LANIAKEA FOR PIPA, HORN IN F, DOUBLE BASS, PIANO, AND LAPTOP: SOME CONSIDERATIONS AND ANALYSIS

by

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***LANIAKEA* FOR PIPA, HORN IN F, DOUBLE BASS, PIANO, AND LAPTOP: SOME CONSIDERATIONS AND ANALYSIS**

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Laniakea, for pipa, horn in f, double bass, piano, and laptop is a 22 minute original musical composition. The present paper will explore its key concerns, which includes composing within a complex set of logistics, writing for an unusual ensemble, and programming computer software for the purpose of real-time performance. This paper will also provide an aesthetic context for the work by exploring its influences and how they relate to the formal structure. It will then engage in an analysis of the rhythm and pitch derivation, and finally, explore the relationship between the acoustic ensemble and electronics.

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Acknowledgements

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1.0 Introduction:

Laniakea is an original composition for pipa, horn in f, double bass, piano and electronics written between 2014 and 2015. It is the largest and most complex composition of mine to date, in terms of the notation, orchestration, programming, and coordination involved. This piece has served as a stepping-stone to accomplish many of my long-term goals as a musician, collaborator, and composer.

Like many of my compositions, the title for this piece came after I finished composing for this unusual ensemble. I wanted to choose a name that wasn't easily recognizable but still served as a proper descriptive label. *Laniakea* is the name of a recently discovered galaxy supercluster that is the home to our galaxy, the Milky Way. This supercluster encompasses over 100,000 galaxies and is stretched out over 520 million light years. The Milky Way is located on the furthest reaches of this structure, close to a vast empty region of space called the Local Void. We are moving along a cosmic flow, the paths that galaxies migrate along, towards an unknown source known as The Great Attractor. Due to general relativity, our concept of the shape of such a large structure is distorted as spacetime bends through gravitational lensing at great distances. To this day, scientists have struggled to come up with a definition as to where a supercluster ends and begins. The name *Laniakea* means "Immeasurable Heaven" in Hawaiian, a fitting name for the vast size of this cluster.

In no way do I intend for this composition to be programmatic. Instead, I see some conceptual comparisons between my work and the *Laniakea Supercluster*. The tempo of this composition is constantly in flux and is never the same from one performance to the next. The randomized electronic sounds at the beginning and the ending of the piece are always changing without ever repeating. Ambient textures and drones connect smaller sections from one to the next as a variety of different movements are sewn together into a larger continuous piece of music. I see a similarity to the concept of a large body of galaxies drifting along a cosmic flow to an unknown destination.

This composition is a response to several compositions that I had written in previous years. *Breakfast of Champions* for solo piano, *Tin Foil Hat Revelations* for saxophone quartet, *The Owls Are Not What They Seem* for string quartet, and *Hive Collapse* for brass quintet all have a common compositional aesthetic, where I explore the concept of arranging short instrumental juxtapositions that range from spastic improvisatory gestures to moments of stasis. Each of these compositions contains a flow of one contrasting idea after another, however each of these ideas were written out of order, starting with the pitch material first, and then orchestrated later in the writing process. I approached *Laniakea* differently by starting first with the many logistics required to perform the composition. The limitations regarding the use of technology, as well as the abilities of the performers committed to performing this work, were a greater influence to the music than my original approach of starting with pitches and rhythms.

Guided by the complex logistics, I approached the form in a more expansive way. I still use juxtapositions in this work and at first it may seem like several pieces in one, but the ideas are much longer than my previous works, and the transitions are intentionally smoother. I purposefully took many risks in this process with the hope of challenging myself as a composer to develop different methods of generating music in the future. Before considering a traditional pitch and rhythm based analysis of this piece, it is important that I discuss the logistical background.

1.1 Genesis of the Composition: Logistics of Real-Time Electronic Music

The genesis for *Laniakea* began with my desire to work with electronics in real-time. As an avid performer, I had become bored with the limitations of instrument and fixed media. Whether it is by following a click track or by adjusting to graphic audio cues provided in a score, this style of integrating fixed electronic music with acoustic instruments requires musicians to strictly follow a pre-recorded audio track. Each performance contains a certain level of predictability that may inhibit some performers. The performer must always adjust to the track, however the track can never adjust to the performer. If the electronic sounds in a composition were to be performed by a human in real-time, then these obstacles would no longer be a concern. By choosing to integrate performable electronics in real-time within a chamber ensemble of acoustic instruments, all performers have equal influence to the slight elasticity of tempo associated with traditional performance.

Another benefit to using performable electronics in real-time is that it opens up the possibility for electronic compositions to be considered pieces of repertoire in the concert music tradition. A notation could be created for a virtual instrument no different than which a percussionist would use to work with foreign instruments. In order for this to be a possibility within *Laniakea*, the electronics should be performed from a custom-built software-based application capable of being installed onto a computer with the appropriate specifications. There are several ways to accomplish this; however, I primarily use Max/MSP, a visual programming language for music and multimedia. With Max/MSP, I am able to customize an application so that performers can use their own laptops.

I have chosen to write music that is idiomatic for a performable computer and could never be replicated with instrument and fixed media. For me, this means that the composition must have no regular pulsation, no conductor, and no need for a click track. This is the primary motivation behind the flexibility in tempo in *Laniakea.* In no way am I claiming to be the first composer to attempt this; instead I wish to contribute to electronic music by pushing it towards greater versatility.

Several years of work are needed for a Max/MSP user to develop the virtual tools they need for personalized intuitive performance of electronic music. In addition, the computers themselves pose several problems, including the overuse of the CPU (Central Processing Unit) or RAM (Random Access Memory). It can be difficult to predict how much CPU will be used in the long run while initially sketching out a composition. Many composers avoid the use of computers for this reason, opting for the more traditional use of instrument and fixed media based because of its reliability. In an effort to make the performance aspect run as smoothly as possible, I used Max/MSP for specific functions such as algorithmic sequencing and MIDI communication between computer, interfaces, and additional software.

To avoid a possible setback involving live processing I employed the use of another program, Ableton Live, a popular software music sequencer and digital workstation that is designed to be an instrument for live performance as well as a tool for recording, arranging, mixing, and mastering. It communicates fluidly with Max/MSP through inter-application MIDI. A customized template from Ableton Live can be exported to a performer's computer, and it works flawlessly with the Max/MSP patch created for this composition. All the sample playback and processing abilities available in Ableton Live can be reproduced in Max/MSP; however, the electronic sounds required for *Laniakea* could be easily performed on Ableton Live with efficient CPU or Ram usage.

1.2 Choice of Instrumentation

I decided that it was important to have the premiere of *Laniakea* performed by musicians who I know personally. Like the music of Duke Ellington, the music is catered to my colleague's strengths, interests, and personalities. While some of these details were created collaboratively, I still have the last word when it comes to creative control. In no way do I see this method as a sacrifice of my artistic intent; instead I perceive it as a way to maximize the potential of the performance. I was capable of making minor adjustments in the composition based on the results of these rehearsals.

To some extent I see writing for an unusual combination as a rebellion against the current trend of standardized chamber groups, such as the string quartet, brass quintet, Pierrot ensemble, etc. I am not opposed to writing for those types of groups; I just see it as essential for me to also write for non-traditional instrumental combinations with unique orchestrational issues.

My first consideration was the overall balance of the sound of these instruments. The laptop had to be amplified; the pipa also had to be amplified, as the sound could easily be drowned out by the loud horn and the dense electronic textures. Based on the already present need to amplify two of the instruments, I felt it necessary to amplify the rest of the ensemble as well and provide live sound mixing so that the acoustic instruments had a proper dynamic balance with the electronics.

Another consideration regarding the use of the pipa and the electronics are the unfamiliar sounds produced by these instruments in a concert music setting. The pipa is traditionally from China and is rarely used in modern chamber ensembles, and the electronics are capable of producing almost any sound imaginable. This was the motivation behind the use of preparations in the piano, producing acoustic sounds that could be interpreted as modulated audio samples, thus emulating the electronic sounds. By placing Blue-Tack (art gum) on the octave node of some of the piano strings, the fundamental is slightly flattened and the timbre is distorted; the resulting sound is a detuned minor 9^{th}.

To alter the sound of the horn, the sound is distorted, as if altered electronically, by playing a full stop into a thin sheet of aluminum. The double bass does not use any alterations in timbre through the use of preparations, but instead through the use of extended techniques, such as crunching the hairs of the bow against the back of the bass.

All of these considerations regarding electronics, instrumentation, specific performers, rehearsing, amplification, and the alteration of the acoustic instruments were heavy influences in the compositional process of *Laniakea*. Every note, rhythm, gesture, section, and sound written into the score was placed after first observing the many logistical obstacles present in this complex situation.

2.0 Digital Interface:

The electronics have been designed to send and receive information via MIDI between a computer and two separate MIDI controllers. I chose two relatively common, portable, lightweight, and somewhat inexpensive MIDI controllers for this piece: the Novation Launchpad and the Korg NanoKONTROL. Both of these devices have been designed to automatically map to various commercially based music software. For the purpose of this composition, their commercial capabilities have been bypassed and all functions have been customized.

The Launchpad, which has a 64-button grid arranged 8-by-8, is used for triggering musical events both on and off. Similar tasks could be achieved by using standard MIDI keyboards; however the Launchpad has been chosen for this piece for several reasons. Unlike a MIDI keyboard, the Launchpad has LEDs installed under each button. When a button is pushed, the light turns on to inform the performer that the musical event is taking place. When the button is pushed a second time, the light turns off and the musical event ends. Also, with most MIDI keyboards, a key has to be held down for a musical event to occur. With the Launchpad, the performer can press the button and is free to take care of other tasks, as their hands are free.

For the purpose of performability, I have designed my own notation for this device. Instead of treating it like a single grid arranged 8-by-8, I decided to divide the buttons into four different groups of 4-by-4; I labeled each of these new groups as quadrants. In my opinion, it is easier to see these 4 different groups and locate specific buttons in these smaller groups of 16 buttons. Each of these quadrants, which are labeled 1 to 4, is used for different groups of sounds in sections of the piece (See figure 1). Each quadrant is then broken down into 4 rows, labeled alphabetically from A to D, and 4 columns, labeled numerically from 1 to 4 (See figure 2). This system of grouping is easy to master by other performers than myself.

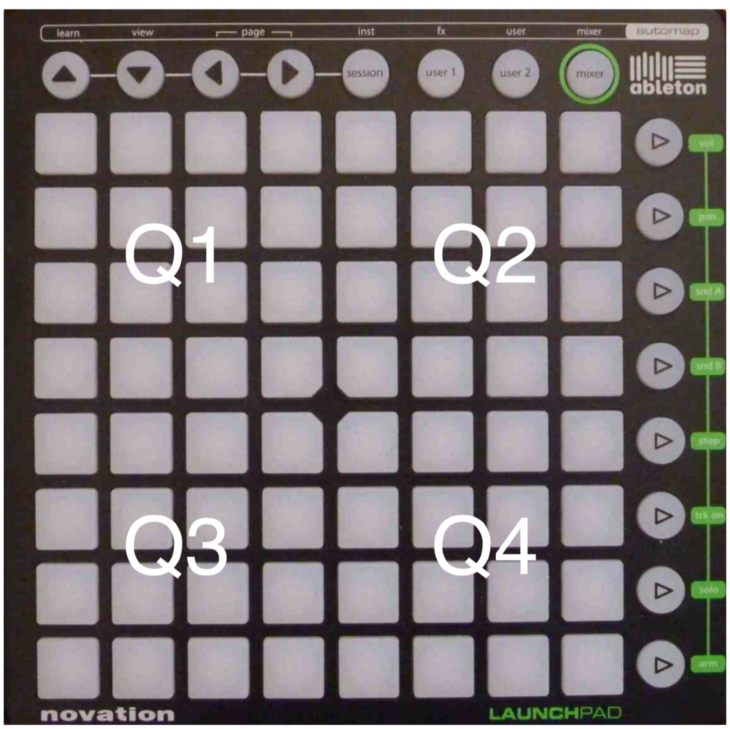


Figure 1: Image of Novation Launchpad with labeled quadrants

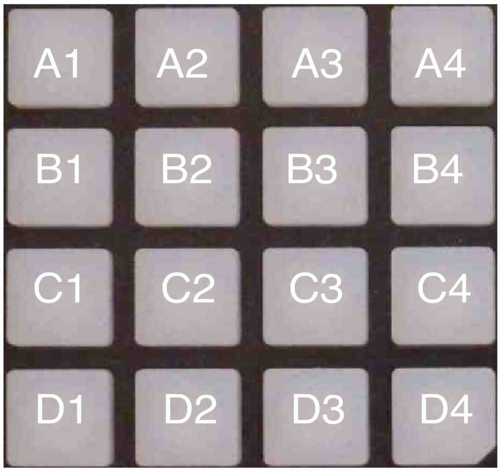


Figure 2: Image of buttons labeled within a quadrant

Unlike many MIDI keyboards, the Launchpad is unable to sense velocity. Fortunately, the musical events that are triggered in *Laniakea* do not require velocity upon triggering. All volume and modulations are controlled by the Korg NANOKONTROL, a small MIDI device that has 9 different channels, each with a fader, a knob, and 2 buttons (See figure 3). Each channel has been designated to a different musical event that has been coordinated with a button, or several buttons, on the Launchpad. The faders control the volume of each sound and the dials control a special feature, effect, or modulation within some of the sounds.

Figure 3: Image of Korg NanoKONTROL

2.1 Max/MSP: Programming and Sequencing

Max/MSP is capable of manipulating audio in real-time with a vast amount of customizable possibilities, and in *Laniakea* serves it three different functions. First, it sends and receives information from the two different MIDI interfaces. Secondly, it sends information to Ableton Live. Lastly, it serves as an algorithmic sequencer that controls the generative musical events that are heard in both the introduction and the ending of the piece.

In the patch I customized for *Laniakea,* Max/MSP is able to receive and interpret MIDI data from both the Launchpad and the NanoKONTROL. The Launchpad is capable of receiving MIDI data from Max/MSP; while this device produces no sound, the data it receives can be used to turn LEDs on and off, as well as alter the color of each LED. When a button is pressed on the Launchpad, it sends a MIDI number to Max/MSP, which sends it to Ableton for the purpose of turning a musical event on or off. Max/MSP also sends data back to the Launchpad to show the performer that the corresponding musical event is either on or off. This way, it is possible for a performer to work exclusively with the MIDI devices without having to look at the computer screen, which increases the performability of the virtual instrument. Unlike the Launchpad, the NanoKONTROL does not receive MIDI; instead, as the performer moves a fader or a knob, the NanoKONTROL sends MIDI information from 0 to 127 through a designated MIDI channel. Max/MSP receives this information and sends it directly to Ableton, where the modulation and synthesis of electronic sounds are produced.

The most complex part of this Max/MSP patch is the algorithm I created for the introduction and ending of the piece. When this musical event starts via the Launchpad, the first of three different metronomes is turned on. In Max/MSP, the “metro” object functions as a metronome sending out a single signal called a “bang” at a specified interval based on milliseconds. “Metronome 1” is currently set to 1000 milliseconds, which means that it will send out a bang once a second (See figure 4).

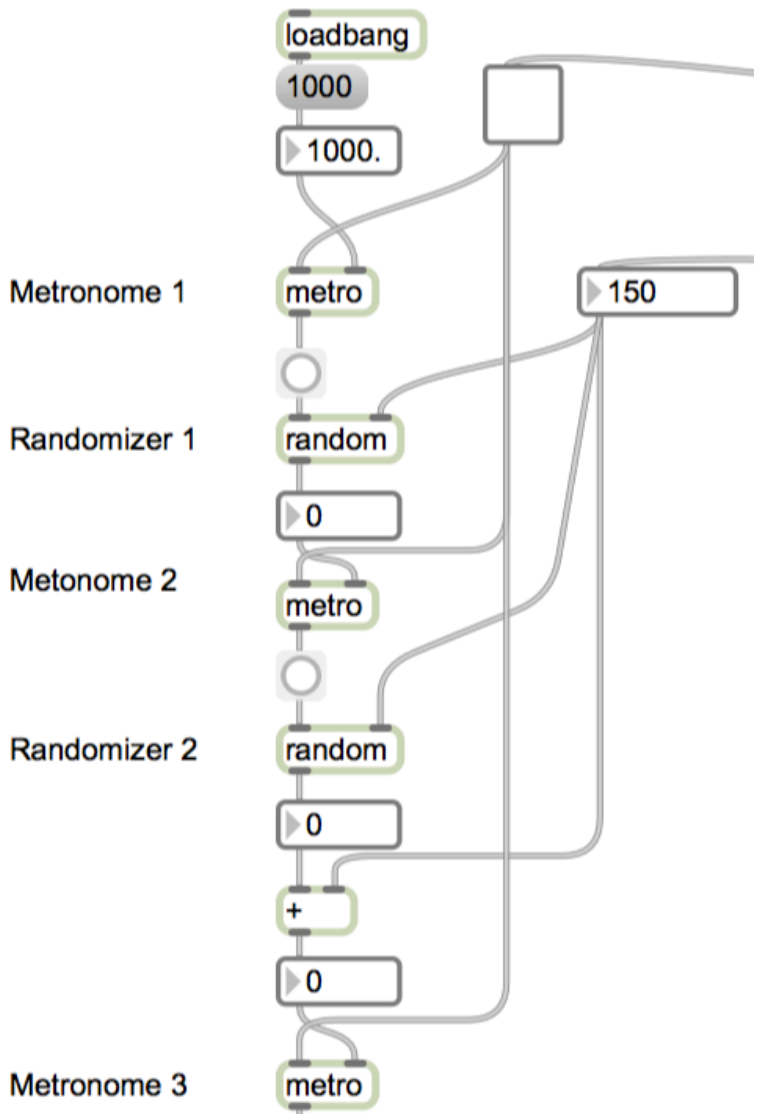


Figure 4: Max/MSP Algorithmic Metronome

The bang is then sent to the next object called “random.” The first of the two randomizers is currently set to 150, which means that every time it receives a bang, it will send out a number between 0 and 149 (a total of 150 integers) to the second metronome. The number it receives from the first randomizer is interpreted as the rate in milliseconds that it will send out a bang. Since the number is constantly in flux between 0 and 149, the speed of this metronome is constantly changing. The number set for the randomizer can be altered in real-time via the knob on channel 1 of the Korg NanoKONTROL. At its minimum, the random set of numbers could be 25 (between 0 and 24) and the maximum is 1000 (between 0 and 999). This interactive variety alters how the range of possible tempos for the metronome is constantly changing.

The bang from the second metronome is sent out to the second randomizer, which is also set to the same integer as the first randomizer (between 25 and 1000). This random number is then added to the same number that is being sent to the two different randomizers. The sum of these numbers is then sent out to the third and final metronome. Like the second metronome, the speed at which it sends out a bang is constantly in flux. This last bang from the series of randomized metronome clicks is somewhat unpredictable. The number that is being controlled by the dial on the NanoKONTROL is capable of increasing or decreasing the possibility of a bang being sent, but the outcome is still randomized, as if the machine is improvising and performing at an irregular rhythm without a traditional metric pulsation.

The bang from this final metronome is sent to a different sub-patch where the signal is split into 5 different destinations. The information is randomized in different ways and sent as MIDI data out of Max/MSP and into Ableton, where it plays samples and modulates the sounds in a variety of methods. The first signal is designated for the samples themselves. Each of the 33 samples varies in size from several milliseconds to two seconds long. The source audio for these samples is of various recordings of drops of water. Each sample is designated to a different MIDI note that will play when sent from the sub-patch in Max/MSP, which is randomized, so it is unpredictable which sample will play. The next destination for the signal in the sub-patch is designated for velocity, randomized between 35 (relatively soft) and 127 (as loud as possible). The third destination is for randomized stereo panning between left and right (See figure 5).

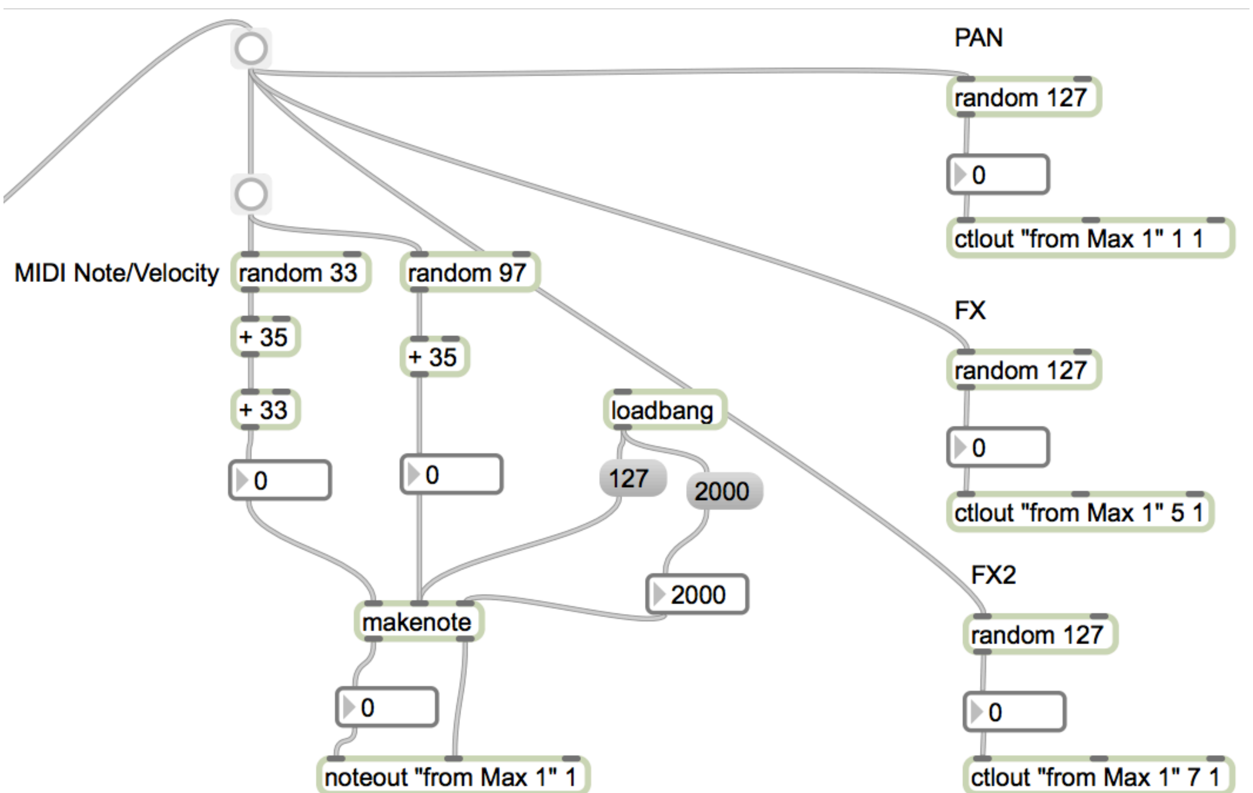


Figure 5: Max/MSP MIDI routing for MIDI note, velocity, pan, effects 1, and effects 2

The last two signals are designated for virtual auxiliary effect sends within Ableton. The first effects send is for a dry/wet mix for a reverb effect set to 14.7 seconds of decay time. When the MIDI number 0 is received from the sub-patch, the sound is completely dry; when 127 is received, the signal is mixed with a maximum amount of reverb. The second also uses a dry/wet mix, except the auxiliary channel includes several multilayered real-time granular synthesis effects known as grain delays. The grain delay effect in Ableton samples incoming audio at very small chunks called "grains," and emits each grain after an audio delay. The first of the two grain delays plays the grains back at an irregular rate, emulating a broken echo effect. The second of the two delays plays the grains back at a faster rate pitch, shifting the sound at least an octave higher, which results in a crackling sound.

From top to bottom, this algorithm alters the tempo at a somewhat unpredictable rate, which then triggers a random sample in Ableton that is also randomized spatially. Each time a sample is triggered, there is an unpredictable reverb mix as well as a variable mix for the granular synthesis effects. There are two of these algorithms working at the same time, but at their own randomization that is out of sync with each other. However, both of these algorithms are controlled by a randomized on and off switch in which its frequency of muting the MIDI signals is controlled by the same dial that alters the randomization from the NanoKONTROL. When the corresponding dial of the NanoKONTROL is set to its lowest limit, the sparse sounds swirl in and out of speakers in the performance space. When the dial is set to its maximum, a chaotic frenzy of randomized glitch sounds fill the room. The frequency of these sounds may be somewhat controlled by the NanoKONTROL, but the variety of sounds is unpredictable. The result is an evolving, never repeating soundscape of unrecognizable altered water sounds that seem to be created by a natural source. Every parameter of this algorithm has been taken into consideration. Many of the steps rely on randomized events, yet the overall functionality of this patch is completely under my control, and the musical results were as intended.

2.2 Incorporating Ableton Live

Ableton Live isn't exclusively used for the algorithmic playback at the beginning and ending of *Laniakea*; it is also used for producing and altering simpler sounds throughout the piece. If the acoustic instruments are emulating electronic sounds, the electronic sounds are emulating acoustic sounds as well. Most of the sounds contain samples I made by recording the ensemble. An additional score had to be composed just for the purpose of having the performers play the parts that were to be sampled. As a result, the sounds of the original ensemble used for the premiere will always be a part of future performances of this piece. The samples have been altered to serve as a ghostly version of the live instrument; therefore these sounds could work when used with other performers.

Max/MSP was used heavily in this pre-production phase. There are two methods used in editing these samples to ready them for real-time playback. The first is called a "spectral freeze," which freezes several grains of a selected audio and creates several seamless ambient loops based on frequency. The higher the spectrum, the faster the loop. The result is not a typical jagged granular looping effect; instead it is a much smoother and more organic result. The spectral freeze was used for both the electronic horn drones from pages 10-12, and the electronic bass drones from pages 10-14. Both of these sounds have a smooth and stable sustained pitch.

The other method I used in pre-production recording is a custom-built grain delay in Max/MSP. Its irregular pulsation is controlled by a similar sequencing method that I used for the introduction algorithm. The samples that I created with this technique are the electronic pipa drones and the electronic piano drones (pages 10–12) as well as the electric horn solo drones (page 13). This method was also used for other more unrecognizable sounds, such as the clicking sounds on page 14, which were created from recordings of the clicking sounds produced by the pipa and the piano in the same section, and the sound of the bass player crunching the hairs of a bow against the back of the instrument on page 17, both of which are filtered by a low pass filter sweep. The only non-instrumental sound used in the entire piece that uses this algorithmic grain delay in pre-production is the sound of a randomly filtered virtual white noise generator. The pulsations of each of these sounds have been set to different ranges of erratic tempos to contribute to the flexible tempo and ambient nature of this piece.

3.0 Musical Interests and Influences on the Form:

The formal structure of *Laniakea* may be better understood in the context of my diverse musical interests. I spent the majority of my upbringing raiding my father's enormous record collection. This disorganized personal music library contained

Stockhausen, Frank Zappa, Beethoven, The Beatles, Stravinsky, Pink Floyd, and Miles Davis. In the 1990's, when I was in school, musical scenes had become so segregated that it was discouraged to mix musical genres. To this day, thanks to the exposure to my dad's record collection, I remain eclectic in my musical tastes, and I try to include this eclecticism in my compositional work, sometimes reflecting this variety within a single piece.

The concept of having several smaller movements sewn together into a larger work is prominent in my own work. In the late 1960's and early 1970's, many pop groups from England began to experiment with the possibilities within the length of one side of a vinyl record. Side two of The Beatles 1969 album *Abbey Road* contains a 16-minute medley of eight short songs and Pink Floyd's 1973 album *Dark Side of the Moon* has each side of the album presented as a continuous piece of music with five songs each. In addition to this concept of creating album-length pieces of music without pause, both *Abbey Road* and *Dark Side of the Moon* contain many self-referential themes that are revisited in new contexts throughout the albums in order to create a cohesive experience.

Instead of representing *Laniakea* as a multi-movement work, it has multiple sections with a variety of sounds linked together by similar pitch material. I also view the many sections and transitions of this piece as comparable to analog production methods. The transitions from section to section vary from drastic juxtapositions (similar to tape splicing methods) to longer ambiguous mutations (similar to crossfade techniques used with faders on analog mixing boards).

3.1 Formal Structure and Proportions

Since a quintet of pipa, horn in f, double bass, piano, and laptop computer is in no way a traditional ensemble, I had no historical references. Certain subsets of the group blend better than others, so instead of forcing this odd group of instruments to mix, I decided to provide each of the four acoustic instrumentalists with their own soloistic sections, surrounded by transitional materials played by different combinations of the group. There are a total of nine sections in *Laniakea;* each of these sections is divided by double bar lines and labeled with a Roman numeral (see figure 6).

Section	Pages	Instruments
1	1	laptop
2	1 - 4	pipa (solo), laptop
3	5 - 9	horn, bass, piano (solo)
4	10 - 12	pipa, horn, bass, piano, laptop
5	13 - 14	pipa, horn (solo) piano, laptop
6	15 - 17	bass (solo)
7	17	horn, piano, laptop
8	18 - 22	pipa, piano, laptop
9	22	laptop

Figure 6: Instrumentation for each of the 9 sections

The lengths of each section was initially composed intuitively. Sections 2 and 6 are similar in length as they are similar in concept. The pipa solo in section 2 contains fragments of musical material that is used throughout the piece, while the double bass solo in section 6 contains fragments of musical material that had already occurred. Both of these sections consist of contrasting materials, like a tape splice. Sections 3 and 5, the piano solo and the horn solo, are similar in length as well, and contain smooth transitions to the following section in comparison to the pipa and double bass solos. Unlike the similarities of these solo sections, the remainder of the sections contrast with each other proportionally. Section 4 is drastically longer than all of the sections as it consists mainly of drones and sustaining tremolos. Sections 1 and 9 contain the same musical material (solo laptop algorithmic sequencer).

3.2 Rhythm and Pitch

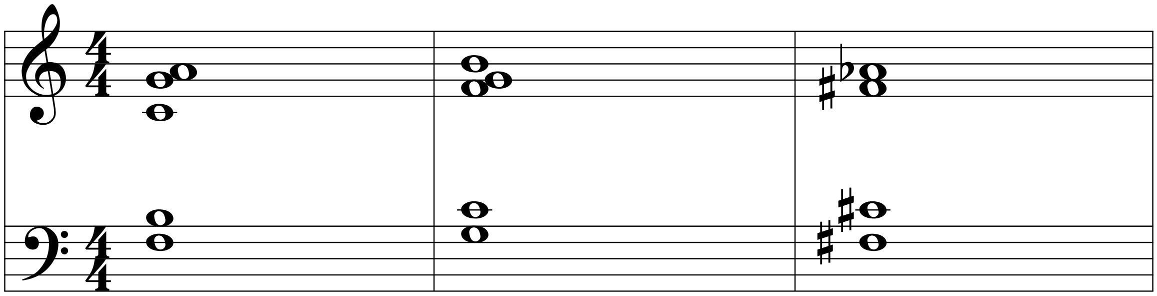
The rhythm in *Laniakea* intentionally avoids pulsation supporting the elasticity of the piece by employing the use of grace notes, dotted rhythms, and various tuplets. All tempos are suggestive, and a conductor should not be used for the performance. In section 3, the piano, horn and the double bass rarely change pitch on the same beat, resulting in flexible phrasing. Section 4 relies on entrances cued by different members of the group as each instrument swells in and out of audibility. The performers are encouraged to play with flexible tempo during each of their solos. Most entrances throughout the piece are smooth, with exception to the occasional drastic juxtaposition, such as the transition from section 2 into 3, or the cut-and-paste style in section 6.

The harmony used by the piano in section 3 is derived from a series of chords created intuitively in the pre-compositional process, based on the sound of the prepared strings. The blue-tack preparations flatten the fundamental of each note but the second partial remains bright and in tune. No initial consideration to tonality was given, although there is a similarity between many of these chords. The initial limitation is that all of these chords are played on the 24 prepared notes, which range from F3 - E5 (See figure 7).

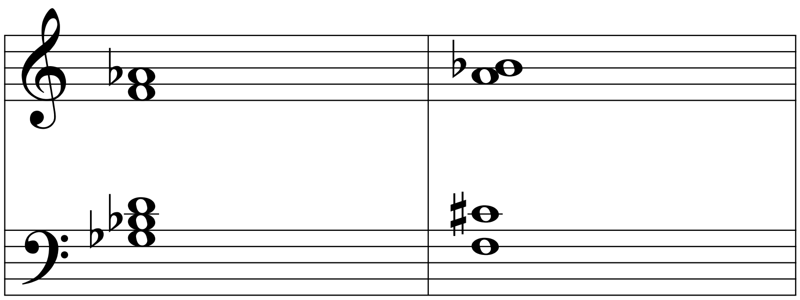
The chords can be split into two parts based on which hand performs it. Many are built off of either a Gb augmented triad or a G minor triad, such as the chords on page 6, 8 and 9, but the triads do not have traditional harmonic function. Many tend to move stepwise. The tritone dyad (F/B) in the left hand on page 5 is the same interval of the chord on page 9, but one octave higher.

The progression of the chords from section 3 moves from less to greater similarity. The first chord on page 5 consists of F, B, C, G, and A. For the second chord, the F and the B move up stepwise to G and C, while the C and A from the first chord move up to F and B. Both chords contain three common notes with some octave displacement. The third chord on page 5 consists of no common tone, and contains one less note than the previous chord resulting in a large contrast from the first two chords. Page 6 consists of two contrasting chords; there are no common tones between the first five-note chord (Gb, Bb, D, F, and Ab) and the second four-note chord of (F, C#, A, and Bb).

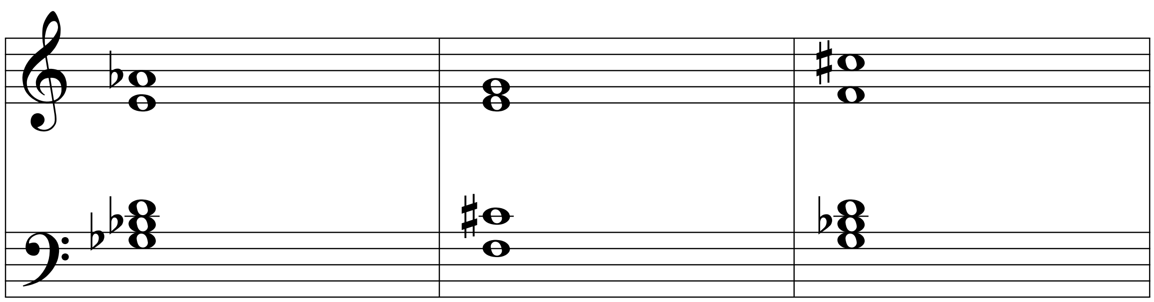
page 5 chords



page 6 chords



page 8 chords



page 9 chords

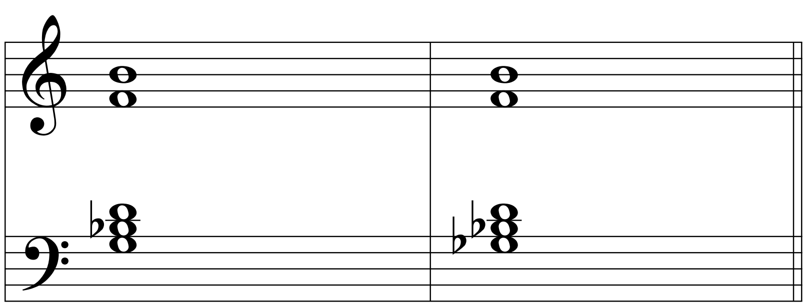


Figure 7: Chords from section 3 (pages 5 - 9)

The passage from page 8 through page 9 consists of five chords, four of which are similar to each other with only contrasts between each other on page 8. The two chords on page 8 contrast in number of pitches and in sound; however, unlike the contrasting chords of the two previous pages, the first two chords on page 8 have a common tone (E). The third chord on page 8 contrasts with the second by moving to a five-note chord with no common tones. The next two chords in the sequence contain similar material in terms of number of pitches and the use of common tones. Moving to the first chord on page 9, which consists of G, Bb, D, F, and B, with F being the common tone, the sequence finishes by moving to a chord consisting of Gb, Bb, D, F, and B, which contains three common tones, the most similar of movements in the sequence.

The pitch material in section 3 has been dispersed throughout *Laniakea.* Many of the chords played by the pipa in section 2 are derived from the piano chords in section 2, altered by the limitations of the possible fingerings in the pipa. The chords used in section 8 are also derived from section 3, moving from contrasting to similar material in the motion from chord to chord. The melodic passages in section 3 were composed intuitively based on creating material that segued from one chord to the next, and by attempting to avoid any functional tonality with the pitches in the horn and the double bass. This pitch material has also been incorporated into other sections, such as the pipa solo in section 2, and the double bass solo in section 8.

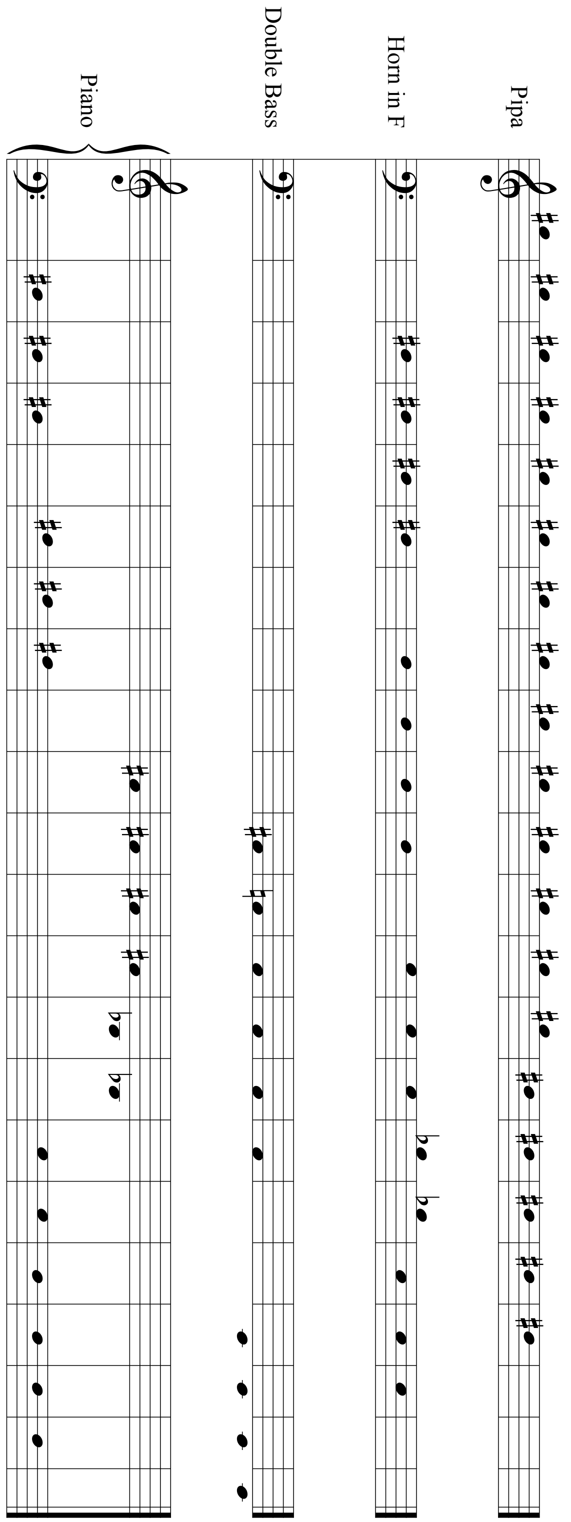


Figure 8: Reduction of section 4 (in C), pages 10 - 12

Some of these sections were intended to contrast with this similar use of pitch material on a larger level. Section 4 contains a different use of pitch material by containing octave-displaced intervals based on 2nds and 7ths. Figure 8 is a reduction of section 4, pages 10-12, including sounding pitches from the electronics, but excluding tremolo notes and higher-pitched *ponticello* bass notes. With the assistance of the electronics, this entire section is a clustered mutation from the G# on page 10 to the low E on page 12.

3.3 Electronics Imitating Instruments, Instruments Imitating Electronics

Throughout *Laniakea,* there are many times where the electronics imitate acoustic instruments, and where the acoustic instruments imitate the electronics. These imitations can be as obvious as the horn and bass emulating the granular delay of the piano sample on page 11, or as subtle as the electronic sounds and pipa complementing each other in section 2, as they are both somewhat percussive and high in timbre. In section 3, both the horn and the bass play a murky irregular ostinato in the same register emulating a recording played at 1/4 of the original speed. The piano performs several extended techniques by scratching the lowest piano string with a plastic clarinet reed case, imitating a digital granular synthesis effect.

At times, the acoustic instruments fade out as the computer fades in samples of the electronic drone version of the same instrument. This crossfading sonic mutation of acoustic instrument fading out, as an electronic sample of the same instrument continuing the pitch, is a recurring technique from here to the end of the piece. The acoustic instruments also perform crossfades, emulating yet another electronic effect. In section 4, when the piano begins the low F# on page 10, the horn fades in and continues the same pitch (written C# in the treble clef) as the piano has faded out. This crossfading of notes recurs between the same instruments. The piano begins with Bb in the treble clef from page 11 into page 12, and fades out on page 12 as the horn continues the same pitch (written F natural in the treble clef).

The electronic bass drone sounding a low E continues into section 5 as the horn performs its solo, coupled with a ghostly sample of the same pitch with the lowest frequencies filtered out. The horn continues by playing a full stop covered by a thin aluminum sheet, which creates a distorted sound and continues the concept of acoustic instruments emulating electronic production; the same can be said of the sounds produced from the metal sheet waved around in the air. The pipa and the piano perform clicking sounds referencing the timbre of the high-pitched grain delay that they eventually crossfade with. The double bass solo in section 6 contains several moments of extended technique emulating distortion and filtered noise. Section 8 consists entirely of crossfades from the piano to the pipa.

4.0 Final Thoughts

The compositional process and completion of *Laniakea* was an intentional learning experience. I needed to create a blueprint for what I want to accomplish musically in the future. The success of the creation and performance of the algorithms and samples with real-time processing is a stepping-stone for me to create more complex and intuitive virtual instruments. The same could be said for the formal arrangement of each of these sections in relation to instrumentation and the collections of sound possible with this ensemble. The benefit of using a programming language such as Max/MSP is that it is part of an additive process; I can copy and paste or even edit older versions of patches. I hope to use the laptop as a performable virtual instrument in the near future. I know with continued experience, I will be able to comfortably perform or compose for laptop as if it were a traditional instrument.

To be critical of my own work, I can honestly say that my initial approach to considering logistics and form as priorities may have caused the pitch material to suffer in this composition. This is not to say that I am dissatisfied with the outcome, as I don't think it would have been possible for me to complete such a large piece with this many obstacles if I used my old compositional methods of starting with pitch and rhythm first. Now that *Laniakea* is complete, the next step is to integrate these concepts and develop new compositions with a greater balance of methods. Greater risks can be taken in both the electronics and the musical gestures. I am pleased with the results and I know that this hard work has paved the way for greater compositions in the future.