Consistent with this focus on the contemporary, I use modern technology to transform sound materials based on present-day life experiences. Through the process of composing and dissecting the *mise en scène* behind these sound materials,[14] I attempt to explore the fantastic world inside our minds.

My composition *Giant Dipper* is an example of transforming sound materials taken from human life experiences. This composition attempts to simultaneously convey two different journeys: one where the experience of a roller coaster ride, with scream-inducing vertical and horizontal motion propels a rider's thoughts moment to moment; the other is the excitement offered by the experience of speed of a car race through the mind of a seven-year-old girl.

The inspiration for the two vignettes resides in the personal stories of my family. The roller coaster ride refers to the famous Giant Dipper at the Santa Cruz Beach Boardwalk, a family favorite that we look forward to every year on our summer vacation. This roller coaster ride opened in 1924 and is still considered one of the most exciting roller coaster rides in the United States. The second story, conveyed in counterpoint to the first, describes an intense, yet

[14] *Mise en scène* is the design and arrangement of scenery and stage properties in scenes for a theatre or film. This term is used to imply that the sound materials can help listeners to arouse imagines of storyboarding.

joyful, imaginary car race. This second story is told by Jayshing Goolsby.[15] Sometimes she is the announcer for the race. Sometimes she is the race car driver. Yet at other times, she is simply her everyday seven-year-old self. The two stories unfolded together at times juxtaposed. Elsewhere, the two stories occur interspersed sequentially with one after another.

<u>The Data-driven Instrument in *Giant Dipper*</u>

For *Giant Dipper*, I chose to use the Gametrak spatial-position controller[16] as a performance interface to generate and transmit data to Max. Within Max, the data streams are mapped then routed to Kyma to control sound-producing algorithms in realtime.[17]

The basic architecture of the data-driven instrument is shown in Figure 4.

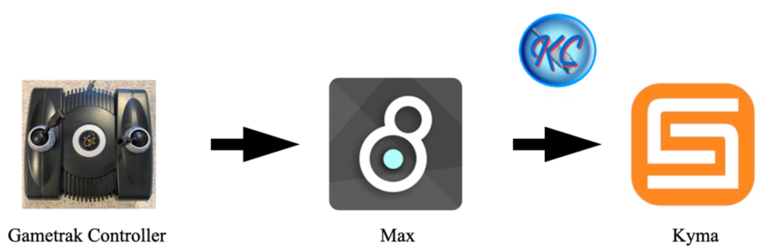

Figure 4. Fundamental architecture of data-driven instrument for *Giant Dipper*

The Gametrak base unit is a weighted device originally designed to be positioned on the floor in front of a display and used in a golf simulator game environment on PlayStation 2. Because of its straight-forward operation, rich expressive potential, and affordable cost, the Gametrak spatial position controller has become one of the most popular and reliable performance interfaces for data-driven instruments.

[15] Jayshing Goolsby is my younger daughter. She was seven-years-old when this recording was made.

[16] https://helpful.knobs-dials.com/index.php/Gametrak_notes. Accessed October 20, 2022.

[17] The Max patch used in this composition was derived from the Max patch used in *Lariat Rituals* by Dr. Jeffrey Stolet.

Attached to the base unit of the Gametrak there are two retractable nylon cables. Each of the two nylon cables are connected to a set of gears which are built inside of a hard plastic encasement. The nylon cables can be drawn out in three-dimensional space to articulate X, Y, Z axes (Figure 5). Each hand corresponds to its own X, Y, and Z Cartesian coordinates. Thus, six possible data streams can be created to be mapped and routed to desired musical parameters.

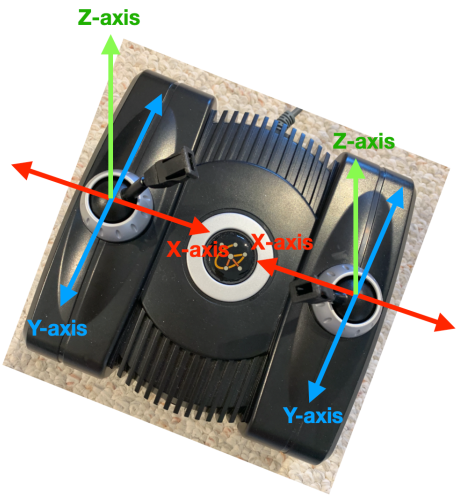

Figure 5. Gametrak X, Y, and Z
Cartesian coordinates

There are many ways to use the Gametrak in a project besides placing it on the floor as originally intended. For instance, the Gametrak can be placed on a table *(Lariat Rituals*)*,*[18] contained inside of an object *(Immigration (Gametrak Variation)),*[19] hung on the ceiling

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[18] Dr. Jeffrey Stolet composed *Lariat Rituals* in 2011 for Gametrak and Kyma. A video recording of the performance can be viewed here: https://www.youtube.com/watch?v=quA3WxWCdzI. Accessed October 17, 2022.

[19] *Immigration (Gametrak Variations)* is a composition by Dr. Olga Oseth. She places the Gametrak in three different positions: inside of a backpack, on a table, and on the floor.

(Pendaphonics),[20] or hacked and repurposed *(Concertronica* [21] *and Distance-X.)*[22] When performing *Giant Dipper*, I choose to place the Gametrak on a table to allow a wide range of physical motion that best accompanied the central theme and sound source of a roller coaster ride.

Figure 6. Gametrak placement for *Giant Dipper*

The Gametrak is connected to my laptop computer running Max via a USB port. The data is received through the "hi" object within the Max environment.[23] The route object is then used to parse the data received into different streams, which are sent downstream to Kyma to control the sound-producing mechanism.

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[20] *Pendaphonics,* created by Anne-Marie Hansen, is a tangible physical-digital-sonic environment and interactive system. In this project, the Gametraks are ceiling mounted with balls or another object. https://www.researchgate.net/publication/221308530_Pendaphonics_a_tangible_pendulum-based_sonic_interaction_experience. https://vimeo.com/106262873. Accessed October 17, 2022.

[21] The Concertronica, created by Hugh Jones, is a controller instrument based around the design of a traditional Concertina. This instrument uses strings on a pulley system that have been hacked out of some old Gametrak PlayStation controllers. http://www.crewdson.net/the-concertronica.html. Accessed October 17, 2022.

[22] *Distance-X* by Jon Bellona employs both a hacked Gametrak as part of the performance interface.

[23] "hi" is a Max object that stands for Human Interface. The "hi" object receives data from human interface peripherals, such as a trackpad, keyboard, and virtual USB game controllers.

Compositional Structure

Giant Dipper employs a through-composed form that permits the two narratives to concurrently unfold. I named each of the thirteen sections to help visualize for myself the musical and expressive intent. Table 1 (below) shows how the two stories coincide with each other over time (shown in relation to video timecode).

Timecode	Scene Name	Roller Coaster Ride	Car Race
0:10	Beginning	Crowd Sound (laughing/talking)	
0:57	Well, let's start…		Announce the beginning of Car Race
1:15	O-Wo-Blan	Crowd screaming at the park	Interesting sound from car race
1:30	Jump - Rhythm		Rhythmic vocalization
1:55	Get Ready	The start of Giant Dipper roller coaster	
2:12	Crazy Sound	Crowd streaming on the ride	Exciting sound from car rarer
2:37	Crowd Chant	The crowd shouts "Giant Dip…"	Car race faster and faster.
3:10	Tsi Sound	The ride stuck on the top (Dialogue on the roller coaster)	
4:14	Dream	Dream World	Dream world
7:08	TAU Play	Crowds on roller coaster scream back	
8:12	End of Ride	Relief from the ride	Announcer: First place Happy singing & congratulations
8:26	Are you Done?		Reveal the place of the recording
9:23	Ending Sound	Ending sound effect (sound source from Roller coaster rude and car race)	Ending sound effect (sound source from Roller coaster rude and car race)

Table 1. Formal Outline of *Giant Dipper* showing the occurrence of each narrative fragment

Sonic Materials

The sound materials of *Giant Dipper* come from two key sources: a home recording of a seven-year-old girl singing, talking, and imagining having a car race; and a set of field recordings of the roller coaster at the Santa Cruz Boardwalk amusement park (Santa Cruz, CA). I recorded the girl's singing with a SONY Linear PCM-D50 recorder. The sound materials of the roller coaster at the Santa Cruz Boardwalk were recorded using the Voice Memo app inside my iPhone. When I recorded the sound of the crowd in the park, I held the iPhone in my hand. During the actual roller coaster ride, I left the iPhone inside my purse to prevent it from falling out during the ride. Because I chose to capture the roller coaster sounds as part of a larger sonic environment (as opposed to an ultra-question studio environment) I embrace the collateral sonic artifacts of my source recordings. To minimize the considerable wind and unwanted noise from the original recordings of the roller coaster an equalizer was used during sound editing to improve clarity.

This composition uses various audio playback techniques to present the sound material. For instance, the initial sound is that of a mix of a crowd chanting in cheers at the theme park along with the playback of a resynthesized voice of a girl. In this instance, the left hand pulling controls the amplitude of the crowd chanting and the right hand controls the amplitude of the resynthesized girl's voice.

Where, in virtual space, a sound occurs is vital as I simulate the experience of a roller coaster ride. Spatialization of the sounds was controlled by the Y-axis of the right-hand cable. Figure 7 shows the Kyma sound design of the panning.

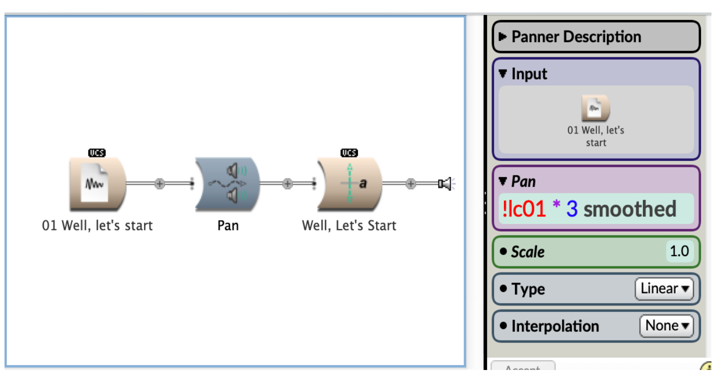

Figure 7. Kyma sound design shows right-hand Y-axis control the panning

Along with segments of audio that are directly played back, *Giant Dipper* uses granular processing, analysis and resynthesis, and Kyma's TAU algorithm. The movements of both of the Gametrak's cables are designed to control the various parameters of the sound, including amplitudes, frequencies, spatializations, reverbs, and playback speed in realtime by manipulating the combinations of X, Y, and Z coordinates.

The Graphic Score and Performance Techniques Employed

In Western societies, the primary method for composers to preserve their musical ideas was to notate pitch and rhythms on staff paper that included additional markings indicating instrumentation, dynamics, tempo, and other music-related information. This notational practice was highly pitch-focused and evolved over many centuries. When composing for the data-driven instrument, however, the traditional notation system proved inadequate because it could not provide important information needed for the performance. To compensate for traditional notation's shortcomings, I created a musical score that provides performative instructions showing not only how to perform the composition in time, but also how to play and control the unique data-driven instrument to control specific musical parameters in realtime.

As an example, of my score, Figure 8 shows the graphic score of the "Dream" scene.[24]

[24] The entire score for *Giant Dipper* is provided in Appendix A.

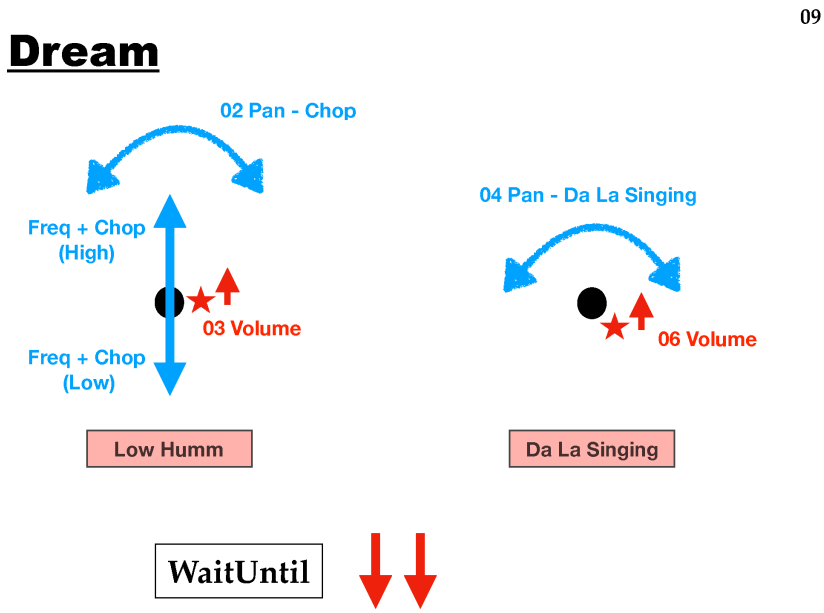

Figure 8. The graphic score for the “Dream” scene

When performing this scene (starting at 4:30 in the video playback), the left-side string controls the manipulation of the “Low Humm” sound while the right-side string controls the “Da La Singing” audio file manipulation. Pulling the left-side nylon string towards the left or right will generate a data stream to control the panning of the “Chop” sound. In contrast, pulling the Gametrak string on the left-side straight forward or backward generates a data stream to send to Kyma, which then changes the frequency the of “Chop” sound so it goes higher or lower in pitch. In Figure 8, the blue horizontal curved arrows denote that pulling the left-side or right-side nylon string towards the left or right will manipulate the panning of the “Chop” sound or “Da La Singing” sound. The blue vertical arrow indicates pulling the Gametrak string on the left-side straight forward or backward. The red vertical arrows pointed upward indicate pulling either string straight up and down will change the volume. At the bottom of the score, the two red arrows pointing downward indicate that if the performer releases both Gametrak strings and lets them return to their initial positions, the *WaitUntil* Sound object inside Kyma will be triggered and the next scene will be started.[25]

In other cases, instead of indicating how the X, Y, and Z coordinates impact the musical parameters, the score was used to illustrate the sequence of sound events that need to be triggered. For example, the score for the "End of Ride" section shown in Figure 12 uses a series of red arrows pointed upward to indicate the pulling of the string upward to trigger audio playback. The two red arrows pointing downward at the bottom of Figure 9 tells the performer that crossing the two cables will trigger the playback of the sample "Are You Done in there?" then move on to the next scene.

Figure 9. The graphic score for the "End of Ride" scene

[25] The WaitUntil Sound object is Kyma's version of a fermata.

Performance instructions for each section of the composition were rendered as graphic (png.) files using Apple's Pages software.[26] Then, using the ImageDisplay Sound object, each section of the score appears at just the right moment in sequence in realtime as the composition progresses.

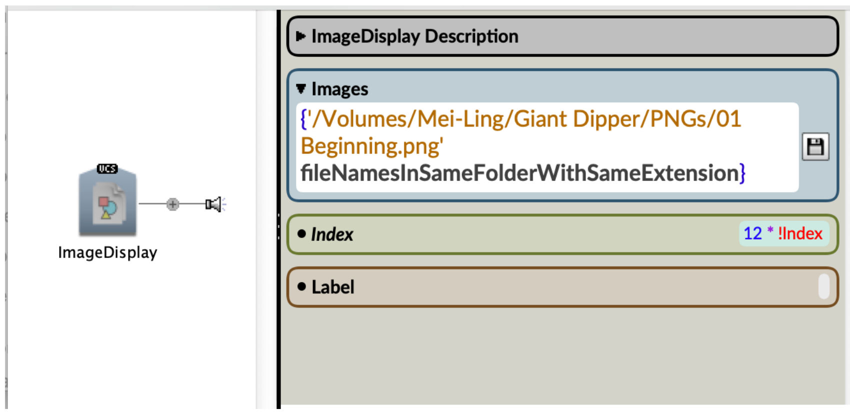

Figure 10. ImageDisplay Sound object inside Kyma

The complete graphic score of this composition is attached in Appendix A.

[26] Pages is a word processor that comes included with most Apple devices.

FAREWELL

Storytelling Components

Farewell is a composition based on a story about friendship and grounded on audio recordings of a reading in my own voice of the Chinese poem 賦得古原草送別, "*Farewell on Grassland,*" by Tang dynasty poet Bai Juyi (白居易).[27] This poem equates a parting of friends to seasonal changes of the wild grasses of the plains in China. One reason I chose this poem is due to the cultural ubiquity of the second stanza, still commonly quoted in daily conversation throughout Chinese speaking cultures despite having been written more than 1200 years ago. Below is the translation of the poem:[28]

離離原上草， How luxuriantly the plains grass grows,
一歲一枯榮。 Wilting and rising again once every year.

野火燒不盡， Wildfires burn, but they are never exhausted;
春風吹又生。 Spring breezes blow, and up they spring again.

遠芳侵古道， Ahead, wild growths overrun the ancient path,
晴翠接荒城。 And surround the old fort under cloudless skies.

又送王孫去， Again I'm sending the royal friend off,
萋萋滿別情。 My sorrow at parting is rich as the grass richly grows.

In the poem, Bai Juyi does not directly describe the relationship with his friend. Instead, he uses the changing of the seasons as a farewell metaphor for the sadness we feel when one season passes and is combined with the longing of looking forward to the new one ahead.

---

[27] Bai Juyi (772–846), was a well-known government officer and Chinese poet during the Tang dynasty. He wrote many poems about his experiences in government and his views of daily life while serving as the governor of three different provinces. In addition to his straightforward, clear, and approachable poetic style, Bai Juyi is also known for his social and political criticism.

[28] The translation of the original Chinese is from: vacantmountain.wordpress.com/2013/05/30/translation-thursday-赋得古原草送别-bidding-farewell-on-the-plain-by-白居易-bai-juyi/

Change forces confrontation with to which we are attached and is not dependent on a human's will. Additionally, the first four verses of this poem are often quoted in Chinese literature as a metaphor for the powerful vitality of new things. As the poem suggests, there can be severe cold, or the power of wildfires, which can be destructive to beloved and cherished places. Despite challenging forces, the poem describes a new world of living things will be born again in the spring breeze.

The Data-driven Instrument in *Farewell*

Designed for the Wacom tablet and Kyma, the complete structure of the data-driven instrument for *Farewell* is shown in Figure11.

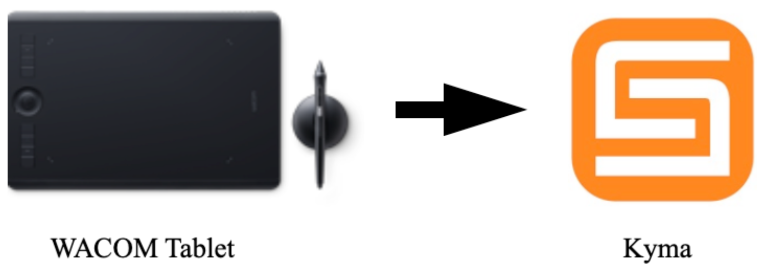

Figure 11. Fundamental architecture of data-driven instrument for *Farewell*

Originally used as a drawing tool by digital illustrators, the Wacom tablet allows users to generate data by drawing with a special stylus pen or with fingers on the tablet's surface.[29] The Wacom tablet provides a performer great precision in performance. The Wacom tablet has 8192 levels of pen pressure, up to 60 levels of pen tilt recognition, and a spatial resolution of 5080

[29] Additional information about the many versions of the Wacom table is available at: https://estore.wacom.com/en-US/tablets.html

Lines Per Inch.[30] These tablet/pen attributes generate an abundance data for detailed sound control. Data from the tablet can then be routed to Kyma to control musical parameters.

Since this composition was inspired by a Chinese poem, it was appropriate that I chose a controller that related to Chinese literature through the action of writing. In the Chinese tradition, poems of this era were written using brush and ink on paper, a form of calligraphy. Such Chinese calligraphic gestures can be emulated on a Wacom tablet. On the Wacom, the tablet's surface represents paper and the stylus pen represents the brush. Thus, calligraphic literary actions are metaphorically rendered to a sonic realization. Poetry and calligraphy both play important roles in representing the deeply philosophical aspects of Asian culture. Along with the recording of the Chinese poem's recitation and the act of using the Wacom tablet as a symbol of Chinese calligraphy, *Farewell* combines and transforms these two art forms through the use of data-driven instruments.

Compositional Structure

The form of *Farewell* is a ternary (ABA') structure. The video time codes for each section are as follows:

0:10 - 2:29	Section A
2:30 - 6:51	Section B
6:52 - 9:10	Section A'

As the poem is not a linear time-based storytelling structure, the composition is not written to line up with the poem's description. Instead, the recording of the poem is used as the basis to generate the variety of sounds used in the composition.

The composition begins with four semi-pitched long notes, statically positioned in the four corners of the listening environment, entering one after another and performed by touching

[30] Information from: https://www.wacom.com/en-cn/products/pen-tablets/wacom-intuos-pro

each of the four corners of the tablet. All four notes eventually coalesce to form a unified sound at 2:00. At the end of Section A, the left hand five-fingered, downward-spinning performative action (at 2:10) triggers each sound to start rotating their apparent position around the listener. The rotation of the sounds in the listening space also announces the transition to Section B.

In Section B, we hear sonic motives that convey different moods and feelings or sounds to which I ascribe association. We can hear the melodic "Eee," which for me signals sadness at parting, the sound of drumming that aligns with the departure, a low howling sound that denotes the struggle, and the crackling fire sounds that correlates to grass burning in the fields. These motives intertwine with each other to create a montage of sounds mirroring the scene painted by the poem.

Section A recurs in variation and uses similar compositional techniques. We hear from the four corners the recurring four-pitched notes, but with different timbre, frequencies, and characters, actuated with different performative actions. In Section A', rather than using the stylus to draw on the surface to generate data as in the Section A, the right-hand index finger traces the Wacom surface to generate data streams. Metaphorically, the abandonment of the Wacom apparatus, the pen, for the more primal human finger aligns with the allegory of the poetic text. The composition concludes with a sonic manipulation of the last verse of the poem.

Sonic Materials, Sound Design and Data Mapping Strategies

The recitation of the Chinese poem has unique vocal intonations, thus providing wonderful sonic material for manipulation. To enhance these unique intonation features, I extensively use Kyma's TAU algorithm. Kyma's TAU is a powerful tool for manipulating the human voice and for converting speech into pitched sound material. Along with the TAU algorithm, the synthesis techniques used in *Farewell* also include granular processing, analysis and re-synthesis, and sampling techniques.

The beginning four semi-pitched notes at the start of Section A are created using Kyma's TAU algorithm. Each note is built using four TAU objects to manipulate pitch contour. Each TAU object is slightly detuned and have random values added to continuously change their pitches. The frequencies of each TAU sound are controlled by the degree of tilt of the stylus. When the pen is held straight, the pitch changes less. When the pen is tilted to the side at steeper or shallower angles, notes are detuned more or less. The result of nuanced detuning and random pitch shifting in micro scales creates a shimmery sound effect. Figure 12 shows the design of the first semi-pitched note in Kyma Sound as well as the Capytalk for each frequency parameter inside the TAU object.

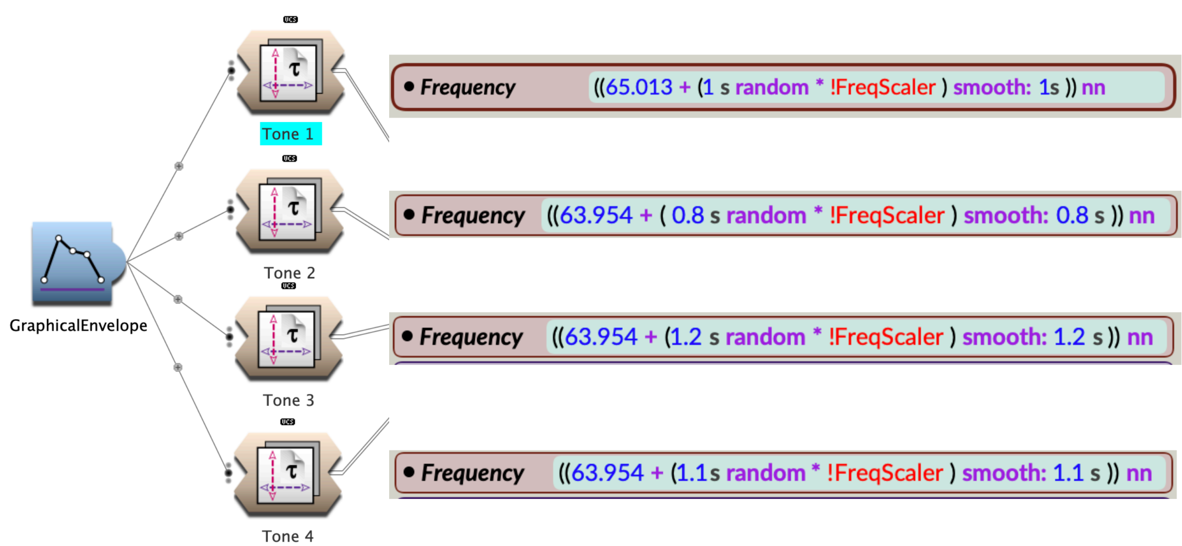

Figure 12. Four TAU objects and frequency parameter design

Section A' begins at 6:52 and is based on different sound design techniques. Additionally, the four different notes are spatially positioned in a reverse order from their original position in Section A. Instead of using TAU to generate sound, Section A' uses the Kyma Sound object

Chopper to extract a very small segment of my reading of the poem. The design of the Kyma Sound is shown in Figure 13.

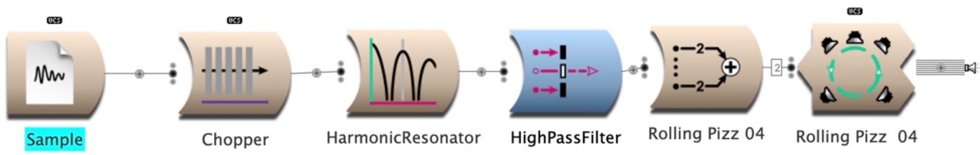

Figure 13. Kyma sound design for A' section

Beyond pitch manipulation, the spatialization of the four semi-pitched notes in both sections A and A’ are carefully designed. When the stylus touches the upper right corner of the Wacom surface, the sound is triggered and is heard coming from the front right speaker. As the stylus pen draws on the surface diagonally to the bottom left corner, the spatial position of the note moves diagonally to the rear left speaker. The three notes that follow are also designed to be spatially positioned in a similar fashion. Eventually, all four notes are spatially positioned in the four separate corners of the listening area.

THE LIGHTED WINDOWS

Storytelling Components

The Lighted Windows is based on a children's storybook of the same name,[31] written by Jefferson Goolsby.[32] *The Lighted Windows* tells the story of a young girl who, discontent with her home life, escapes to explore her neighborhood at night and fantasizes about the different lives being lived behind the neighborhood's lighted windows.

Feeling frustrated with her family, the protagonist, Jayling,[33] decides to run away from home one evening. After roaming around the neighborhood for a while, she decides to go inside one of the houses. Invisible to the inhabitants, she walks about the house observing what everyone doing behind those lighted windows.

After visiting three different families, she comes to her final stop, at once strange but familiar. This is *her* house. Why did it suddenly seem so different to her? Upon entering, she sees her parents talking intently. Her sister was sitting at the dining table doing something. She says hello, but no one can hear her. She panics. The story ends with Jayling lying in bed wondering what her window might mean to another person walking down the street.

The story of "The Lighted Windows" was inspired by a family conversation during a Christmas Eve car ride to see Christmas lights displays around our town. During the drive, our daughter, Jayling, kept imagining and talking about what kind of people might live inside those

[31] *Storybook* is a book authored by Jefferson Goolsby that contains a story or a collection of stories and is intended for children.

[32] Jefferson Goolsby is an intermedia artist. His creative work integrates video (multichannel, screen-based, expanded cinema, and live cinema); interactive systems; sound design; installation; performance; and image making. His work explores themes of geographic displacement, and his research focuses on emerging distribution systems and alternative production processes. Jefferson and I got married in 2002 and we have been collaborating on many projects since then.

[33] The name of the protagonist in this story, Jayling, is coming from my daughter, Jayling Goolsby. She is also the voice talent of the young girl in this composition.

beautifully bedecked houses. Jayling's imagination and our ensuing conversations allowed her to discover the different contexts within which a person may view one's life.

<u>The Data-driven Instrument in *The Lighted Windows*</u>

The Lighted Windows is an interactive electronic music composition, performed with two Nintendo Wii Remote controllers (also known as Wiimotes), OSCulator software, and custom software built in Kyma. I selected the Wiimotes as the controllers to perform this composition for two reasons. First, because the Wiimote controllers are readily functionally known by the general public, my performative actions within composition can more readily be understood with applied to sound control. Second, the wireless controllers give the performer freedom of movement on the physical space of the stage while enabling accurate responsiveness for sound control. Wiimotes facilitate the development of physical movement that conceptually and psychologically aligned with the primary storyline where the protagonist wanders from place to place. The basic architecture of the data-driven instrument is shown in Figure 14.

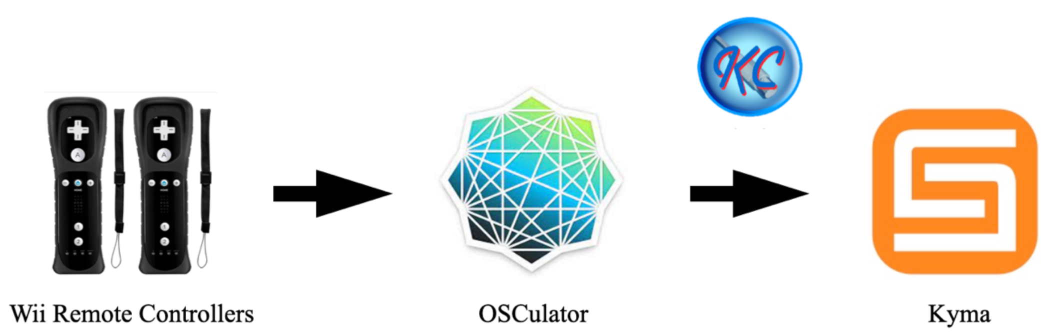

Figure 14. Fundamental architecture of data-driven instrument for
The Lighted Windows

The two Wiimote controllers are connected to the computer through OSCulator via Bluetooth connections.[34] Each Wiimote provides eleven buttons (ten on the front, one on the back) and six continuous controllers: Pitch, Roll, and Yaw, and Accelerometer data across three dimensions. Figure 15 shows the orientation associated with Pitch, Roll, Yaw and the directions for Accelerometer (X, Y, and Z, respectively.) [35]

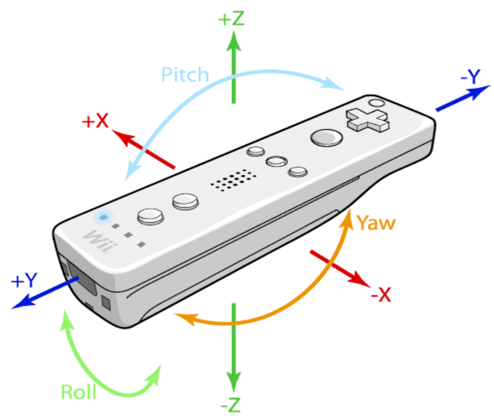

Figure 15. Wiimote controllers

During a performance, I hold a Wiimote in each hand and use the continuous movement and interplay of the two Wiimotes to actuate events and control musical parameters in realtime.

<u>Compositional Structure</u>

The structure of the music composition follows the structure of the written story. In Goolsby's story "The Lighted Windows," the primary feature of the text is that, first, the reader starts and ends at home, and second, within the large-scale journey from home and back again, there exist three sub-journeys that the protagonist takes. The musical structure aligns with the broad sweep of the story by using continuous chimes sounds as the primary underlying musical

[34] OSCulator is a software that can provide connections between Wiimotes and computer software. https://osculator.net/. Accessed October 28, 2022.

[35] Image from https://osculator.net/doc/faq:wiimote.

motive. The composition also aligns with the stories sub-journeys by creating varies sound world and performative actions to support the structure.

To accommodate this format of an audio storybook performed with live electronic music, the composition is divided into scenes. These scenes, in turn, facilitate rehearsal by providing convenient starting points. Here are the scenes with video timecodes and with descriptive titles:

0:00-0:40 Scene 1 - Opening title
0:41-1:20 Scene 2 - Introduction
1:21-2:34 Scene 3 - Escape from home
2:38-4:15 Scene 4 - First house visit
4:16-4:30 Scene 5 - Back to the street after first house
4:31-5:43 Scene 6 - Second house visit
5:44-6:04 Scene 7 - Back to the street after second house
6:05-6:40 Scene 8 - Third house visit
6:41-7:20 Scene 9 - Back to street after third house
7:21-7:49 Scene 10 - Her own house
7:50-8:16 Scene 11 - Panic
8:17-9:27 Scene 12 - Back to reality
9:28-10:01 Scene 13 - Coda

I use the Wiimotes to control the flow of the story and the sonic material that supports the storyline. For example, whenever the protagonist goes back to the street after visiting a house, the chimes sound returns and I use Wiimotes to control the frequency and volume of the sound.

Sonic Materials and Data Mapping Strategies

The spoken voice is an important musical element in *The Lighted Windows.* In this composition, Jefferson Goolsby provides the sound of the narrator's voice and Jayling Goolsby provides the sounds of the protagonist's voice. The audio recordings for both were done in my home studio, then edited into separate smaller segments for real-time manipulation. In addition to playback of audio files segments, I also used granular processing, analysis and re-synthesis, and Kyma's TAU algorithm.

One of the important aspects of the composition's sound design is that the narrator's voice is recorded in realtime and then played back in four individual *Sample* objects to create a continuous chime sound. Figure 16 shows the Kyma Sound Chime algorithm signal flow graph.

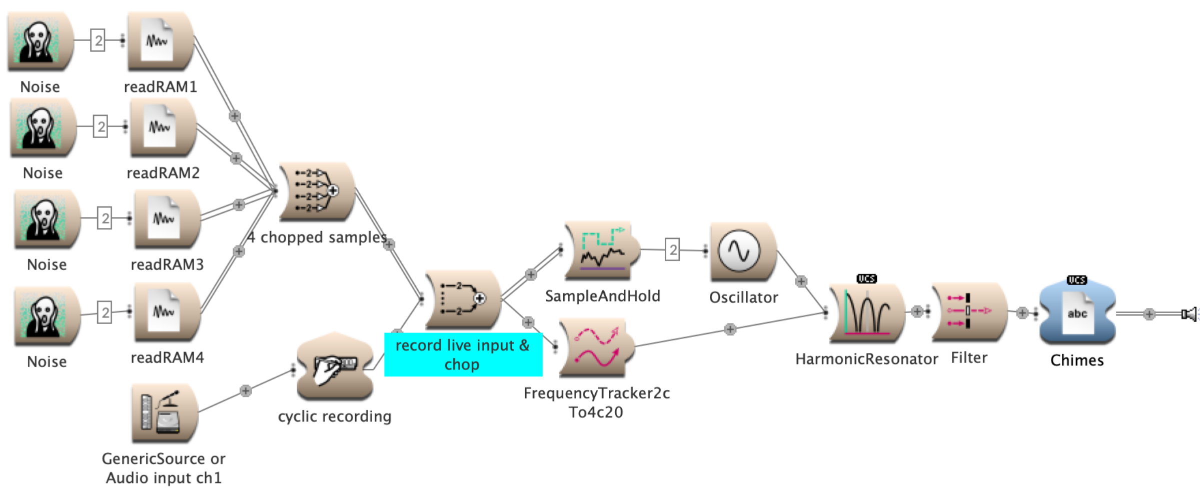

Figure 16. Kyma Sound Chime algorithm signal flow

In Kyma Sound Chime Sound, the narrator's voice is used as an audio input and is recorded into RAM anew every three seconds. Simultaneously, there are four *Sample* objects that use this real-time recording of the narrator's voice, that have random start points, and that are combined into a single stereo signal. The *FrequencyTracker* then outputs a continuously updated estimate of the frequency of the mixed sound generated by the four samples. This estimated frequency is then used to set the fundamental frequency of the *HarmonicResonator*. The mixed sound for the four samples is also used to control the frequency of a sine wave oscillator.

The principal control sources used in *The Lighted Windows* are the Wii Remotes' pitch, roll, yaw, and accelerometer data streams, and the array buttons on each of the Wiimotes. These data streams are received on my host computer via OSCulator and routed to Kyma which provides the responding sound-producing algorithms. For simplicity, I assigned the pitch, roll, yaw, and acceleration data as well as the data output from Wiimote Buttons A, B, Plus and 2 to MIDI continuous controllers 1-7 and 11-18. Figure 17 shows the routing scheme for the control data in *The Lighted Windows.*

✔	Message	Event Type	Value	Chan.
☑	/wii/1/accel/pry	–	–	–
☑	0: pitch	MIDI CC	1	1
☑	1: roll	MIDI CC	2	1
☑	2: yaw	MIDI CC	3	1
☑	3: accel	MIDI CC	4	1
☑	/wii/1/button/A	MIDI CC	5	1
☑	/wii/1/button/B	MIDI CC	6	1
☑	/wii/1/button/Plus	MIDI CC	7	1
☑	/wii/2/accel/pry	–	–	–
☑	0: pitch	MIDI CC	11	1
☑	1: roll	MIDI CC	12	1
☑	2: yaw	MIDI CC	13	1
☑	3: accel	MIDI CC	14	1
☑	/wii/2/button/2	MIDI CC	15	1
☑	/wii/2/button/A	MIDI CC	16	1
☑	/wii/2/button/B	MIDI CC	17	1
☑	/wii/2/button/Plus	MIDI CC	18	1

Figure 17. Routing scheme design in OSCulator

The final destination for each of these 18 MIDI continuous controllers is Kyma's sound-producing algorithms.

In *The Lighted Windows,* I use Wiimote buttons to control the start and stop of a scene and to initiate individual sound events. The continuous controller data streams (pitch, roll, yaw, and accelerometer) are used to provide ongoing control a range of musical parameters in Kyma including Frequency, TimeIndex, and Reverb.

Stage and Body Position as Theatrical Elements

In *The Lighted Windows* my physical location and body position within the performance space are deliberately designed and importantly support the telling of the story.[36] For instance, whenever the protagonist is about to enter a house, I reorient my body position to face a different corner. Changes in my body positioning do not have direct impact on the control of the sound, but are important visual domain events that support changes of scene in the story or shifts in mood.

Furthermore, I use body positioning to reinforce any bits of the underlying story not clearly stated in the narrative. For instance, in the opening scene, I stand directly facing the audience. As soon as the narrator starts telling the story, I then turn my back to the audience. In the context of theater (and life), turning one's back to the audience communicates a sense of discomfort and resistance, and for me enunciates the uncertainty in the girl's mind.

During the performance, my movements and physical orientation reflect and even mimic those of the protagonist girl wandering around the neighborhood. During her journey, she questions the possibilities of what an ideal family might be. The video is intentionally produced in black and white consistent with the time of day being nighttime and the nature of the girl's experience being surreal as she slips deeper and deeper into other worlds.

[36] Within traditional theater, the notion of *body positioning* describes how and where a performer, or an actor stands onstage in relation to the audience. There are eight different body positioning in the theatre design. http://theatreatthefort.weebly.com/body-positions.html

Towards the end of the story, the girl experiences a moment of frantic fear. Has she traveled so far into those other worlds that she's now lost her place with her own family? Has her family lost awareness of her existence? At this moment, both of my hands wave frantically in the air signaling the girl's panic while simultaneously controlling the sound.

MG-SHE IS SUCH A WONDERFUL PERSON TO KNOW

Storytelling Components

MG-She is such a wonderful person to know is a composition about my mother-in-law, Marilyn, whose initials are MG. We – my husband, our daughters, and I - all call her grandma. In the spring of 2021, grandma passed away. This composition was created in memory of our beloved Marilyn.

Marilyn's gentle voice is very much a part of our memories about her. Her positive attitude, caring tone, and sweet humor peppered our countless family times together, including family dinners. Marilyn loved to collect Blue Willow dinnerware, never missing a chance to buy pieces when she saw them at the yard sales. Marilyn also liked heavy flatware. Those heavy spoons, forks and knives would teeter on her precious Blue Willow dinnerware. Meals were punctuated by the clinking of flatware on plates and the occasional clatter of a knife hitting the floor. The Blue Willow dinnerware with the heavy utensils became a symbol of grandma's house.

Always a mother, Marilyn's voice showered us with love. At bedtime, she never failed to say goodnight with hugs and kisses, while wishing us, "Good night. Sleep tight. See you in the morning."

Marilyn's own memories also find their way into this composition. One day, while one of my daughters was sitting with her grandma on the front porch, my daughter asked, "Do you remember anyone back in your high school?" "Georgiana," she said. One day during lunch break, a group of friends walked downtown, when Georgiana decided to lay down between the railroad tracks to let the train run over her because she wanted to draw the attention of a boy she liked.

We heard another of Marilyn's memories more than a few times. When she was a little girl, a new piano arrived on their doorstep. Back then, it was very rare for a household to have a piano. When the piano was delivered to her house, she and her younger brother were eager to play it. Her mother looked at them and said, "Uh uhn. This is *my* piano." When grandma told us this story the first time, she was 85 years old. After so many years, she still remembered her mother's reaction clearly. That memory stuck with her.

Then there was the story about running away from home. Marilyn sneaked out her bedroom window one night but got caught by her mother and was sent right back home. She then went on to tell us that trying to run away from home was just her nature. I was astounded. This pattern of behavior did not fit in with the picture of her in my mind.

During the last two months of her life, I had the privilege of taking care of her. Every morning, she would ask for help getting out of her bed, change into her daily clothes, and walk to the living room, where she would settle in to savor her morning coffee. These simple routines that seem so easy for most could take an entire hour for her to accomplish. Nonetheless, she refused to lay in bed all day even if she could only sustain ten minutes in the living room with her family.

Grandma always said "thank you" to everyone, even for everyday kindness. When I brought her a cup of coffee, she said thank you. When I walked with her alongside her walker, she said thank you. When I lifted the spoon to her mouth to feed her, she said thank you. Even when she no longer recognized me those last few days, she still thanked me for everything I did for her. During the period of time when I was staying with her day and night, I grew to understand what she really meant when she said, "Be happy with what you have." Her graciousness taught me a way of being in the world that was not a passive acceptance of one's fate. Nor should one's way in the world be about anger and envy about what one does not have. Grandma's "Be happy with what you have" truly came from being thankful and grateful about things around her.

To help us hold on to these memories of Marilyn and because my medium is music, I chose to write a piece to record my memories of her and to convey the essence of who she was as a person – her tenderness and caring towards people and her optimism. Thus, the composition's title, *MG - She is such a wonderful person to know,* reflects these intentions.

Data-driven Instrument in *MG-She is such a wonderful person to know*

Because the piano was a prominent memory of my mother-in-law, the choice of a more traditional keyboard-shaped controller seemed appropriate. Beyond the story of being denied her eager longing to play her mother's piano, there was a strong sense of her forever longing to make music. Sadly, she never received any musical training.

The complete data-driven instrument for *MG-She is such a wonderful person to know* consists of the ROLI Seaboard RISE 49[37] and Kyma. The ROLI Seaboard is a keyboard controller that simultaneously serves both as a traditional piano-like controller and as an asymmetrical, multi-point three-dimensional fader. With its MIDI Polyphonic Expression (MPE) capabilities,[38] the ROLI Seaboard allows the performer to conveniently and simultaneously modulate musical parameters such as timbre, pitch, and amplitude.

Using the ROLI Seaboard as the performance interface, data can be produced when playing on the keyboard, pressing on the stripes, or pushing the buttons on the side of the

[37] The ROLI Seaboard RISE 49 is a multi-dimensional MIDI controller. More information can be found at: http://roli.com/products/seaboard/rise2.

[38] MPE is a new specification based on the existing MIDI protocol. More information about MPE can be found at: https://www.musicradar.com/news/what-is-mpe-and-why-should-you-care-about-it

keyboard. Data output from the ROLI is scaled and offset within Kyma and then routed to the sound-producing mechanisms also contained within Kyma. The structure of the data-driven instrument is shown in Figure 18.

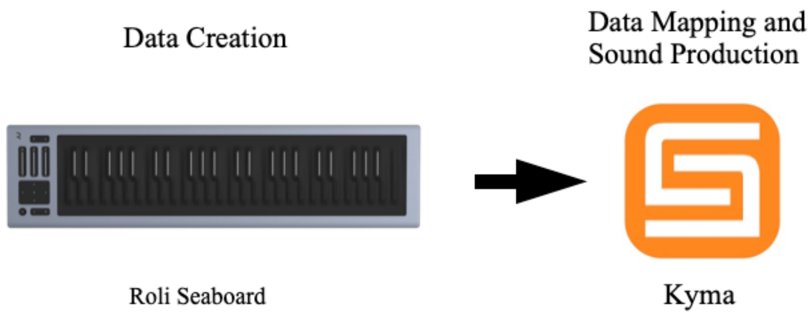

Figure 18. Complete structure of data-driven instrument for
MG-She is such a wonderful person to know

Compositional Structure

The composition is constructed from a collection of memories – my memories of her and her memories. Therefore, this composition can be seen as a story of memories inside memories.

I think of my composition as being divided into nine sections of unequal length and of differing functions and which starts and ends in a dream-like sound world. There are short transition passages between sections. The following paragraphs describe the structure of each section with a video timecode given.

0:13-2:06 The composition begins with a single bell sound. The opening bell's pitch connects the listener to the music that is to follow: the first eight measures of Claude Debussy's *Clair de Lune*. The opening bell's pitch matches the lowest note of the first chord in *Claire de Lune*, which was the composition I played for Marilyn during her brief hospitalization. In this section, the voice of Marilyn is heard calling the names of her three sons. The voices are blended in with both bell sounds and the synthesized arrangement of *Claire de Lune*.

2:06-2:28 This is a transition passage where a sweeping wind sound can be heard from a low-pitched to a high-pitched register. For me, this sweeping sound is like a time machine that takes the listener back to Marilyn's high school years.

2:29-4:29 In this section, Marilyn is remembering her childhood friends and tells a story about them. Marilyn's voice is accompanied by a low humming wind sound as well as a wind chime melody.

4:30-4:54 This section serves as a second transition and represents an exploration of the sounds of family dinners with Marilyn on her much-loved Blue Willow dinnerware. Except for a sweeping wind sound, this transition includes sounds modified from the audio samples of utensils clinking on dishes. The transition leads us to another enunciation of Marilyn's childhood memories.

4:55-7:27 This section is the longest and most rhythmic section of the composition. In this section, Marilyn is remembering her memories of repeated attempts to run away from home. While we hear her voice describing these escape attempts, the sounds of clinking utensils function as a percussive rhythmic pattern. We also hear Marilyn's voice saying *hi, howdy, good, oh ya, etc.,* reminiscent of her positivity. The juxtaposition of the rhythmic pattern of clinking utensils and the short samples of her voice creates an amusing counterpoint texture.

7:28-7:50 This is the third transition, which is more intense than the previous two. In this transition, we can hear a train coming and passing by the listening audience, leading us back to a calmer next section.

7:51-9:57 This section is filled with melodic lines and arpeggiations articulated with a bell sound. Blending with her voice, the sensory impression of the section immerses listeners in MG's view of the world.

9:58-11:25 This section echoes the beginning section where she calls out the names of her sons. Here once again, Marilyn is talking to her sons, calling their names and saying good night to them. At the same time, she is wondering if she is in a dream world. The arpeggiation of the bell sound returns to reinforce this dream-like state.

11:26-13:37 The ending coda section uses a repeated single note F, the same note heard at the very beginning. The repeating bell sound with constant pitch is symbolic of a death knell. The composition concludes with Marilyn's farewell.

Sonic Materials and Mappings

Because this is a composition about my memories of my mother-in-law, I intentionally drew all my sound materials from objects and events that I felt had strong connections to my memories of her. In general, the entire composition is constructed based on three sound sources: 1) audio recordings of family gatherings, 2) the sound of wind chimes, and 3) the sound of eating utensils clinking Blue Willow dinnerware. Specifically, the primary sound materials arise from audio recordings of her voice that were taken from the family recordings. Using segments of her recorded voice, the composition tries to convey her unceasingly positive view of life. From audio recordings of the family gatherings, I also extracted samples of the sound of eating utensils clinking on dinnerware. The sound of wind chimes was recorded outside her house by the front porch.

The mapping of individual samples of Marilyn's voice, the sound of wind chimes, and the utensil clinking to different keys on the ROLI Seaboard is an essential aspect of the compositional design. The Kyma Sound object *KeyMappedMultiSample* provides a way to assign a group of audio recordings to specific ranges of a MIDI keyboard. Figure 19 shows the mapping scheme for samples of Marilyn's voice and utensil clinking sound in Kyma.

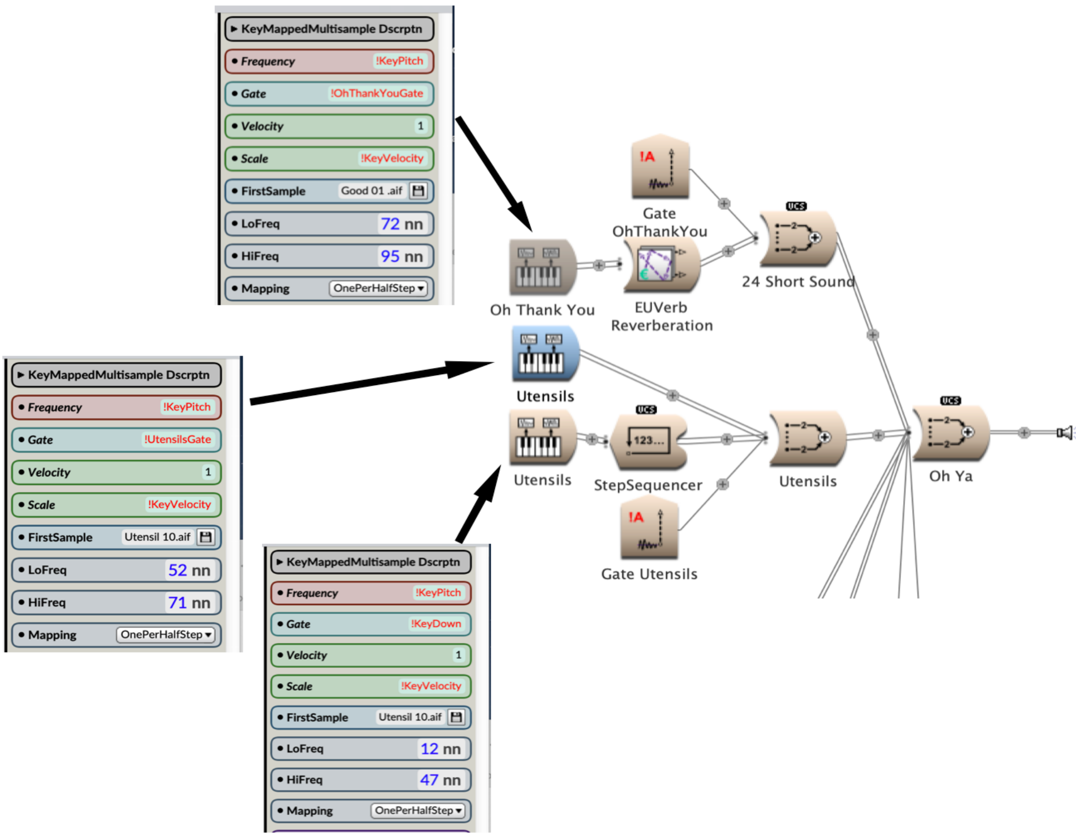

Figure 19. Mapping scheme of audio recordings of MG's voice and eating utensils clinking sounds in Kyma

This composition also uses Markov chains[39] as a controlling mechanism to create the chime melody based on Debussy's *Claire de Lune*. I used Kyma's Script[40] object to create a simple version of a classic Markov chain. All the notes from *Claire de Lune* were written into a

[39] A Markov chain is a random process in which the probability of next state depends on the condition of previous state. More information on Market Chain for music generation can be found here: https://medium.com/towards-data-science/markov-chain-for-music-generation-932ea8a88305

[40] Kyma's *Script* object can be used to generate sound and sound control algorithmically.

standard MIDI file. The *Script* object was then modified by replacing its original MIDI file with my *deb-clai.mid* file. The function of the *Script* object was to create a Markov chain that was trained by *Claire de Lune*. The resulting Kyma Sound was used to generate a new chime melody, which became part of the composition. Figure 20 shows the revised Kyma Script.

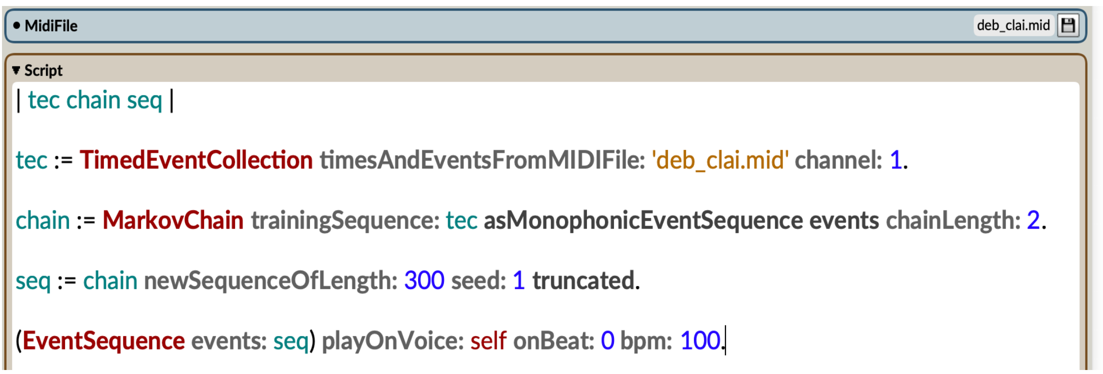

Figure 20. Kyma *Script* that produces a Markov Chain

The result of this process is a new sequence in the style of Debussy's *Claire de Lune.*

<u>Performance Techniques Using the ROLI Seaboard Controller</u>

When performing, one can feel the main difference between ROLI and the traditional piano keyboard is the interface. While the traditional keyboard interface is ridged and produces discrete notes on an equal-tempered scale, the ROLI interface is soft, pliable and capable of producing frequencies between equal-tempered notes.

The Seaboard performance interface is designed to produce five distinct data streams which ROLI designate as *Strike*, *Press*, *Glide*, *Slide*, and *Lift*. *Strike* corresponds to MIDI note-on velocity.[41] *Press* describes the Key aftertouch applied to the keyboard after a key has been depressed. *Glide* describes horizontal movements from side to side to bend and adjust pitch. *Slide* describes vertical movements of fingers up and down the interface (in a 90-degree

[41] 5D Touch is an abbreviation for ROLI's 5 dimensions of touch. More information can be found here: https://support.roli.com/support/solutions/articles/36000019157-what-is-5d-touch-

association with *Glide*. Together, the *Glide* and *Slide* data streams form a two-dimensional X-Y fader configuration. *Lift* corresponds to MIDI release velocity data. I use *Strike*, *Press*, *Glide*, and *Lift* in *MG-She is such a wonderful person to know*. One can even combine different touches to create various playing techniques. For instance, in the final section (video timecode 11:26) when generating the data to trigger a bell sound representative of a tolling death bell, *Strike* and *Glide* combine to create the glide-vibrato effect. After pressing into a key and holding the note with the pad of my finger, I then wiggle my finger from side to side to create the pitch-bend effect by gliding.

Another example of applying different performative techniques occurs in the opening section. Multiple finger gliding and pressing techniques with the left hand are applied in the opening section. Instead of striking each note one by one, I strike and then hold the key while applying pressure to control the amplitude while gliding to the next note. The duration of each glide needed to be precisely rehearsed to match the desired tempo. The right hand, in contrast, plays the principal melodic line with a high crystal bell sound controlled by striking the keys with variable arm weight to simulate traditional staccato performance techniques. The purpose of utilizing two different kinds of performing techniques is to create contrasting sound worlds.

The three transition passages (that begin at video timecodes 2:06, 4:30, and 7:28, respectively) use *Strike*, *Glide*, and *Press* to control the sound. By moving my fingers along the bottom of the keyboard surface ribbons a sound can be bent upward or downward several octaves. Beyond controlling the frequencies, the amplitudes, and formants, cutoff frequencies of filters are also controlled.

SUMMONER

Storytelling Components

My composition, *Summoner* is propelled by an imagined story that centers around my mother-in-law who was a great lover of all kinds of animals. She kept more than two dozen peacocks in her backyard located near a city park in northern California. In my imagined story, her spirit emerges each night to summon her beloved peacocks and owls out of the darkness, orchestrating a symphony of their own nighttime storytelling. In Christian art, peacocks are portrayed as symbols of immortality while owls are harbingers of death. Thus, in *Summoner*, I draw on the oppositional tensions (of immortality and death) bringing together the two contrasting energies to influence the form and shape the sonic tapestry.

The primary sounds contained in the composition were, in fact, based directly on audio recordings of peacock calls, owl hoots, and other anonymous bird vocalizations. The bird sounds were recorded in my mother-in-law's backyard. The composition transforms these original recordings, exploring the mysticism, majesty, death, and immortality symbolized by these species while taking an excursion into the enigmas, mythologies, and necromancy of these creatures. The summoner not only seeks to summon the birds, but also to tell their dramatic stories.

The Data-driven Instrument in *Summoner*

The complete data-driven instrument for *Summoner* consists of the Leap Motion, custom software created in Max, and Kyma. Inside Max, the data streams are parsed and scaled, then routed to Kyma to be realized in real-time. The structure of the data-driven instrument is shown in Figure 21.

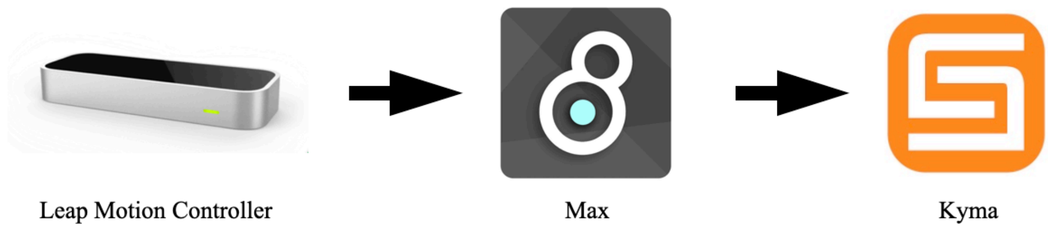

Figure 21. Complete Structure of data-driven instrument for *Summoner*

The Leap Motion is an optical hand-tracking device that can senses the movements of a performer's hands and fingers. Inside the Leap Motion, there are two 640 x 240-pixel near-infrared cameras and three LEDs, situated on either side and between the cameras. The Leap Motion device is capable of tracking hands within a pre-defined three-dimensional interactive zone that extends upwards to approximately 60 cm and with a field of view between 120° and 140°.[42, 43]

[42] https://www.ultraleap.com/product/leap-motion-controller/

[43] Alex Colgan, "How Hand Tracking Works." Leap Motion. Accessed April 5, 2022. https://www.ultraleap.com/company/news/blog/how-hand-tracking-works/

Figure 22. Leap Motion hand-tracking interaction zones

The data acquired by operating the Leap Motion controller are then sent to Max software which runs on a host computer that serves as the initial point for data processing. To efficiently acquire the Leap Motion data, I adapted the Max object "aka.leapmotion" developed by Masayuki Akamatsu. This external Max object parses the data acquired from Leap Motion into individual streams for convenient use.[44] After the data are parsed inside Max, it is then sent to Kyma to control sound production. [45, 46, 47]

[44] Masayuki Akamatsu is a musician, multimedia artist and programmer who has created a number of external Max objects that are widely used. "aka.leapmotion" Max external object package was downloaded from https://github.com/akamatsu/aka.leapmotion. Accessed March 23, 2018.

[45] Figure 22 image from https://mocap.reallusion.com/iclone-motion-live-mocap/leap-motion.html

[46] The Max patch used in this composition is based on Dr. Chi Wang's work, which can be found in her composition *Magic Fingers.* https://vimeo.com/95141260. Accessed January 2, 2023

[47] The Max patch used for this composition was operated under the macOS Big Sur Version 11.4 operating system.

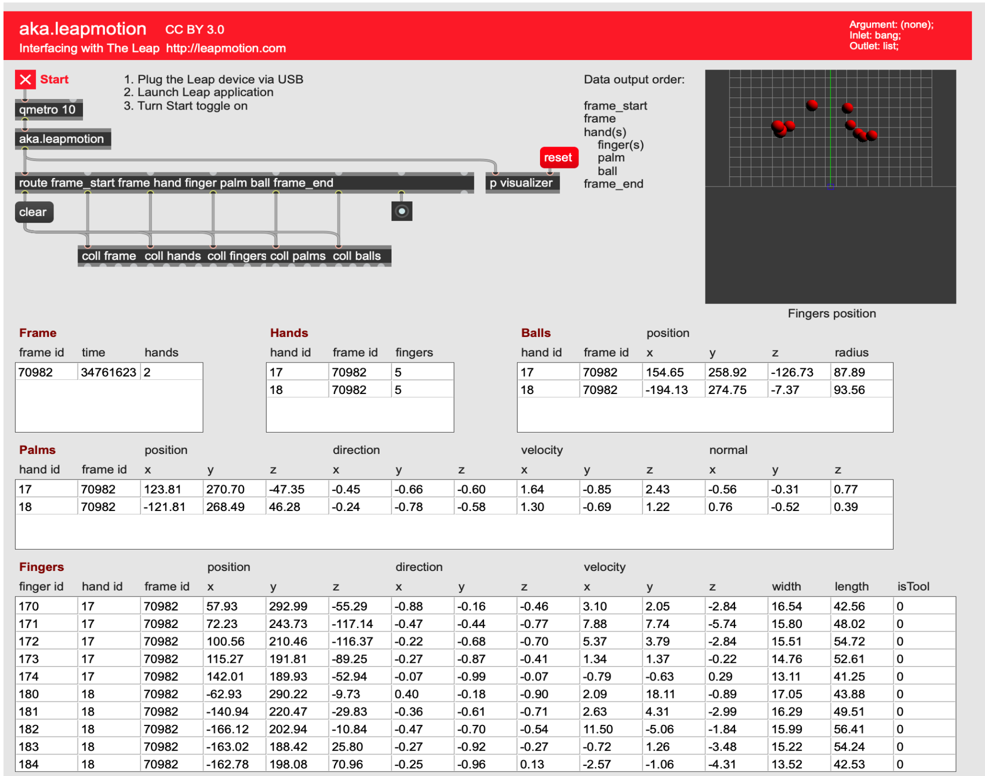

Figure 23. The aka.leapmotion Max help patch

Compositional Structure

Summoner can be understood as a loose AA'B form with an extensive transition between sections A and B and a coda. The video time codes for each section are as follows:

0:11 - 0:47 A Section
0:48 - 1:38 A' Section
1:38 - 3:00 Transition
3:05 - 4:52 B section
4:53 - 5:22 Coda

The composition starts with bird sounds emanating from all spatial directions. The A' section is a variation of A, in which the movements of both hands direct the transformations of each animal call. At 1:40, a crystal glass sound initiates the start of the transition section. Within the transition section, a low rumbling sound slowly emerges, joining with the other sounds to produce a sonic transformation that leads to the first climax point at 3:00. This climax announces the opening of mythologic and necromantic realm, summoning the unknowns emerging to our world.

Starting at 3:05, the sounds of big bangs are the driving force for the vigorous B section metaphorically summoning of the stories of the birds. Banging sounds are accompanied by a steadily accelerating, rhythmic pattern, a blizzard-inspired wind sound, and the barbaric brutal uproars, all being summoned to come out together and dance frantically towards the zenith at 4:52.

Summoner ends with a whistle sound (coda), signaling the end of the odyssey.

Sonic Materials and Data Mapping Strategies

The primary sonic materials for *Summoner* are recordings of peafowls calling and owls hooting. Along with sampling techniques, granular synthesis and analysis and re-synthesis are used to transform the sounds of these animals.

At the beginning of *Summoner*, we can hear short samples being played back with reverberation in a surround setting. Both hand palms' opening then closing gestures trigger the sample playback. Inside Kyma, audio samples are selected randomly from a repertoire of pre-selected samples and played back. This random selection process creates interesting musical outcomes for each performance because the playback sequence of the samples is randomly selected. This is shown in Figure 24.

Figure 24. Capytalk expression in Index parameter field to produce random selection

Section B contains three main sound layers: a layer comprised of metallic banging sounds, a layer built on a harsh wind noise, and a layer of rhythmic sounds. The banging sounds are triggered by how fast the performer's right fist moves. The pitch and location of each occurrence of the banging sound is different each time it is triggered. When the performer's left hand reaches forward and breaches a predetermined threshold, the harsh noise sound is triggered. The frequency and amplitude of the noise is controlled by moving the left hand upward and downward vertically. The rhythmic sounds that are panned in circular patterns accelerate each time the right hand triggers the banging sounds.

Performance Techniques and Mappings

In a musical performance, the ideal space would be a dark concert hall with a few LED lights. Controlled darkness is desirable because of the nature of the near infrared sensors. Ambient incandescent (tungsten) and halogen lights well as the daylight can interfere with the accuracy of Leap Motion detecting the hand and finger location.

All performative movements in this composition are based on the concept of turning an intangible sound into an imaginary physical object. By breaching numerical thresholds, I can trigger or stop the sounds in the composition. I also use hand distance and speed to trigger musical events. The 3-D distance between the two hands as measured by the infrared sensors is calculated by Max and those values are used to trigger musical events. For example, at 3:00 in the video recording, when the distance of both hands reaches a threshold that I predetermine, an explosive sound is triggered. The metallic banging sound in Section B is triggered by how quickly my exits the Leap Motion's observable sphere and returns to it. The pitch of each banging sound is indeterminate and is selected through an algorithm resident in Kyma.

Changing the shape of my hand is also an important performance technique within the composition. For example, during the transition section at 3:04, I use movement of all ten of my fingers – thus changing my hand shape – to control and change the frequencies of the peacock sounds. The speed of vertical movements of my fingers directly impacts how fast the frequencies of the sounds change and simultaneously intensify the buildup of sound.

GOLDEN SLUMBERS

Storytelling Components

Golden Slumbers is dedicated to the memory of the victims of the Sandy Hook Elementary School shooting that occurred on December 12, 2012 in Newton, Connecticut. During this incident, 20 children between the ages of six and seven years old, along with six adult staff and faculty, were killed. These deaths instilled in me a tremendous feeling of tragedy. While beginning to respond to such an incomprehensible incident is difficult, as a composer and a mother with young children I responded using my personal thoughts and my musical knowledge and capabilities.

Seeing one's own children grow up happy and healthy means providing a safe and loving environment for them. The constant back-and-forth of call-and-response between parent and child happens in a myriad ways. Parents call their child's names to waken them and get them to the dinner table. Parents sing to them to sleep to quiet their fears. In an instant, school shootings erase a parent's ability to protect and comfort their children. Parents are suddenly left helpless to protect them. Parents fail in their role as protectors. All of the cherished moments from the past and potential moments of the future are abruptly and cruelly stolen from us as parents. Society fails.

Though parenting is full of uncertainties, the tragedy of the Sandy Hook shootings arouses an inordinate fear of not being able to provide a safe place for my children. A second fear – the seemingly unstoppable gun violence all around us – is growing. Since Sandy Hook, there have been many others, including the Marjory Stoneman Douglas High School incident (17 deaths), Santa Fe High School incident (10 deaths), Robb Elementary School incident (22 deaths) to name only a few. Each time a mass shooting occurs, this country hotly debates gun control, ranging from proposals to make the background-check system universal to new federal and state legislation banning sale and manufacture of certain types of semi-automatic firearms and magazines. Yet, the status quo persists. People continue to die in mass shootings, which in the United States, seems to have become a societal norm.

To inform and shape a complex narrative structure for my composition *Golden Slumbers*, the continuous news reports and information about the Sandy Hook shootings are juxtaposed and entwined with well-known "Lullaby" texts from England and Taiwan in addition to sonifications based on gun violence data. Additionally, the specific pitch structures used in the composition support the articulation of the complex intermingling of concerns and emotions of children, parents, and culture.

Design and Implementation of the Data-driven Instrument in *Golden Slumbers*

Golden Slumbers is composed for amplified voice, a custom-made wireless wearable performance interface, video output, Max, and Kyma. The instrumental architecture in this piece is a complex variant of the basic instrumental model of a data-driven instrument previously discussed. In *Golden Slumbers* the basic model, shown in Figure 25, is first expanded to include data streams from external datasets containing information about gun violence and a microphone that facilitates the input directly into Kyma of an analog signal representing my vocalizations (shown in Figure 26).

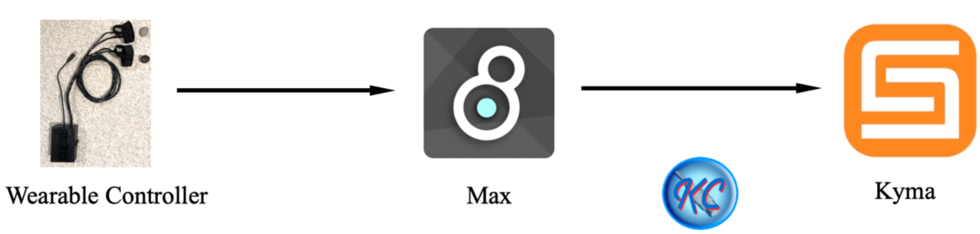

Figure 25. Basic model of the data-driven instrument

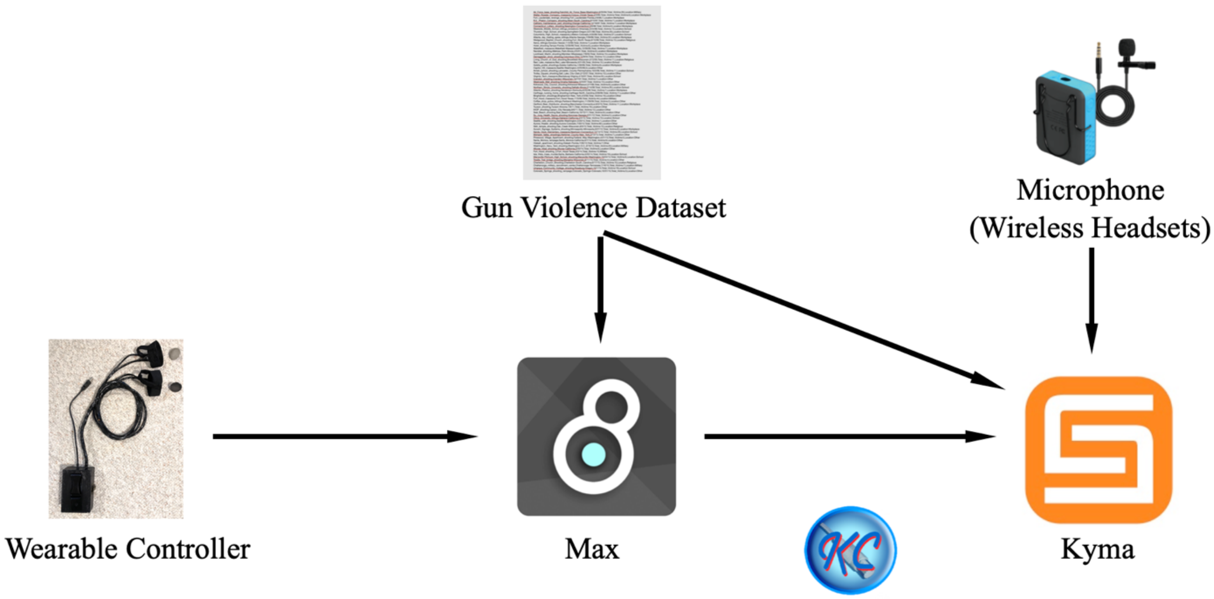

Figure 26. Complete architecture of data-driven instrument for *Golden Slumbers*

This instrumental configuration is also different from the other six compositions in my portfolio dissertation in that the instrumental structure also outputs videographic content through the Jitter capabilities in Max.[48]

Because my on-stage mobility is crucial for the theatrical design of this composition, I chose to build a wireless wearable interface to give the performer the capacity to move freely in the stage space. The following paragraphs describes how I built this wireless wearable interface and the basic components that make up its structure.

[48] The Max patch used for this composition was operated under the macOS Big Sur Version 11.4 operating system.

The basic components of this wearable interface consist of two ESP 32 microprocessors,[49] two MPU 6050 six-axis motion-tracking devices,[50] two hall effect sensors, and two magnetic disks.[51] One of the ESP32s is configured to create a Wi-Fi access point in order to provide a local area network between the computer and the wireless wearable interface during the performance. Another ESP 32 is connected to the wearable controller interface.

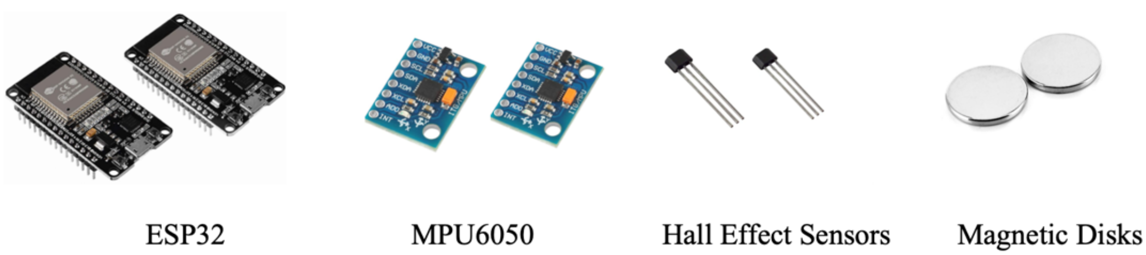

Figure 27. Wearable interface parts

Elastic bands are used to hold the sensing technologies in place on my hands. In the central area of my hand around my palm elastic bands are employed to hold an MPU 6050 and a Hall effect sensor that are both sowed into the band. Once secured in position the MPU6050 and the Hall effect sensor on each hand are connected to one of the ESP32s by 22-gauge standard wires. Additionally, small circular elastic bands to which quarter-size magnetic disks are attached are positioned on my middle fingers of both hands. (see Figure 28)

[49] ESP32, developed by Espressif, is a series of microcontrollers with Wi-Fi and Bluetooth capabilities with a wide variety of input and output capacities that is compatible with Arduino programming language. More information can be found here: https://randomnerdtutorials.com/getting-started-with-esp32/

[50] MPU6050 is an integrated 6-axis Motion-Tracking device that combines 3-axis accelerometer, 3-axis gyroscope, and a Digital Motion Processor™ (DMP). More information can be found here: https://create.arduino.cc/projecthub/MissionCritical/mpu-6050-tutorial-how-to-program-mpu-6050-with-arduino-aee39a

[51] The Hall Effect Sensor can detect the change, strength, and direction of a magnetic field produced from a permanent magnet or an electromagnet. More information can be found here: https://www.electronics-tutorials.ws/electromagnetism/hall-effect.html

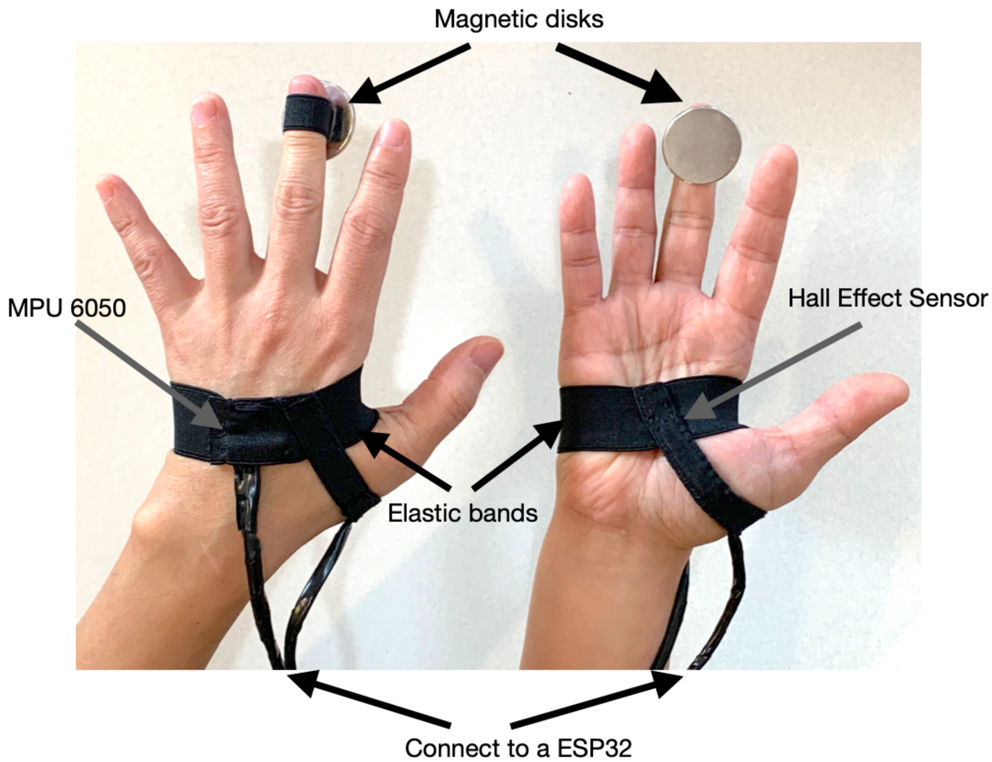

Figure 28. Elastic bands securing the positions of sensing technologies

The wires which are connected to the sensors are routed to a small wooden box whose dimensions are 4”x 3”x 1.5” that serves as the protective housing for the central hub to which data flows. This central hub consists of a PCB Solderable Breadboard and an EPS32 soldered to it. The USB connection (upper part of image in Figure 29) is used for powering the EPS32 and is connected to a portable battery charger that is clipped to my belt for practice and performance. These connections are shown in Figure 29.

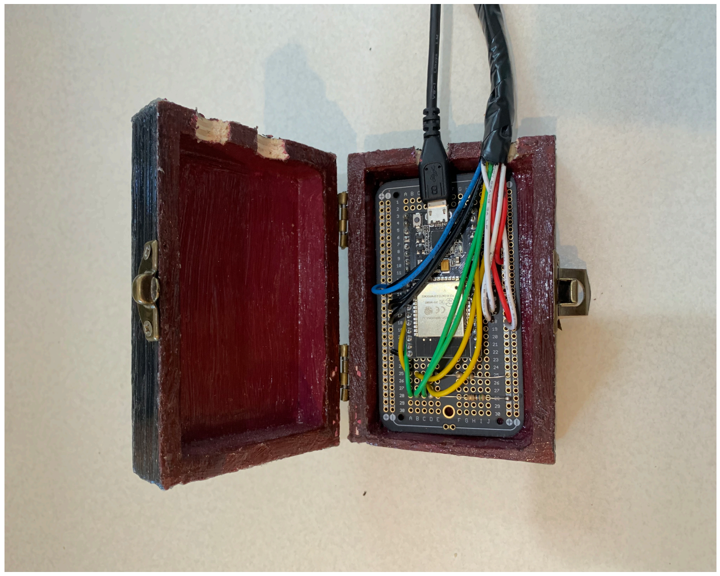

Figure 30. A Breadboard with EPS32 soldered on
inside the wooden box

A metal belt clip is affixed to the outside surface of the wooden box to secure the circuit-filled container to my waist belt during performance. Figure 30 shows the complete wireless wearable interface.

Figure 29. The complete wireless wearable interface

Multiplicity of Texts

Golden Slumbers unfolds in three movements that are guided by three texts that are presented individually and that are intermingled, combined, and fragmented.

The first movement is principally centered on a listing of the names of the Sandy Hook victims. In this introductory context, I sound the names of the Sandy Hook victims within a broader musical fabric that also contains bell sounds and my vocalization captured with the microphone provided by a wearable headset.

The second movement is derived from a Renaissance poem *"Cradle Song,"* a lullaby from the 17th century dramatist Thomas Dekker's 1603 play *Patient Grissel,* written with Henry Chettle and William Haughton. The original poem contains two stanzas. Only the first stanza is used in this composition.[52]

<u>*Golden Slumbers* - by Thomas Dekker (first stanza)</u>
Golden slumbers kiss your eyes,
Smiles awake you when you rise.
Sleep, pretty wantons, do not cry,
And I will sing a lullaby,
Rock them, rock them, lullaby.

In *Golden Slumbers,* the lullaby sung by the performer is recorded and manipulated in realtime while also being modified for playback in the next movement. Concurrently, I trigger a choral accompaniment in between occurrences of the lullaby's text.

In the third movement, a traditional Taiwanese lullaby, *The Lullaby* (Cradle Songs) by Lu Chuan-Sheng depicts a mother rocking her baby to sleep.[53] I sing this song as part of the

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[52] This 400-year old poem, may be familiar to audiences because it is also used by The Beatles. The lyrics for their song of the same name appears on their album *Abbey Road.*

[53] Lu Chuan-Sheng (1916-2008) is a Taiwanese composer who composed more than 200 choral pieces. He founded the first children's choir in Taiwan – the Rong-Shing Children's Choir – in 1957. More information about Lu Chuan-Sheng can be found here: https://baike.baidu.hk/item/%E5%91%82%E6%B3%89%E7%94%9F/4768228

musical fabric of the third movement. Simultaneously, segments of Dekker's *Cradle Song* lyrics initially heard during the second movement return to be juxtaposed with the Taiwanese lullaby.

搖嬰仔歌	*The Lullaby (Cradle Songs)*
嬰仔嬰嬰睏，一暝大一寸；	*Sleepy baby, growing one inch a night;*
嬰仔嬰嬰惜，一暝大一尺，	*Sweet baby, growing one foot a night;*
搖子日落山，抱子金金看，	*Rock the baby until sunset, staring at the baby in my arm,*
你是我心肝，驚你受風寒。	*You are my sweetheart; worry you will get cold.*

Golden Slumbers also uses data sonification to incorporate a dataset from the Gun Violence Archive database.[54] At the beginning of the third movement, I use my right-hand palm to trigger the listing of names, places, and number of victims of mass shootings in the United States between 1982 to 2021. This same body of data is simultaneously projected on a video screen.

Harmonic Structure

Golden Slumbers is unique among the compositions in my portfolio dissertation in that much, but not all, of its musical fabric revolves around pitch structures, the most notable of which are equal-tempered tuning and symmetrical pitch and pitch-class structures. One of the widely known attributes of such symmetric pitch-related structures is that they possess no *center of tonal gravity* because their elements are symmetrically disposed around a single axis of

[54] The Gun Violence Archive database is downloaded from https://www.motherjones.com/politics/2012/12/mass-shootings-mother-jones-full-data/

symmetry. An example of this type of symmetrical construction shows a whole-tone collection symmetrically disposed around a single axis of symmetry is shown in Figure 31.[55]

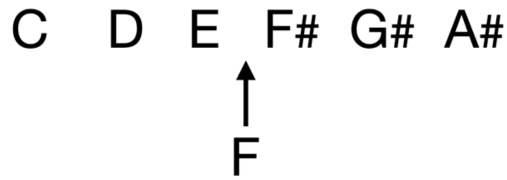

Figure 31. Whole-tone collection symmetrically
disposed around the pitch-class F

With respect to my composition, understanding these symmetrically disposed pitch structures is essential. I employ in *Golden Slumbers* both whole-tone and octatonic pitch-class collections that are both symmetrical in their structure. Because symmetrical pitch-class structures are not tilted towards any center of tonal gravity or resolution of tensions in the way Western scales and Church modes are, a musical uneasiness or anxiety is created that cannot very well resolve itself, much like the gun situation in America. To achieve momentary musical relief from the predominance of this tension-filled musical symmetry, I employ one asymmetrical harmony, which is most widely known as Scriabin's *Mystic* chord. If one knows much about Scriabin and his *Mystic* chord we might first note that the pitch structure first appeared in his *Prometheus: The Poem of Fire,* whose extra-musical discourse relates to the Promethean myth where humanity is granted, among other things, technology (guns). We might also note that near the end of Scriabin's life we believe that he was suffering from some sort of mental instability and delusions. This historical context, for me, makes my use of the *Mystic*

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[55] For a more in-depth discussion about symmetrical pitch and pitch-class structure in the Western 20th-Century composition, consult Elliott Antokoletz, *The Music of Bela Bartok: A Study of Tonality and Progression in Twentieth-Century Music*. University of California Press, 1990.

chord a point of relief in a sea of symmetrically generated tension, notable and excruciatingly ironic.

To organize the underlaying progressions comprised of subsets of these two symmetrical collections, I use Neo-Riemannian harmonic theory.[56] The application of Neo-Riemannian harmonic theory was suggested to me by Richard Cohn's article "Maximally Smooth Cycles"[57] and by Clifton Callender's, essay "Voice-Leading Parsimony in the Music of Alexander Scriabin."[58]

In the first movement, there are six arpeggiated chords articulated with a bell sound. The ordering of these subset harmonies can be understood with procedures described in the Cohn article, which I apply here to create a feeling of stillness.

Figure 32 shows the six arpeggiated triads used in the first movement and how the individual pitches of each bell note move smoothly in between and among the major and minor triads. While the bell sound is musically smooth and calming, the juxtaposed names of the victims produce a contrasting tension.

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[56] Neo-Riemannian theory (NRT) is an analytical system that explains harmonies directly to each other without referring to a tonic. Gollin, Edward, and Alexander Rehding (eds), *The Oxford Handbook of Neo-Riemannian Music Theories*, Oxford Handbooks (2011; online edn, Oxford Academic, 18 Sept. 2012), https://doi.org/10.1093/oxfordhb/9780195321333.001.0001. Accessed 25 Nov. 2022.

[57] Cohn, Richard. "Maximally Smooth Cycles, Hexatonic Systems, and the Analysis of Late-Romantic Triadic Progressions." *Music Analysis* 15, no. 1 (1996): 9–40. https://doi.org/10.2307/854168.

[58] Callender, Clifton. "Voice-Leading Parsimony in the Music of Alexander Scriabin." *Journal of Music Theory* 42 (1998): 219.

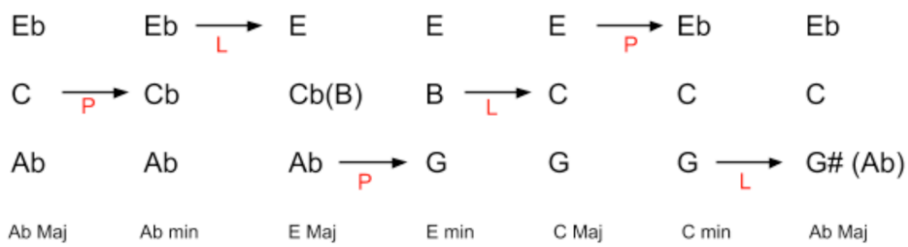

Figure 32. Six arpeggiated chords used in the first movement

In the second movement, Scriabin's *Mystic* chords and whole-tone scales are combined.[59, 60] According to Callender, the *Mystic* chord is a minimal perturbation of the whole-tone scale. For instance, taking a whole-tone scale and moving one of the pitches up by one half-step results in Scriabin's *Mystic* chord. On the other hand, taking a whole-tone scale and moving

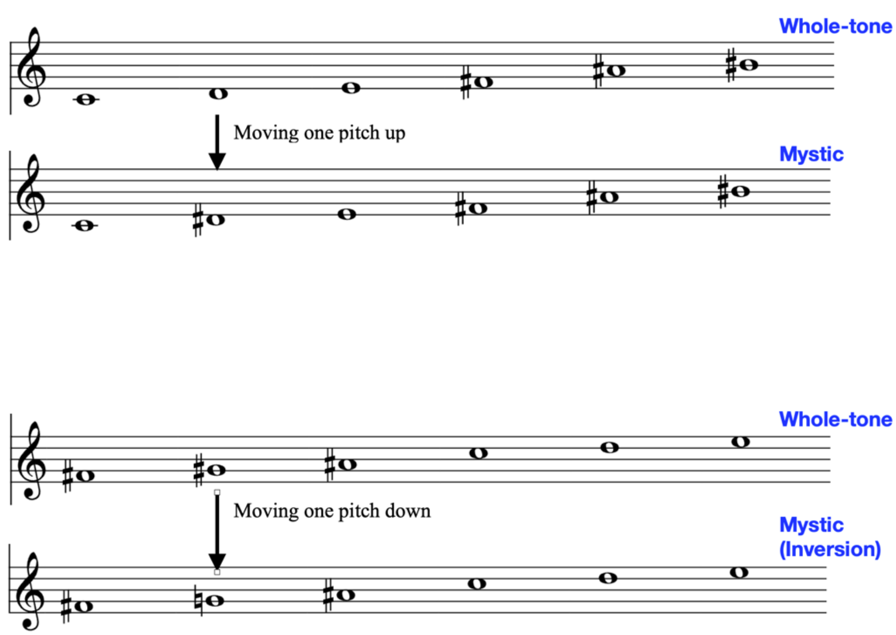

Figure 33. Minimal perturbation of the whole-tone scale
and *Mystic* chords

[59] The *Mystic* chord (also called Prometheus chord) is a complex six-note scale. This mystic chord first appeared in *Prometheus: The Poem of Fire,* Op. 60 by Alexander Scriabin in 1910. The *Mystic* chord is often interpreted as a quartal hexachord consisting of an augmented fourth, diminished fourth, augmented fourth, and two perfect fourths. The *Mystic* chord can be spelled in different ways.

[60] A whole-tone scale is a six-note scale where each pitch is a whole-tone interval from its nearest neighbor.

one of the pitches down generates a *Mystic* chord inversion. The opposite is also true. Moving one particular pitch in any *Mystic* chord will turn the chord into a whole-tone scale. Figure 36 shows minimal perturbation of the whole-tone scale and *Mystic* chords.

In the second movement, the accompanying chords for the text are constructed from transforming either a *Mystic* chord or whole-tone scale. Alternating back and forth between the whole-tone and *Mystic* chord creates the surreal musical world that I sought to convey in this section.

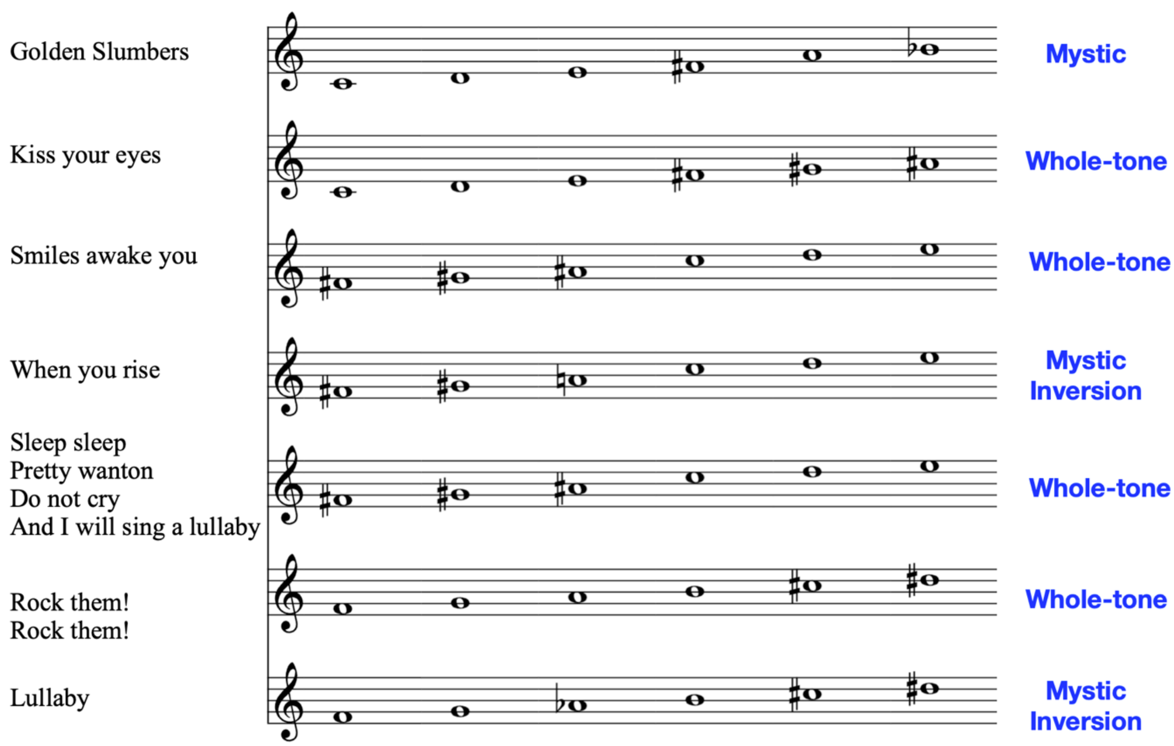

Figure 34. The accompanying chord design in second movement

The third movement used both whole-tone and octatonic scales.[61] Inspired by the Callender article, I used procedures that allow for the seamless shifting between the whole-tone and octatonic scales.[62] In the middle of the third movement, I use a Callender-derived procedure to transform the whole-tone scale into an octatonic scale (Figure 35). Together, these two pitch-class collections create the sound world that I call *Sound of Stars*.

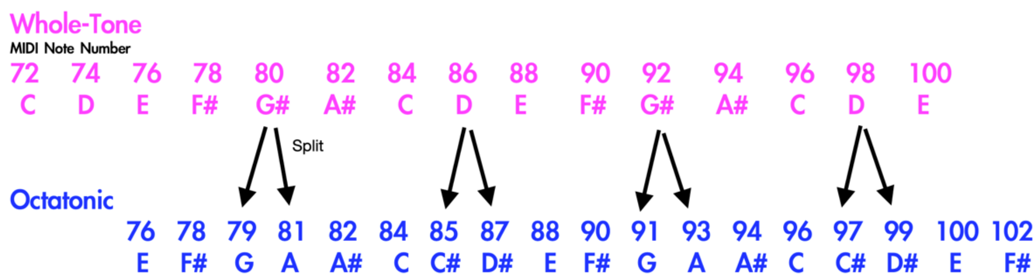

Figure 35. The split transformation from Whole-tone scale to octatonic scale

Data from the Gun Violence Archive database is applied at two places within the third movement. Initially, the information of each gun violence incident in the database is projected on the screen. Subsequently, a continuous low bass drone that contains a steady beat is sounded, each beat accompanied by a statistical representation of each mass shooting that occurred in the United States between 1986 and 2021. While each articulated beat metaphorically represents one mass shooting incident, the number of victims is sonified by the amplitude of the low drone sound itself.

[61] An octatonic scale is an eight-note scale based on alternating whole and half steps. More information about octatonic structures can be found here: https://williamwieland.midcoip.net/theory/scales/octa.htm

[62] In Callendar's article, one can use the *Split* procedure to create more notes and use the *Fuse* procedure to decrease. For example, an E note and splits into Eb and F, while note A and note B can fuse into Bb.

Performance Techniques Employed

There are three essential hand movements used in the performance of *Golden Slumbers*:

1. Rotation of left and right hands to produce the data streams output from the MPU 6050 sensor Accelerometer X-dimension
2. Movement of left and right hands upward and downward to control the data streams output from MPU 6050 sensor Accelerometer Y-dimension
3. Closing and opening of palms to let the quarter-size magnetic disks touch the Hall-Effects Sensor and trigger sound events

For instance, at the beginning, the closing and opening of my palms trigger the sounding of a name of a victim. The rotations of my hands (Accelerometer X-dimension) control where in space a sound is emanating, and the upwards and downwards motions of my hands (Accelerometer Y-dimension) control the amplitudes of the sounds.

The three performance techniques described above do not represent the full array of performative actions used to perform *Golden Slumbers*. At 4:34, for example, my left arm points towards the screen and my open palm causes the start of the video projection of the names and places to be triggered. In addition, this same performative act causes the start of the low bass drone. An image of this moment is shown in Figure 36.

Another example of a performative action that extends beyond the list of the three initially offered can be found at the beginning of the composition. In this instance I begin standing upstage right,[63] with my body position one-quarter left.[64] As the music evolves, I slowly

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[63] "Upstage right" describes a stage location. There are nine common stage positions often referenced that instruct the performers as to how they are to enter and directions to move on the stage. More information can be found here: https://ldryanconlon.com/9-common-stage-directions/

[64] There are eight basic body positions for performers on stage. More detail information can be found here: http://theatreatthefort.weebly.com/body-positions.html

walk diagonally across the stage, arriving downstage left, with the body position oriented three-quarter right. I use this diagonal spatial path on stage as a metaphor articulating a journey through personal trauma.

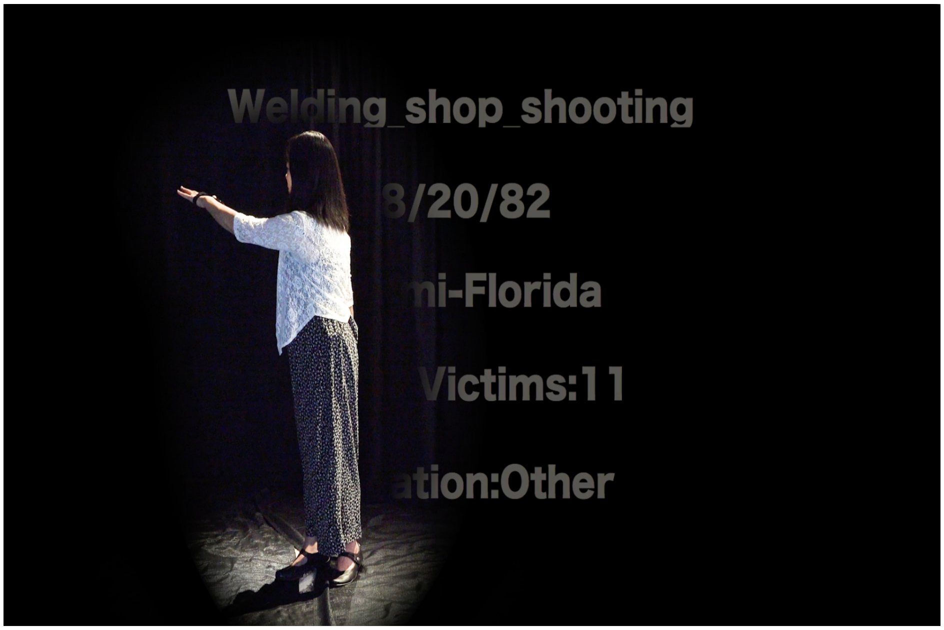

Figure 36. The left-hand palm open to trigger the start of projections at 4:34

Unquestionably, *Golden Slumbers* utilizes theatrical actions to indicate meaning and emotion. During the performance, not facing the audience strives to signify, “I am processing my emotions and my reflection, and you are watching me processing it.” The walking motion on stage introduces the concept of *time passing,* while posing the question, “Are we reaching a solution?” Through movement of walking diagonally across the stage, the trauma repeats itself (theatrically) and parental loss, grief and love for their children is relived. This vicious cycle of violent death by gun violence, loss and grief is enacted on screen with the projection of the next yet undetermined location of mass gun violence, hopefully provoking the audience to contemplate who the next victims may be and whether we as a society have learned anything at all from our horrific history of mass killings.

21C

Storytelling Components

21C is a collaborative work produced with intermedia artist and poet Jefferson Goolsby, who also performed the spoken word component of the piece in the audio/video recording. This composition explores the crisis of the individual in a culture that has become inextricably enmeshed with computer-based technologies and digital sociologies.

Awareness of crisis plays an important role for human beings to survive in this vast universe. During the 19th century, the crisis of the individual was precipitated by one's role and position in a strict and demanding society. In the 20th century, crisis of the individual was provoked by the idea of being alone in a cold universe where God is dead. Now as we leave the first quarter of the 21st century, the crisis of the individual seems to be constructed by and within a realm of a dataverse,[65] where questions of truth and existence constantly confront us.

21C reflects this sense of changing norms over time. All of the interface and performance devices selected for the work represent technologies of different eras that are and were intended to facilitate communications, whether with each other, across society or even with the universe. These technologies also have the potential to simultaneously construct a crisis of the individual predicated on one's position – one's perceived presence or lack of presence – in the world of communications. *21C* tells a story about how the massive dataverse has impacted individuals, ecosystems, and the universe. *21C* conveys an awareness of crisis by creating a sound world to question the existence of the individual. For many people today,

[65] Dataverse is a made up word that combines *data* and *universe* together. *(data + universe = dataverse)* It describes the amount of data we encounter in a daily base as massive as a universe. In 2006, a project called Dataverse was lunched by Gary King and is developed at Harvard's IOSS. More information can be found here: https://dataverse.org/

existing online or not has become a prime and primal driver of self-perception, valuation, and behaviors.

Data-driven Instrument used in *21C*

The data-driven instrument for *21C* is comprised of an iPhone, a computer keyboard, a 19th century telegraph sounder, and custom sound-producing algorithms resident in Kyma. In *21C* the data-driven instrument serves to produce the sonic tapestry around which the textual component is entwined. There are two performers on the stage: one performer recites the poem and the other operates the devices. Throughout this dissertation, the person reciting the poem is referred to as Performer1; the person operating the devices is Performer2.

Three analog audio signals are sent to Kyma that are either control signals or sounds that are heard in the composition, or both. An analog representation of the voice of Performer1 is sent to Kyma via a wireless headset containing a microphone. The telegraph sounder and computer keyboard each has a contact microphone attached to it. When Performer2 taps the telegraph sounder or types on the keyboard, the contact microphone picks up the vibration and sends the audio signal to Kyma as a control signal for further sound manipulation. The iPhone sends data to the computer via OSC transmission protocol using the TouchOSC application.[66, 67] The basic structure of the data-driven instrument is shown in Figure 37.

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[66] OSC (Open Sound Control) is a communication protocol for networking between computers, musical interfaces, and other multimedia devices. OSC transports data via the internet within a local subnet using UDP/IP protocol. UDP (User Datagram Protocol) is an application that can send messages (datagrams) to other hosts on the same IP (Internet Protocol) connection. More information can be found here: https://opensoundcontrol.stanford.edu/

[67] TouchOSC is modular control surface software that runs or the Apple iPhone or iPad and is developed by Hexler LLC. More information can be found here: https://hexler.net/touchosc

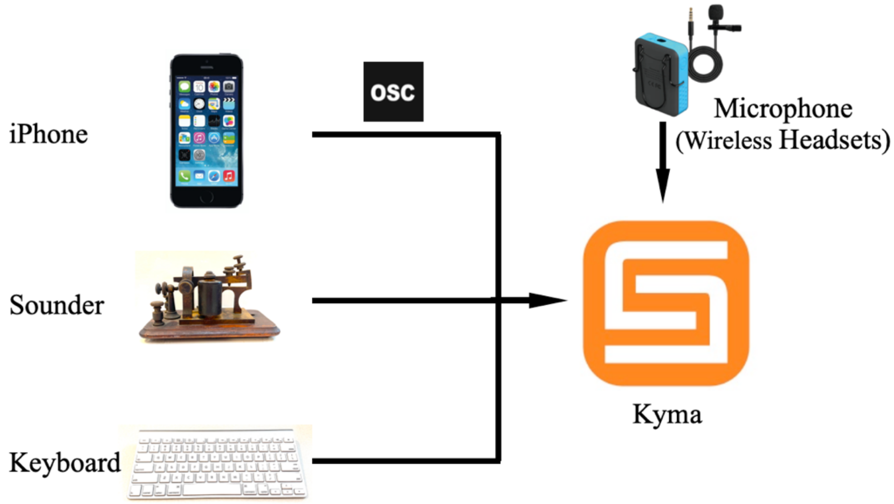

Figure 37. Complete structure of the data-driven instrument for *21C*

Compositional Structure

The form of *21C* is a two-part structure (AB) that parallels the poetic form of the *21C* written text. Section A of the musical form can be understood as being further subdivided into four smaller parts (abcd) that align with evolution of the poem. To bridge the contrasting musical sections A and B, I composed a short transitional passage (Trans) within A section and between A and B sections, as well as a short coda at the end of the work. Figure 38 depicts the formal structure with the paragraphs that follow describing the contents of each section.

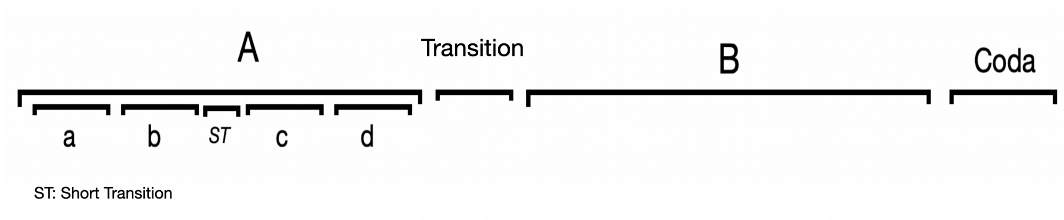

Figure 38. *21C* compositional structure illustration

2:24-3:23 (Section Aa) The composition starts with both performers presenting the clicking motive (part a): Performer1 says the words “click, click, click,” while Performer2 clicks on the surface of an iPhone to trigger the sound of typing a text message on an iPhone.

Both performers walk around the stage aimlessly without intended directions or goals, reflecting the concept of being lost in the dataverse.

3:24-3:50 (Section Ab) The poem starts to address the rapacious mind and insatiable desire. The music is filled with glissando effects between layers of synthesized sound.

3:51-4:15 (Short Transition) This is a short transitional link and contains only one sentence: “I want to be content, but I am only product.”

4:16-4:45 (Section Ac) The textual subject here centers on the relentless and continual surveillance of society’s members. We are aware that cameras located almost everywhere watch us and follow our every action at every moment. Social media giants as well as ordinary business practices have become surveillance-centric to the extent that one author coined the term “surveillance capitalism.”[68] To build this atmospheric pervasiveness of surveillance technology, we can hear many different types of cameras clicking and lenses shuttering as they “watch over” us.

4:46-6:14 (Section Ad) The last part of the text contained within Section A, depicts planetary destruction initiated by the massive dataverse. Using common terms for modern technology, such as pixel, interlacing, and sampling, the crisis (in my story) is not just a phenomenon occurring within individuals, but now extends to the entire planet. Humanity’s greatest fears of working in the digital world, a world with no backups, ends in an extinction event concluding at the end of Section A.

6:15-7:00 (Transition between Section A and B) A short transition that connects Sections A and B uses the transitional text, “I want to be content, but I am only product.”

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[68] Shoshana Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power,* (Public Affairs, 2019).

7:01-9:55 (Section B) The Section B is constructed by cryptic sentences and is overtly text driven. In Section B, which one might understand as an unrelenting crescendo and intensification, Performer1 recites a group of letters, articulating the crisis with a suggestive and symbolic text. For example, we can hear the performer recites the letters "I M N N I O O D." Those letters can be decoded as *I am in an I/O overdose*. Later we hear the letters of Y R I M which can be decoded as *You are, I am*. Every time, immediately after, the group of letters gets recited, female voices in the musical texture are enunciated to decode the enigmatic listing of letters. Embedded in the musical texture is the telegraph sounder that generate a SOS Morse Code distress signal,[69] which is a series of three short taps followed by three long taps followed by three more short taps. The sound of the telegraph tapping and computer keyboard typing also creates an intense musical counterpoint. Towards the end of this section, Performer1's recitation of encrypted letters gradually evolves into desperate SOS calls for help.

9:56-10:10 (Coda) This specially composed ending section ends with one sentence: *You want to be content*. The word "content" can be interpreted as a noun or an adjective. This ambiguity of meaning leaves an opening the audience to have their own interpretation.

Sonic Materials and Data Mapping Strategies

One of the essential sonic elements for *21C* is the recorded audio of the vibration sound of an iPhone. This vibration is rather like a sonic motive metaphorically representing the "SOS" message. Kyma receives this audio, analyzes it in realtime, and then creates a detailed representation of the sound's frequency and amplitude content. This analysis is then used as the

[69] More information about the Morse Code can be found at: https://www.britannica.com/topic/Morse-Code

basis to generate a new sound.[70] I also use Kyma's Time Alignment Utility (TAU) to further manipulate the SOS vibration sound. Figure 39 shows an example of sound design using Kyma’s harmonic spectrum analysis and TAU to manipulate and transform the iPhone SOS vibration sound.

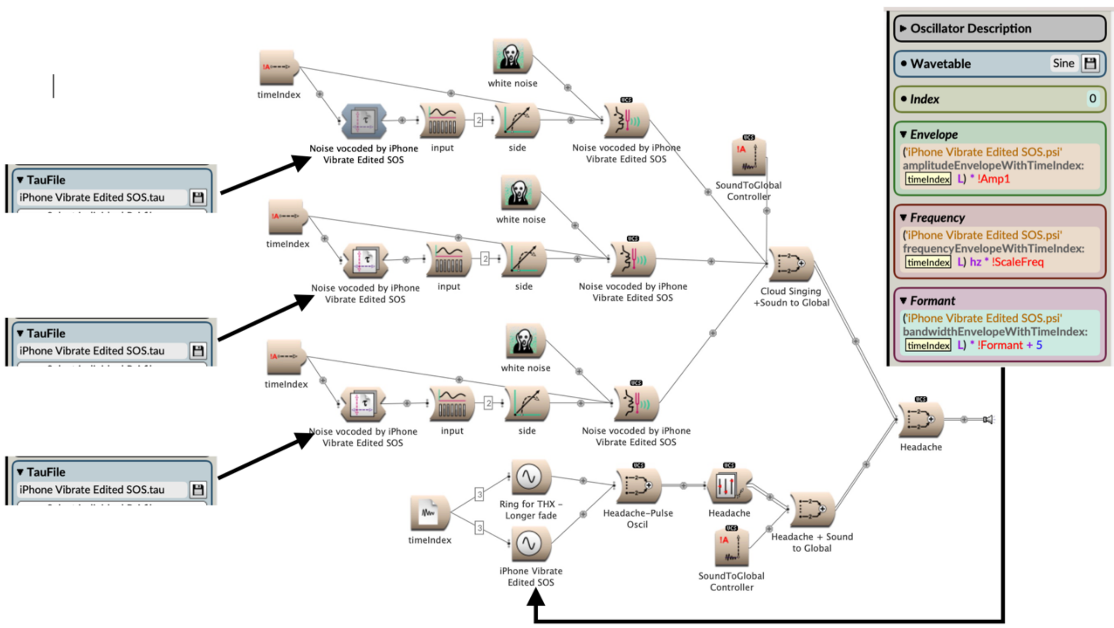

Figure 39. Kyma sound design using iPhone SOS vibration sound

All performance interface devices used in *21C* are intended to mimic acts of various forms of communication. These devices produce clicking sounds when used to communicate. The clicking sound becomes an essential musical motive in *21C*. The different timbers of clicking sounds generated from iPhone, computer keyboard, or telegraph sounder enrich the sound world of this composition.

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[70] Kyma's spectral analysis process analyzes an existing audio recording and produces amplitude and frequency envelopes that may be used to control an arbitrary number of oscillators. Kyma can also execute this same procedure to analog signals input to it.

Additional sounds beyond those produced by the telegraph, keyboard, and iPhone are incorporated into the musical fabric of the composition. During the course of a performance, Performer1's voice is sent to Kyma and recorded into the Pacarana's RAM using the *MemoryWriter* object. Simultaneously Kyma's *SampleCloud* object retrieves the sound data from the Pacarana RAM and applies a granular processing algorithm to it. The granulated audio is sent to the *MultiChannelPan* object to distribute the sound in a surround space. Figure 40 shows the signal path of this one specific Kyma sound.

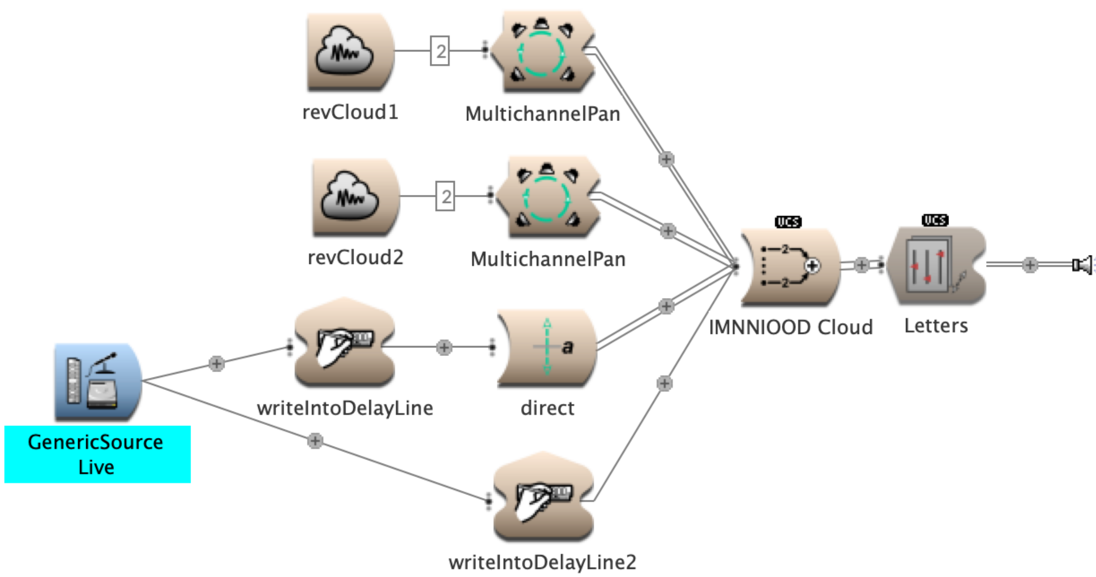


Figure 40. Signal flow of Kyma Sound

Sounds associated with the sending, receiving, and typing of messages on the iPhone were also recorded into Kyma. Data from TouchOSC was mapped to trigger the playback of each individual audio recording. TouchOSC provides a performance interface that I can directly map to each button inside TouchOSC to a sound in Kyma. Figure 41 shows the mapping design between TouchOSC and Kyma.

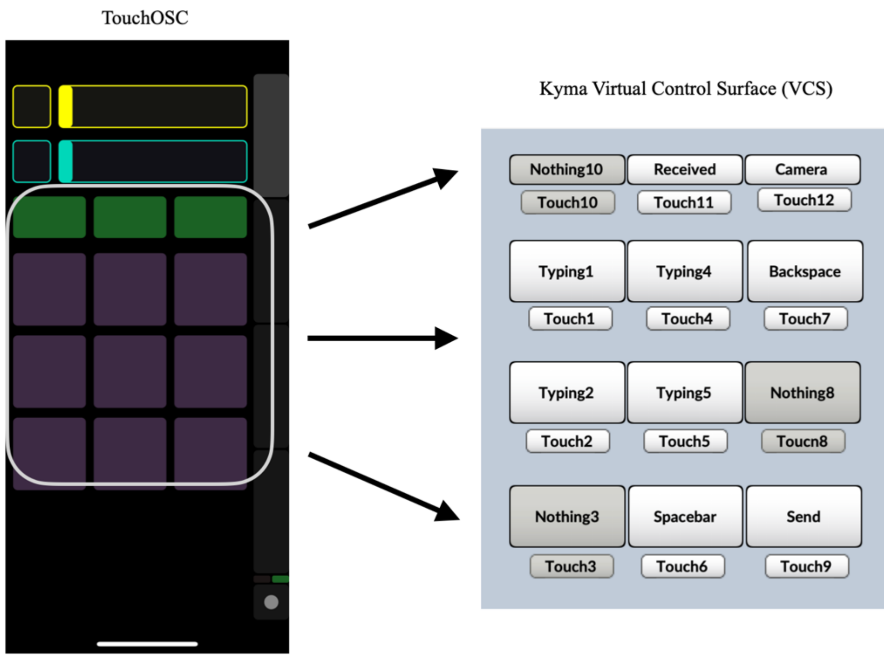


Figure 41. The mapping design **between** TouchOSC and Kyma

Concept of Theatrical Actions Supporting the Larger Story

21C deals with dualities of the conscious and subconscious and the real and unreal worlds, as well as dualities within the music and performance worlds upon which analog world versus digital worlds can be brought to bear. These dualities are most notably articulated by the theatrical interactions of the two performers present on stage. The rationale behind using two performers is to represent dualities within the struggles contained in ourselves and with others across questions of existence.

The dualities of internal and external conflicts can be seen at several junctures in the composition. At the beginning of the composition, Performer2 represents the real world we are in now. Performer2 roams around the stage with her head focused downward. She is constantly typing and sending messages through the phone. On the other side of the stage, Performer1 is reciting the *21C* poem. This represents her subconscious mind. This design of the theatrical action is intended to represent our situational ambiguity. Performer1 might be interpreted as an invisible person who follows and talks to Performer2 while constantly criticizing her behavior and motivation.

Another example of opposing dualities occurs in Section A where sonic manifestations of the real and unreal are juxtaposed. In this instance, the clicking sound of the iPhone represents the real world, while on the other hand, the voice from Performer1 represents a voice coming from an unreal world.

The interaction between the two performers also is conceptualized and designed as a representation of conscious mind versus unconscious mind. Throughout almost the entire performance, Performer2 never looks at Performer1. However, Performer1 is constantly talking to Performer2. Not until the last moments of the composition (video timecode 9:21) does Performer2 finally look up and realize the existence of Performer1.

At 5:39 (video timecode), the music and the theatric design suggest the iPhone has died. Looking for another way to communicate, Performer2 walks to the telegraph sounder and starts to tap the Morse code for SOS as Performer1 begins to recite symbolic letters. Then, Performer2 regresses, disappearing into her own world again, typing letters on the keyboard trying to encrypt the cryptic letters.

Not only is duality represented as the presence of two performers, but the opposing duality is also manifest between *on-stage* (performance) versus *off-stage* (audience). This manifestation of the opposing duality can be seen at one climactic moment in Section B. At 8:30 (video timecode), instead of questioning Performer2 on the stage, Performer1 turns to the audience, looks at them and asks, “Are you OK?”. This theatrical action breaks the invisible wall between the audience and the performers making the audience realize that they too are part of the action and situation themselves.

CHAPTER IV

SUMMARY

This dissertation is comprised of seven compositions composed over the last four years. Employing data-driven instruments, these compositions are real-time interactive multichannel works created using Cycling '74's Max and Symbolic Sound's Kyma as the primary sound creation environment. These compositions combine storytelling with data-driven instruments in what I call a storytelling-data-driven instrumentation paradigm. These storied compositions are by their very nature performative. In these works, I do not simply perform recordings of a text read by a narrator. Rather, I borrow snippets of pre-existing text and poetry – some historical, some more recent – while also incorporating personal stories and events into my works. With regards to instrumentation, I have not only repurposed existing interfaces, but also created wholly new ones. Interfaces used include Playstation 2 Gametrak, Wacom Intuos tablet, Leap Motion controller, Wii Remote, iPhone, telegraph sounder, ROLI Seaboard controller, custom-made devices, and standard *qwerty* keyboard.

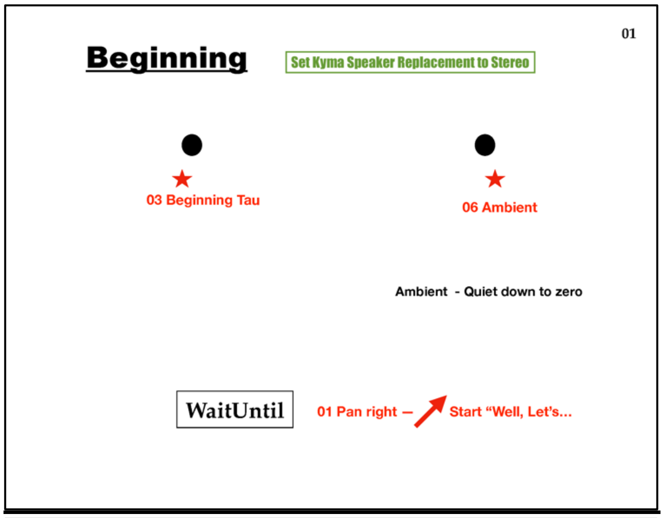
These seven compositions contain seven different stories with diverse themes, from the meaning of family to belonging to human nature and the cycles of the natural world to current societal issues, including gun violence to the potential absurdities of new technologies. All themes focus on my central interest: the human experience. While most composers and musicians choose traditional instruments to express their ideas, I apply data-driven instruments to storytelling. In doing so, I can integrate performance design as part of my compositional toolbox, which, in turn, enhances the power of the storytelling itself. For example, in *Summoner*, all performative movements are based on turning an intangible sound into an imaginary physical object. Further, with the current state of technological development, data-driven instruments carry two unique features, modularity and mutability, which allow us to create unlimited instrumental variations with tremendous musical flexibility as well as the endless potential and ability to transform and contextualize sound material in much more radical and multidimensional ways than with many traditional instruments.

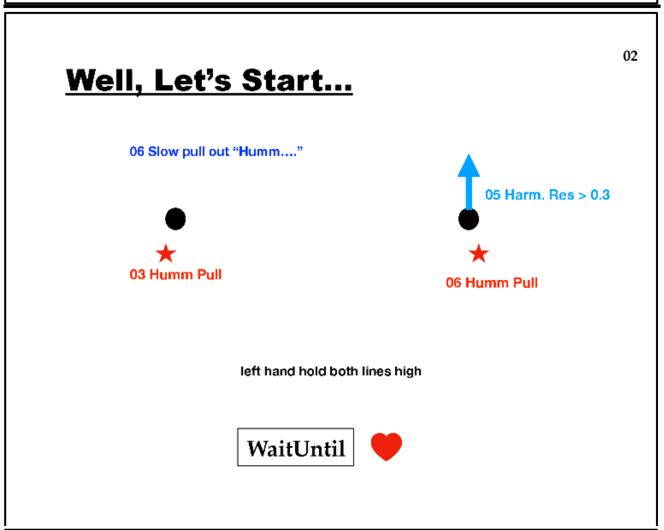
Creating compositions for data-driven instruments can be challenging. It demands one to take on the roles of inventor, composer, and performer. I was constantly doing battle with how to balance my role across these three distinct yet overlapping roles.

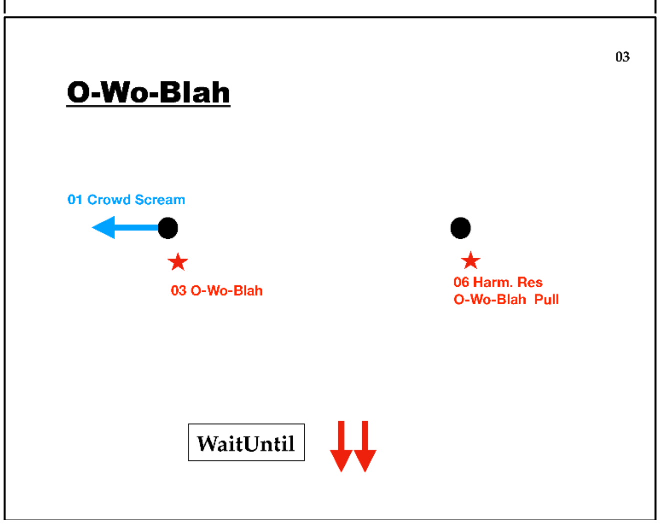
Through the work in this dissertation and through the performance of these compositions, I present the potential of the storytelling-data-driven instrumentation paradigm. Though technologically, intellectually, and conceptually demanding, I believe this approach expands our capacity as composers and performers to communicate human experience and to powerfully reach and impact audiences. Perhaps through data-driven instruments our human experience can be shared in new ways so that individuals, families, and communities can more deeply explore the human experience and our relationships with one another.

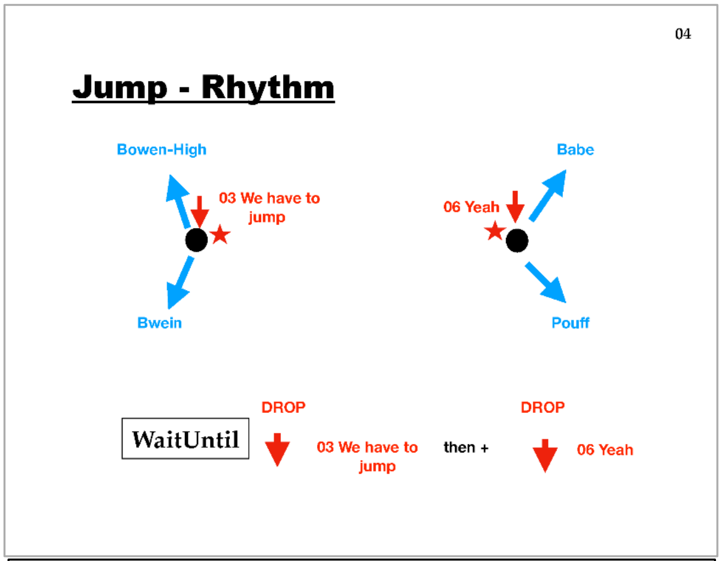
APPENDICES

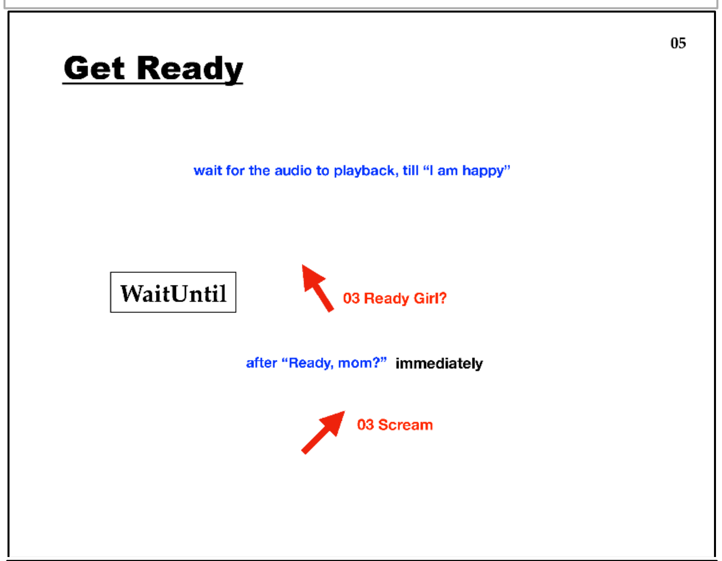
A. SCORE FOR *GIANT DIPPER*

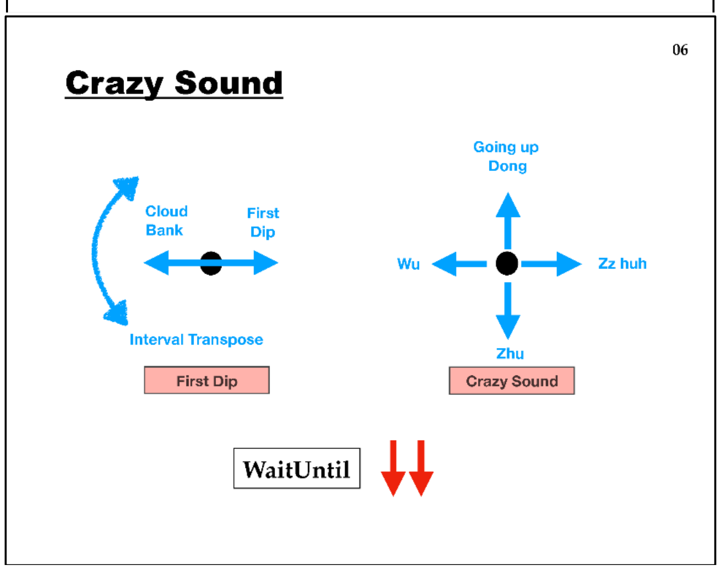


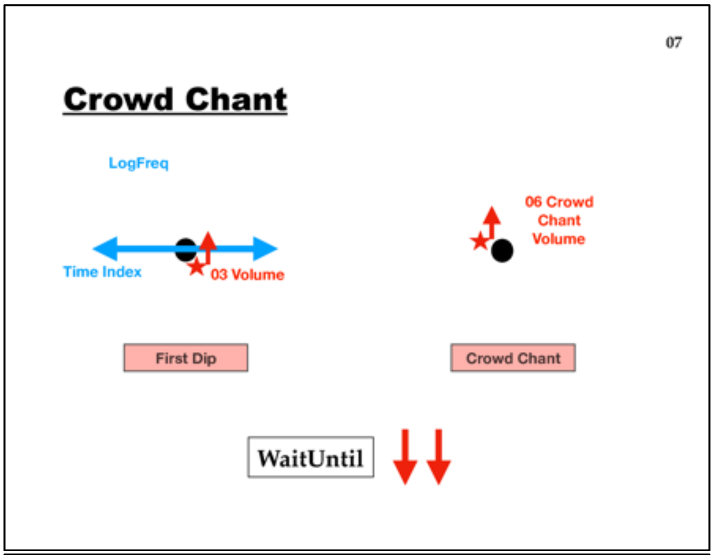


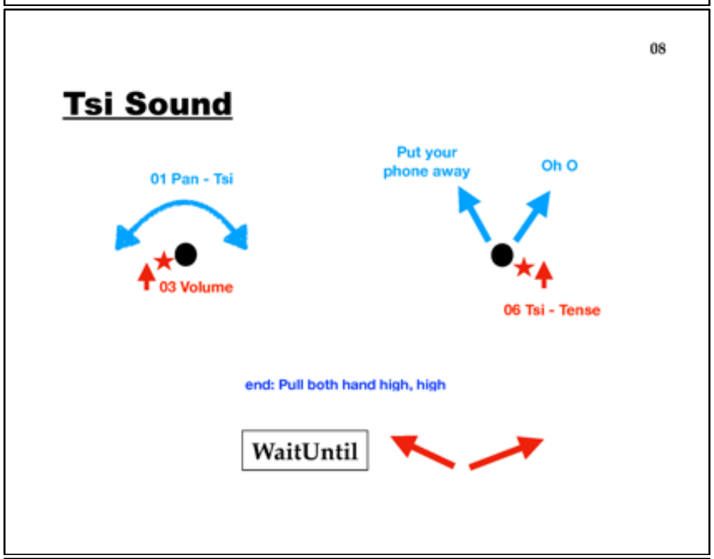


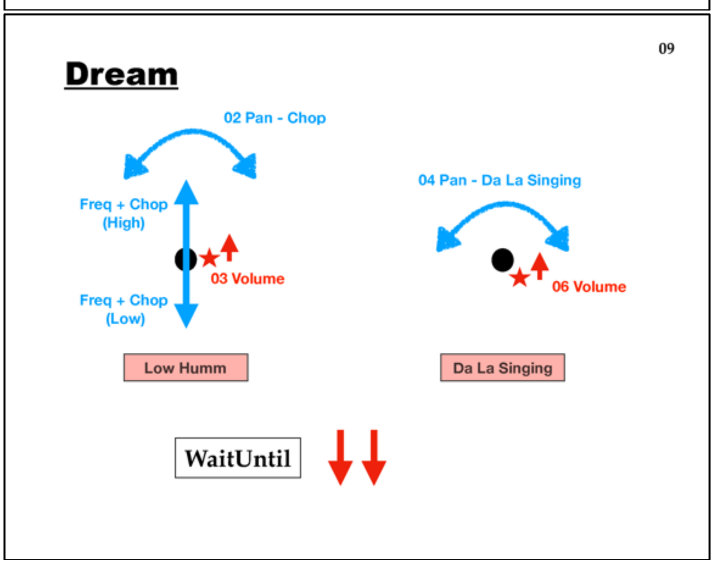

04
Jump - Rhythm
Bowen-High
03 We have to jump
Bwein
Babe
06 Yeah
Pouff
WaitUntil
DROP
03 We have to jump
then +
DROP
06 Yeah

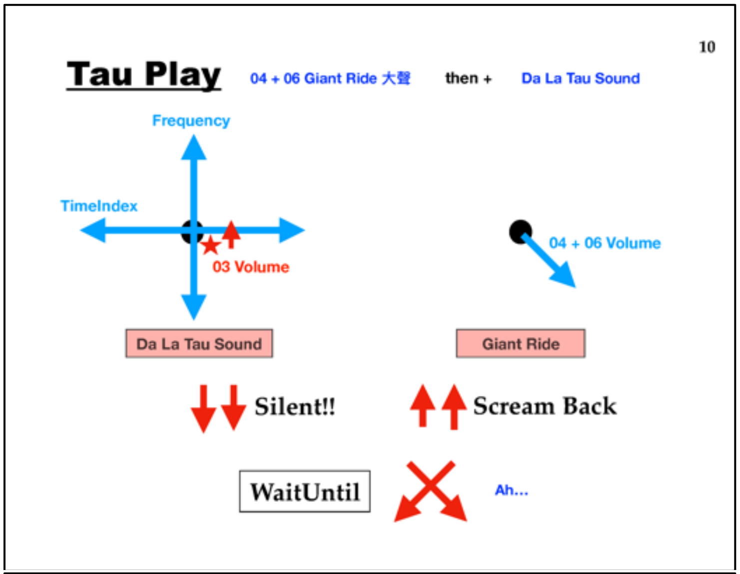

05
Get Ready
wait for the audio to playback, till "I am happy"
WaitUntil
03 Ready Girl?
after "Ready, mom?" immediately
03 Scream


06
Crazy Sound
Cloud Bank
First Dip
Interval Transpose
First Dip
Going up Dong
Wu
Zz huh
Zhu
Crazy Sound
WaitUntil

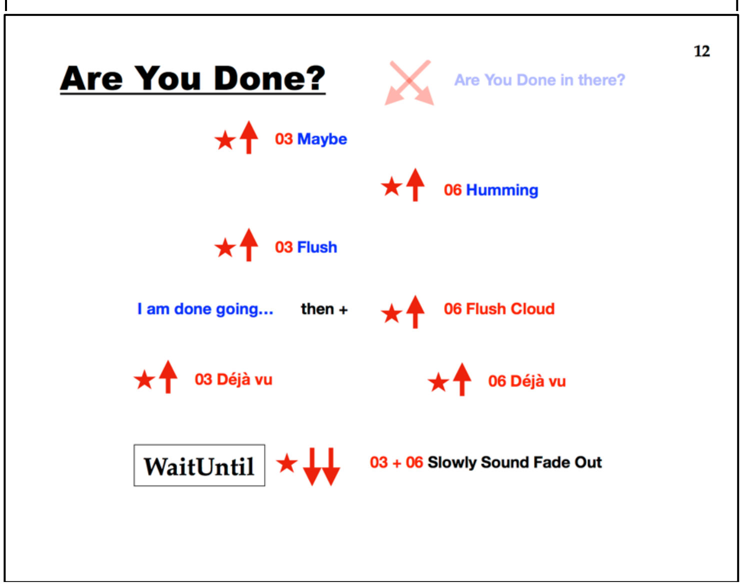

07
Crowd Chant
LogFreq
Time Index
03 Volume
06 Crowd Chant Volume
First Dip
Crowd Chant
WaitUntil


08
Tsi Sound
01 Pan - Tsi
03 Volume
Put your phone away
Oh O
06 Tsi - Tense
end: Pull both hand high, high
WaitUntil


09
Dream
02 Pan - Chop
Freq + Chop (High)
03 Volume
Freq + Chop (Low)
04 Pan - Da La Singing
06 Volume
Low Humm
Da La Singing
WaitUntil


10
Tau Play
04 + 06 Giant Ride 大聲
then +
Da La Tau Sound
Frequency
TimeIndex
03 Volume
04 + 06 Volume
Da La Tau Sound
Giant Ride
Silent!!
Scream Back
WaitUntil
Ah…


11
End of Ride
Ah…
06 Yeah! First Place
03 Na Na Ni….
06 Congratulations!
03 Pull
===
06 Pull
(Congratulations!)
The Happiest Show…
03 Pull
===
06 Pull
(World!)
Are You Done in there?


12
Are You Done?
Are You Done in there?
03 Maybe
06 Humming
03 Flush
I am done going…
then +
06 Flush Cloud
03 Déjà vu
06 Déjà vu
WaitUntil
03 + 06 Slowly Sound Fade Out

B. STORY FOR *THE LIGHTED WINDOWS*

Trouble, trouble, trouble; when will all these trouble ends Jayling had been in trouble three days in a row. Now she found herself sent to bed early, for nothing really, staring up at the ceiling. She felt like she'd been born into the wrong family, into the wrong world.

Jayling slid out of bed, lifted the screen out of her bedroom window, and lowered herself to the ground outside. She figured she'd be back in bed before her parents even knew she was gone. She walked slowly down the sidewalk, streetlight to streetlight, quiet as a shadow. No one else was out, and she felt like she were the only person in the world.

She paused now and then to look at the lighted windows of the houses she passed, with their summer windows opened but the shades and blinds pulled down.

"**All of these houses look so inviting. Like they each have a story. Wouldn't it be nice to just see what it's like inside?**"

"**There's so much I can't see just standing on this sidewalk! I wonder if anyone would mind if I just went in?**"

She went up a walkway to the front door of a house and paused. Then she gently turned the handle, quietly opened the door, and stepped inside.

A family was in their living room watching a show on TV. No one even noticed she'd come in. She walked to where they sat, and still no one looked up. "She's gonna get it," a girl lying on the floor said, and it gave Jayling a start. But then she realized the girl was talking about someone on TV show.

"**How strange.**" "**Hello?**"

There was a boy sitting next to a man on a couch who she thought must be his father, and someone who seemed to be their mother was dozing in a big, soft chair with her feet up. "She'll find a way out," the man said flatly.

"**They don't see me.**" "**Am I a ghost?**"

She patted her body up and down. She seemed to be as solid as ever.

"**Hello?**"

"There," said the father. "She got out."

"**How very strange. They can't even see me.**"

She walked around the house, looking into different rooms.

“**Pretty normal house. Not all that exciting, really.**”

She went back to the front door and walked out to the sidewalk, turning to look back at the house. Then she continued down the sidewalk.

She came to another house, walked to its front door, turned the handle, and stepped inside. She almost stepped on a girl about her age who was lying on the floor just inside. She was playing a game on a small device, flicking her fingers in different directions. She saw a lady sitting on a couch nearby, intently watching a laptop screen and typing something now and then. She leaned over to see that she was scrolling through pictures of dresses.

“**A shopping mall! Right on her lap.**”

In another room she found a man watching TV with the sound turned down, clicking through stations. His eyes looked far away.

“**What’s he thinking?**”

She walked back into the front room where the woman and girl were looking at their screens.

“**I don’t think they’d see me if I was a ghost or not.**”

Jayling went back outside and started down the sidewalk again. She came to another house, where she heard loud voices, almost shouting. She walked up to the door and paused with her hand on the knob.

“**It should be OK if they can’t see me.**”

She went inside. A man and a woman were talking angrily at each other. The woman was sitting up on a bed while the man walked in and out of the room. They sounded so angry, but somehow they didn’t seem all that upset about it, like they were used to talking to each other like that.

“**How terrible to argue all the time. Or to live with someone you don’t like.**”

She went back out and walked for a long while, thinking about everything she’d seen. Sometimes she patted her arms and legs to make sure they were solid.

“**I *think* I’m real.**”

It felt very late, and she knew she should get back to her bed.

“**I’ll look inside just one more house.**”

She stopped in front of a house with a few lighted windows and realized she’d walked all the way back home. She stood out front and could hear voices from inside.

“**It looks so different.**”

She went slowly up the walkway to the front door, quietly turned the handle and went inside. Her mom and dad were standing in the kitchen, very close to each other, talking intently about their work. Her sister was sitting at the dining table making something out of paper.

“**Hello?**” Nobody noticed.

“**Hello?**” Suddenly she felt a panic.

“**I’m a ghost! They can’t see me!**” “**Mom! Dad!**”

She grabbed hold and pulled hard on her dad’s arm.

“**Dad!**”

Her parents stopped and looked at her, and her sister looked up from her project.

“We’re talking,” her mom said.

Jayling looked around at everything in the room. Everything looked so different. She looked up at her mom and dad.

“**Am I here? Because I just wanna be right here.**”

“Isn’t she supposed to be in bed?” her sister asked. But instead of feeling mad, Jayling felt kind of happy to hear her sister’s voice.

“**Thanks a lot.**”

Her sister smiled, then went back to working on her project.
Her mom and dad looked at her, waiting.

“**Are we a good family?**”

Her dad picked her up and carried her back to her room, tucked her in bed and kissed her goodnight, and put his hand on the light.

“**Can you leave the light on? Just for a little while?**”

He smiled and pulled the door closed. She lay in bed, not sleepy, and wondered what her window might look like to someone walking down the street.

C. POEM FOR *21C*

Click click click

I'm lost, in the dataverse
My spirit, just a constellation of clicks
I've got to get my head… out of the cloud… s

My rapacious mind
Tracked, counted, timed
By sexless machines
Copulating with my data
In insatiable algo-rhythms

I want to be content
By I'm only product

And the slo-mo apocalypse I live in
Unfolding every nanosecond
Right outside my door
Photoed and videoed
By a billion cameras

Smothering the earth in pixels
Deinterlacing the plants.
Downsampling the oceans.
Dissolving the spectacular traditions of snow and ice
And all of life
The documentation of an extinction event in countless zettabytes
All of 2k in 4K
No backups

Click click click

I want to be content
By I'm only product.

I M N N I O O D	*I am in an i/o o.d. (overdose).*
Y R U N I N I O	*Why are you and I in an i/o?*
I M N N I O O D	*I am in an i/o o.d. (overdose)*
Y R U N I N I O	*Why are you and I in an i/o?*
Y R U N I A F N I O	*Why are you and I a f'ing i/o?*
U R I M	You are. I am.
I M N N I O O D	*I am in an i/o o.d.*
M I O K	*Am I OK?*
R U	*Are you?*

C I C I	*See I… See I…*
I M O O	*I am… oh… oh…*
S O S O	*Es Oh… Es Oh…*
S O	*Es Oh*
S O	*Es Oh*
S O	*Es Oh*
S	*Es*
O	*Oh*
S	*Es*
S	*Es*
O	*Oh*
S	*Es*

You want to be content

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