Expansion of the Cello Repertoire in the 21st Century: A Collaboration with Composers Paul Eddison Lewis, Thomas L. Wilson, Austin Franklin, and Alex Shanafelt and the Resulting New Compositions for Cello and Electronics - Examined and Recorded by the Performer

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A Dissertation

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in

The School of Music

by
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Abstract

Electroacoustic music has been one of the fastest growing genres in classical art music since the middle the twentieth century. Thanks to the pioneers of the genre such as American composer John Cage, Halim El-Dabh, Karlheinz Stockhausen, Morton Subotnick, Iannis Xenakis, as well many others composers and enthusiasts of the twentieth and the twenty-first century the repertoire of electronic and electroacoustic music has grown tremendously withing the last hundred years. Even today it is still a growing art form as contemporary composers are working with yet to be developed and explored electroacoustic programming and equipment.

The purpose of this project was to commission original electroacoustic works for cello and electronics and to include interpretative discussions from the performer’s point of view. Additionally, this paper presents biographical and stylistic references surrounding the lives and careers of the four composers. The commissioned pieces include original works for cello and electronics: Xenon by Paul Eddison Lewis, Duality by Thomas L. Wilson, Bloom by Austin Franklin, and waveForm by Alex Shanafelt.

The implementation of this project was multifaceted. The author was proudly responsible for the commissions and the selection of the composers represented here (all of whom he respects enormously); for the interpretation, performance, and video documentation of these four new works, and most gratifyingly for the ability and opportunity to have the dialog and shared experience of experimenting with various options and compositional techniques during the collaborative process.

The paper is divided into four chapters. Each chapter presents one of four works along with information about the composer, analysis of the piece, and examination and discussion of the electronic components of these compositions. The author hopes that this project will
stimulate increased interest and enjoyment of such works among cellists, and hopes to present these works in a "performer-friendly" manner.
Chapter 1. Paul Eddison Lewis and Xenon

1.1. Introduction

Xenon for cello and live electronics was written by Florida native composer – Paul Eddison Lewis. Upon my request, Paul Lewis started working on drafts for a solo cello piece around September 2017; a complete work was finished in July 2018 and premiered on August 9th, 2018 at the Tampa Homegrown New Music Concert Series in the composer's hometown – Dade City, FL.

1.2. Biography

Paul Eddison Lewis is a Florida native composer and double bass player. I worked closely with him during my master’s program at the University of South Florida in 2016-18. Paul Lewis has written a variety of works for solo instruments, large and small ensembles, as well as music for electronics and electroacoustic performances. His compositions can be recognized by their “dark” sound with often dissonant harmonies and complex, aggressive rhythmical structures. Lewis’ compositions are mostly thematic, and directly or indirectly address deep social issues and current problems in the world. Some of his works present a more traditional sound, such as Reverie for singing violinist and Euphoria for baritone and sinfonietta accompaniment; others are more experimental and avant-garde such as Achtung! for cello, double bass, and piano, Homage to Tesla for fixed media, and Juggernaut for performing percussionist and fixed media. Juggernaut was written after Lewis visited Trans-Allegheny Lunatic Asylum in West Virginia. During the visitation, he was inspired by the art made from the patients and the true events that have notoriously taken place at the facility. Lewis emphasizes the importance of four aspects of sound - frequency, amplitude, duration, and timbre. In search
of an original sound, Lewis often uses extended techniques on the instruments and experiments with interactive and fixed electronics in his electroacoustic works as well.

Figure 1.1. Picture of Paul Eddison Lewis (sent in an email to the author, February 14, 2020).

Paul Eddison Lewis was born in 1987 in Dade City, Florida. He grew up in a non-musical family. His father, Bryan Edwin Lewis, was a lineman at the local electric company and his mother, Jeanie Cook Lewis, was working at the library in one of the Pasco County school systems. Paul’s interest in composing started in his early teens. Playing snare in middle school drumline, he always found himself getting bored with the repetitive selections that were provided by the band director. So, at the age of twelve, he started to write his own percussion cadences for the battery lines. Although he had an interest in composition, he hadn’t yet thought of becoming a professional composer. After graduating from high school Paul’s parents did not see any reason to further his education. For about 6 months after high school, Lewis was working as a temporary rural carrier at the local USPS office. By a “lucky” accident his position was terminated on a nationwide level. After losing his job at the USPS, Lewis decided to continue his education and pursue his dream. In 2012 Paul Lewis received an Associate of Arts Degree from
the Hillsborough Community College and later a Bachelor of Music in Composition from University of South Florida (2018), where he studied under the mentorship of Dr. Baljinder Sekhon.¹

In 2014, Paul’s work “The Ninth Gate” was honored with the BMI Student Composer Award. In 2019, Paul was commissioned by the Tampa City Ballet to write original music for the production of 7th Avenue in Ybor, which has been featured on Good Day Tampa Bay, Bay News 9, Ybor Main Stage Theater, and the Palladium. During his years of study, Paul has participated in masterclasses and workshops by distinguished composers, such as Stuart Saunders Smith, Hilary Tann, David Lipton, Robert Morris, Michael Schelle, and Yotam Haber. Paul Lewis was one of the featured compositions students whose works were performed for the National Association of Schools of Music during the accreditation process of University of South Florida in 2016.²

1.3. Origin of the piece

Society grows great when old men plant trees whose shade they know they shall never sit in.

— Anonymous Greek Proverb

In his interview, Paul shared with me that this proverb was the initial inspiration for the piece for cello and electronics. He believes that human greed has no limits and that the standing issue of man’s overuse of natural resources has become a major plague of the 21st century. Paul stated that he “feel(s) very strongly about energy consumption and how we are going to leave the planet for our children.”³ Corporations are exploiting the natural resources of our planet and

¹ Lewis, Paul E. (composer of Xenon) in discussion with the author, May 18, 2021.
³ Lewis, Paul E. (composer of Xenon) in discussion with the author, May 18, 2021.
causing great environmental degradation. Unfortunately, human greed is often taking over common sense in face of a profit. Rising pollution levels and global warming are just some of the consequences that eventually will affect every species on the Earth.

With this thought, Paul Eddison Lewis started his composition process on the piece that later received the name Xenon. It is the composer’s response to this ongoing global issue that is affecting everyone. The piece and its title were inspired by further exploration of the alternative energy sources that are known to be cleaner and less harmful for the environment than those that use petroleum products and nuclear power plants.

In the program notes Paul writes: “During the process of splitting uranium, the chemical element gives off extra neutrons and impacts a moderator, typically water. When in contact with the hydrogen nuclei, the neutrons start slowing down, eventually creating fission by hitting another uranium. This is the controlled chain reaction that takes place within a modern nuclear reactor. This neutron dance is controlled to give a steady amount of fissions. Xenon is an exception when absorbing neutrons. Known as a neutron poison, xenon becomes an alternative to controlling the chain reaction significantly decreasing the chances of calamity.”

1.4. Technical requirements and setup for the performance

The performance of this piece requires the following equipment: acoustic cello, computer, microphone, audio interface, stereo splitter cables, pair of loud speakers, and foot pedal that is synced to the computer via Bluetooth or wired connection. The performance of this work requires having the use of Pure Data software and the patch created by the composer installed on the computer. When Pure Data is activated, the computer must have a way to receive

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audio signals and interact in real time with the performer, therefore the setup requires a microphone and amplification system with balanced stereo output. For the best results during the live performance it is recommended by the composer to use a dynamic microphone. This microphone minimizes possibilities of feedback. During the performance the cellist must be able switch scenes in Pure Data using a foot pedal. Bluetooth connection is advised, however wired pedal is also acceptable. I would like to note that the wired connection will complicate the setup on stage. As an alternative option, the electronic scenes in Pure Data can be switched by an assistant who must be following the score during the performance and reacting to the ques given by the performer.5

1.5. Brief description of the patch

The electronics segment within the work Xenon is controlled using the open source coding language Pure Data. Within the coding platform, patches of commands were created to function as a distinct action given to the computer to execute. These functions include reverberation, multiple delays, playback of fixed media, key commands, as well as activation and deactivation of the effects listed above. During the performance, the cellist has the option to either choose a foot pedal, or a second performer to control the scenes within the graphic user interface. Before the piece begins, the performer has the option to save or recall the previous mix within the graphic user interface. Using a dynamic microphone, the violoncello should be amplified directly and should avoid using a condenser microphone to minimize the risk of feedback. Amid the performance of the piece, the acoustics of the cello are analyzed and sent to

5 Paul Lewis, Xenon, eScholarship, University of California, June 15, 2020, https://escholarship.org/uc/item/3hc226vf.: p. 3.
an audio to digital converter and processed using the coding language. See an example of the Graphics User Interface on figure 1.2.

Within the Graphics User Interface, also known as GUI, one can control the volume or output of each fixed media playback using the parameter from 0.0 to 1.0, where 0.0 being silent and 1.0 being full volume. In addition, the performer can control the microphone volume, effects amplification, as well as save and recall a favored mix.

![Graphics User Interface](image)

**Figure 1.2. Graphics User Interface.**

When the audio to digital converter (figure 1.3) processes the signal, the code then reverses the process using a digital to audio converter to send the signal back through the speakers (figure 1.4). The dac~ (digital to audio converter) command contains two inlets for stereo playback.

As one can see on the example above, Digital to Audio Conversion patch includes the lines of code titled short delay, long delay, reverb and mid-delay. Each command is being used
to convert a digital effect to an audio output for the listener. Those commands are referring to the specific sections of the patch that will be described below.

On figure 1.5, one can see the section of the patch that is responsible for the reverb that is applied in real time to the signal received from the audio input. The parameters for the reverb contain the output range and linked to the slider, that allows performer to adjust the amount of reverberation effect through GUI.

Next I present the examples of the code that control playback of fixed media (see figure 1.6). It utilizing the media files that are provided by the composer along with the patch.

Specific times for each delay were implemented during the composition of the piece; “short delay” executes a two second cycle. Note that computer uses milliseconds as an indication of the time value. “Mid-delay” executes a ten second delay and the “long delay” executes a twenty second delay. It is important to mention, that the delay effect actually works by recording the audio from the cellist and recycling the signal back through the speakers within a desired amount of time controlled by the parameters written. In figure 1.7 represented the coding segments that sets up the parameters being used to implement the duration of each delay.

Concluding with the final and most important group of coding, the following is an example of how each scene within the electronics portion of the piece changes and is manipulated. Each group of code controls individual scenes and commands the computer to trigger an effect, a fixed media playback, a fade out/fade in transition, and the activation or deactivation of new or previous effects between scenes (figure 1.8).

Faders controlled on the GUI, are directly linked to the faders seen in the screenshot above. Imperative to make the patch user friendly, it is necessary to be able to control all of the complex code with a single graphic interface. Digital to audio conversion commands are
essential for the electronics to be performed for a live audience in real time. To conclude the section about the electronics in *Xenon*, I would like to present combination of the patches responsible for all the audio effects used in the pieces (figure 1.9).

Figure 1.3. Audio to Digital Conversion patch (adc~).

Figure 1.4. Digital to Audio Conversion patch (dac~).
Figure 1.5. Section of the patch responsible for applying the reverberation effect.

Figure 1.6. Patch section responsible to the media playback in Scene 2 (left), Scene 5 (center), and Scene 6 (right).
Figure 1.7. Sections of patch responsible for executing “Short delay” (left), “Mid delay” (center), and “Long delay” (right).

Figure 1.8. Section of the patch that executes a fade out at the end of the piece.
1.6. Notation and tuning

In search of a “darker” sound Paul Lewis accepted my proposal of using an alternative tuning, also known as scordatura for the entire piece:

Figure 1.10. *Xenon*, Scordatura: strings in order – IV, III, II, I.
In an effort to facilitate legibility for the performer Lewis originally used a notation of two staves connected to each other:

![Notation](image1.png)

**Figure 1.11. Xenon, Original notation with use of two staves: Opening line.**

As seen in the example above, the top staff, indicated as “written”, shows the position of the notes where they would be in standard tuning allowing the cellist to rely on a muscle memory to find the positions of the notes. The second staff, indicated as “sounding”, presents the actual pitches one hears. Since the sole purpose of the second line was only to give a reference to the player during the practice phase, and had no real application during the performance, in the later edition of Xenon the “sounding” line was eliminated. Instead of that the second line of the score now is changed to represent and notate the part of the electronics. See the examples below:

![Notation](image2.png)

**Figure 1.12. Xenon, Notation in a later edition: Opening line.**

![Notation](image3.png)

**Figure 1.13. Xenon, Notation in a later edition: Lines from top to bottom: solo part, delay, fixed media.**
Figure 1.14. Xenon. Notation in a later edition: Lines from top to bottom: solo cello, fixed media.

Figure 1.15. Xenon. Notation in a later edition: Notation of multiple delays (lines 2 and 3) and fixed media (line 4).

I would like to point out that it is crucial to execute the selection of the strings marked by the composer. Changing the original notation may result in unwanted pitch emissions.

1.7. Analysis

*Xenon* is a through composed piece with four contrasting sections that are performed *attacca*. Each of the sections contain a single or multiple scenes that represent the changes in the Pure Data patch and are represented in the score by the number inside of a triangle (ex.: △). Each of the scenes triggers the effects that are applying to the cello sound in real time, or starting the fixed media files, or both.

1.7.1. Section one

The opening of the piece marked *Con Fuoco* (“with fire”, Italian), and consists of a single Pure Data scene △ must be triggered before the first note. That electronic scene starts the reverberation effect that is applied to the sound of the cello, picked up by the microphone and
used to add more depth to the cellos’ sound (already extended by scordatura sound of the instrument). The work begins with a main subject based on the two intervals leading upward by a minor third and then falling downward by a minor second. Those four notes are immediately followed by a great leap across the range of the instrument into a crying “C5”.

![Figure 1.16. Xenon, m.1: Subject (in concert pitch).](image)

In the words of the composer, the chromatic motive of the subject represents “the greed in human nature”. It is the main seed of the whole piece and it appears throughout the whole work on multiple occasions in its original or altered form.

The short motive is almost immediately repeated, with different articulation and increased melodic direction towards the upper “C5”, from which subject is repeated yet a third time however in a different register, augmented in time and with different pitches, but still resembling the direction of the movement (figure 1.17).

![Figure 1.17. Xenon, mm. 2-3.](image)

Every note is growing with increasing tension. Dynamics for each of them are specifically indicated $fp < fff$. After the last crescendo on the upper note the sound is moved the lower register. Like a warming up engine the music is steadily gaining the speed through the use of triplets which are more agitated. This is a musical effort to resemble the enormous burst of

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energy that comes out from nuclear fusion. Each of the next of those passages are going through
dynamic growth and end up with “roaring” power chords that return throughout the wide leaps,
not unlike the one in the first measure. After a full eight measures ranging “all over” the
fingerboard the music finally “calms down” with a short fermata at the end of measure 8.

Figure 1.18. *Xenon*, mm. 5-9.

Measures 8 through 10 uses exclusively *pizzicato*. The Composer is attempting to imitate
the sound of acoustic guitar and writes the instructions *Quasi Guitar* at the end of measure 8. The
strumming chords are interrupted with energetic passages that are using both right and left hand
*pizzicato*. That specific technique is used for increasing the agility of the player allowing him to
perform faster passages with use of *pizzicato*. The short change of the character only lasts for
two measures and at the end of measure 10 we hear the return of the original subject. This time it
performed *pizzicato*, and the last note has moved down a major third to “G2”.

Figure 1.19. *Xenon*, mm. 11-12, return of the subject.
That brings us back to the original emotional state introduced in the beginning of the piece and continues its development through the accelerated ascending passages.

In measure 20 we are introduced to new material. The imaginary engine is now working at full speed. Repetitive double stops on the strings III and IV deliver powerful rhythmical patterns with asymmetrically placed accents that create a sense of instability. The double stops are interrupted with short bursts of sixteenth notes alternated with short slurred sections. Originally, Paul used the traditional notation for the quintuplets:

![Figure 1.20. Xenon, m. 20, original edition.](image)

However, from performers perspective, I found that it is visually easier to follow the complicated accent pattern with different grouping (see figure 1.21). In my opinion the new notation is a clearer representation of the quintuplets with the brackets above the staff.

![Figure 1.21. Xenon, m. 20, final edition.](image)

As we progress towards the end of the first section of the piece, the tension is growing. After a long *glissando* up and down in measure 28 the music is changing its pace again. The working engine gear shifts into the next. Switching to septuplets increases a sense of agitation (figure 1.22).
The bursts of the sixteenth notes are becoming more frequent as well as the long double-stopped *glissando*. Both techniques interrupt the rhythmical flow of the music. After a journey of about three and a half minutes, we finally arrive at the end of the first section landing on a long G3.

1.7.2. Section two

This section starts in measure 40. The electronic part in this section contains two Pure Data scenes. The scene ☞ is to be engaged during the last note of measure 39. It triggers a fixed media file, while the original reverberation from section one remains present. In contrast with the first section, the cello now creates a texture of perpetuated arpeggios. We can still hear traces of the original subject. It is presented by a chromatic descent in the lower voice. In the words of the composer, the arpeggios are “organically emerging from one another”.

Scene ☞ is triggered during the last note of measure 45. It stops the reverberation effect and starts a two second delay, while the fixed media continues to play in the background. During this scene the cello continues the same arpeggiation, but now the performer must attempt to synchronize every beat of the 3/2 measure with the one that is being repeated by the delay to the best of his/her ability (figure 1.23).

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7 Lewis, Paul E. (composer of *Xenon*) in discussion with the author, May 18, 2021.
1.7.3. Transition to cadenza

At the end of the measure 60 performer activates scene ↓. That scene disengages the delay and stops the fixed media file. Once again, we are “haunted” by the subject reminding us that one cannot escape from one's nature. However, this time the theme does not leap to the upper register of the instrument. Rather, after a short cesura, it repeats itself again…and again, each time more persistently. Each repetition is going lower, digging deeper and deeper into the ground until finally a slow and wide glissando delivers the “final blow” and we reach the electronic cadenza.
1.7.4. Section three - cadenza

The cadenza arrives unexpectedly for the audience. It is likened to oil bursting from the ground pouring itself out with an incredible amount of pressure. Unlike all the other scene changes where performer has some room to for interpretation, scene $\text{Cadenza}$ must be activated precisely on the downbeat of measure 62. The cadenza has a duration of approximately two minutes: it is the thematic climax of the piece. Inspired by the works of composer Stuart Sanders Smith the most climactic section is represented with a great contrast to the material presented in the rest of the piece. In Xenon it is represented with electronics “taking over” the sound of the acoustic instrument. While up to this point the part of electronics remained considerably minimal, in the cadenza we can hear a drastic shift to a very aggressive electronic sound with quantized overlaid polyrhythms. During the electronic cadenza the role of cello shifts to an “accompaniment”. The cello is now performing a constant repetition of slowly ascending B major chord that is accompanied by an “open” low B string that is rising to “B quarter tone sharp” and descending back. At the end of the cadenza, the cello states one last time the opening subject of the piece, but this time very slow, in an almost “melting” manner (figure 1.26).

![Figure 1.26. Xenon, Cadenza.](image)

The entire part of the fixed media for the cadenza was created by using just one sound source – a single drum loop that was included with the stock loops provided with the purchase of

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8 Lewis, Paul E. (composer of Xenon) in discussion with the author, May 18, 2021.
the audio interface. It was altered by Using Melodyne, a popular audio software developed by German musical software company Celemony Software GmnH. Melodyne uses the technology that allows the identification and editing of individual notes in the polymorphic material in postproduction, also known as DNA or Direct Note Access. Lewis has manipulated the pitch and length of the sound samples. To attain a deep contrast with the sound acoustic instrument, Lewis also used quantization and polyrhythms, that he stacked against one another. As a result we hear the rhythmical patterns of extreme complexity that can only be achieved with use of a software and not by performer.

1.7.5. Section four

The closing section of the piece starts in measure 64. It utilizes two delays: one has a buffer of 10 seconds and other of 20 seconds. Those delays are triggered by the scene, along with the fixed media file that produces the sound of crackling fire.

In the beginning of the last section the cello creates a background by playing a long B1 that slides upwards by a quarter tone up and then returns to the original pitch that is getting picked up by the electronics. That part is instructed by the composer to be “repeated ad libitum until the scene completely changes” and serves as a transition.

The last section of the piece consists of the monophonic pitch series placed in individual cells. The section is marked Grave Rubato: the duration of each cell must be 10 seconds long. In those cells the first four pitches should progress naturally with a sense of direction and the last note is to be held as needed to fulfill the required length of the cell. As indicated in the score, the

performer is instructed to align the components of each cell with that which is being repeated by the delay. This way the performer creates a homophonic texture that consists of layers staggered on top of each other. See example below (figure 1.27):

Figure 1.27. *Xenon*, mm 65-68, assembling the homophonic material through use of multiple delays.

The first sequence of pitches starts in a relatively high register for cello with the use of artificial and natural harmonics. However, through the course of the section the texture is gradually descending. With use of multiple delays, the cellist creates widely spread triads that would not be possible to play without use of electronics. Towards the end of this long lasting descent, we one last time reach the “rock bottom” of open string IV. That B1 is returning with delay, each time softer. However, the last note of the whole piece is high “E6” with a long *fermata*. That pitch is written as a stopped harmonic, whose flat sound serenely stands above it all. In one of the rehearsal sessions, the composer compared it to the flatline of a stopped heartbeat that will inevitably be our last destination regardless of the wealth we generate through our lives.12

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12 Lewis, Paul E. (composer of *Xenon*) in discussion with the author, June 28, 2021.
1.8. *Xenon*: Complete score and notes by the composer

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*Xenon*

for cello and live electronics

Music by Paul Eddison Lewis

Commissioned by Eduard Teregulov

2019

c.a. 14’

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**Instrumentation**

Cello and live electronics

**Program notes**

During the process of splitting uranium, the chemical element gives off extra neutrons and impacts a moderator, typically water. When in contact with the hydrogen nuclei, the neutrons start slowing down, eventually creating fission by hitting another uranium. This is the controlled chain reaction that takes place within a modern nuclear reactor. One method that will slow the reaction, is the use of control rods absorbing extra neutrons while others simply leak out of the reactor. This neutron dance is controlled to give a steady amount of fissions. Xenon is exceptional when absorbing neutrons. Known as a neutron poison, xenon becomes an alternative to controlling the chain reaction significantly decreasing the chances of calamity.

Although the piece *Xenon* itself is not a direct reflection of the literal neutron dance taken place within a reactor core, it is inspired by its process and the modern science that makes it possible. Effecting the population and environment, modern science plays a key role in our development towards the progression of energy consumption. It is vital to take into consideration the development of modern science over profit, creating a more environmental friendly, efficient, and cost effective livelihood for future generations. To quote a Greek proverb, “A society grows great when old men plant trees whose shade they know they shall never sit in.”

**Performance notes**

**Technical requirements:**

The performance of this work requires the use of a Pure Data patch created by the composer. During the performance, the cellist must switch scenes using a foot pedal, preferable connected through Bluetooth. When Pure Data is activated, the computer must have a way to listen and interact in real time with the performer, therefore the cellist needs to be mic’d and amplified using a balanced stereo output. For the best results, use a dynamic mic during live performance to avoid a feedback problems.

**Equipment list:**

- Computer with an installation of the Pure Data program
- Audio interface
- *Xenon* Pure Data patch in files
- Pedal
- Dynamic instrumental mic (ex. SM57)
- Stereo splitter cables

**Pure Data patch instructions:**

When the Pure Data patch is in use, the performer will see the GUI screen within the program. The patch has already installed a saved mix and to recall the mix for a performance, simply press the button that says “recall”
Using a pedal, each time it is pressed will activate the next scene. Below is a brief description of each scene when activated:

*Scene 1:* Activated the reverb.

*Scene 2:* Plays the first fixed media

*Scene 3:* Kills the reverb and turns on the two second delay

*Scene 4:* Kills the first playback and the two second delay, Turns on reverb

*Scene 5:* Plays the electronics *cadenza* and turns off reverb

*Scene 6:* Fades the electronics *cadenza*, fades in the last fixed media playback and turns actives both ten- and twenty-second delay.

*Scene 7:* Shuts off all effects and playbacks.

At any time the performer needs to go back to a scene, press ‘R’ to reset the patch.
Xenon

Repeat ad libitum until the scene completely changes

Grave rubato

* Hold the whole note before it until the electronic loop begins.
Continue by syncing up with electronic loop.
Chapter 2. Thomas L. Wilson and *Duality*

2.1. Introduction

*Duality* was written by Alabama native composer – Thomas Wilson. Upon my request the main part of electronics is utilizing a specific piece of hardware – loop station Boss RC-300. The discussions of creating a new piece for cello and electronics have started as early as March 2020; the completion of the piece can be dated in November of the same year. The recording of this was presented at 2021 Society of Composers Online National Conference in May 2021.

2.2. Biography

Thomas L. Wilson, is an American composer who currently lives in Baton Rouge, Louisiana. As a member of the Constantinides New Music Ensemble, I performed a number of works written by Thomas, such as *Fighting Mischievous Imp*, *String Quartet Creative Altruism*, *Street Music No. 5* for cello solo, and Concerto for Cello and Flexible Ensemble *Rougarou*.

![Photo of Thomas L. Wilson](image)

Figure 2.1. Photo of Thomas L. Wilson

Thomas holds a Ph.D in Music Composition with minor concentration in Experimental Music and Digital Media from Louisiana State University, as well as M.M. and B.M. in Music
Composition from The University of Alabama. Currently Thomas holds a position of Adjunct Instructor of Music Theory at Louisiana Tech University. Thomas considers his primary mentors to be Mara Gibson, C.P. First, and Yotam Haber. As mentioned on his website, “Thomas enjoys collaborating internationally with performers, including at conferences and festivals such as the Society of Composers Inc. National Conference, the SPLICE Institute, Atlantic Music Festival, highSCORE Festival, and ArtPlay Festival.” 14 Thomas’s thesis composition, *The Reflections of My Introverted Sneakers*, is included on the album by David Brooks, *Early Musings: New Music for Violin*.

Thomas grew up in the suburbs of Birmingham, Alabama. His dad, Larry Wilson, was a microbiologist with a master’s degree from Mississippi State University, and his mom, Lori Wilson, worked as a substitute teacher at the local middle and elementary schools. Even though his parents were not professional musicians, in his interview Thomas shares that his childhood years were surrounded by music. At the age of 5 he received his first video game console – an Atari 2600 - that was purchased at a garage sale. With that console, Thomas started to develop his fascination with video games and the music created for them. During his middle school years, the Wilson family acquired a piano for their house. The composer vividly remembers that “it was an old piano donated by one of the church members… It had a tic-tac-toe board scratched on it.” The instrument very quickly drew Thomas’s attention and quite soon he taught himself how to play some simple arrangements of the game soundtracks that he was interested in. As Thomas recalls, some of his early musical inspiration came from listening music for the video games, such as Spyro, Crash Bandicoot, and Legend of Zelda. From there on, Thomas became more

involved in making arrangements for his favorite games and started writing his own short compositions.

His first composition instructor, Greg Gumina, was a music theory instructor at Shades Valley / Jefferson County International Baccalaureate High School. Even though there were no official composition classes, Mr. Gumina would have his students work on original compositions as a part of the curriculum for the AP Theory class. After high school Thomas was accepted to the University of Alabama, where he did both his Bachelor’s and Master’s degrees in composition. During those years he studied with Marvin Johnson, who was a former student of Milton Babbitt, and also with Craig First, who was an academic descendant of Luciano Berio. First also had an experience of working in commercial audio production, which attracted Wilson to stay at University of Alabama for his master’s where he was able to pick up practical audio engineering skills. His thesis work, *The Reflections of my Introverted Sneakers* for violin and electronics was one of the first compositions that I heard by Thomas. In 2013, he had an opportunity to work closely with renowned American composer, Yotam Haber, whom Wilson also considered a major influence on his professional development. After graduating from UA, Thomas had a two year break from his studies which he spent in Washington State. In 2018 he received a Graduate Assistant position in the Composition Studio of internationally recognized Dr. Mara Gibson at Louisiana State University in Baton Rouge. During his time at LSU, he led and participated in several collaborative projects working on music and sounds for video games, including development of *Lucidscape*, a video game by Feenx Games.\(^\text{15}\) Beginning in the Fall

\(^\text{15}\) “Lucidscape on Steam,” Lucidscape on Steam, accessed July 10, 2021, [https://store.steampowered.com/app/1317500/Lucidscape/](https://store.steampowered.com/app/1317500/Lucidscape/).
2020 Thomas was appointed as an adjunct professor in Louisiana Tech University, where he still teaches Music Theory, as well as a class on the Music & Sound for Video Games.

In his works, Thomas Wilson remains true to his original interests in music. Most of his compositions are thematic and often inspired by a vivid visual or narrative ideas. Despite his developing academic career, Thomas thinks that his music should be performed outside of the concert halls in accessible settings for people who are not commonly or readily exposed to the art music world.

2.3. Origin of the piece

During the lockdown of summer 2020, I was looking for additional ways to expand the sound of cello without playing with other musicians. One of the solutions I found in the purchase of a loop station, the Boss RC-300. That pedal-type recorder allowed me to create multitrack compositions in real time with only use of one instrument. Besides ability of looping the prerecorded material, the pedal is also capable of applying various effects, such as transposition, modulation, distortion, delay, etc.\textsuperscript{16} I challenged Thomas to write a piece for cello and electronics, that would incorporate the use of RC-300.

According to the program notes “Duality reflects the pulling directions the composer has experienced.”\textsuperscript{17} During one of our discussions, Thomas mentioned to me that throughout his life he often felt like he was gravitation between opposite realities. For example his academic career and interest in the pop culture, his studies of art music composition and his work in field of writing the music for the video games. Also, Thomas discovered he was a member of the Poarch


\textsuperscript{17} Wilson, Thomas L. Duality. Baton Rouge, LA: Thomas L. Wilson, Composer, 2020, p. 2.
Band of Creek Indians later in life, which resonates against his suburban upbringing. All these feelings served as main source of inspiration for this piece.

Before I asked Thomas to use in his piece RC-300, he already was working on a piece for cello and electronics. Wilson was working on developing an idea of “fluctuating in motion while staying stable” which originally was named Sustain. That concept was built on interaction of microtonal adjustments of cello and electronics. However, after I brought to him my desire to use the acquired loop station he expanded the piece by elaborating on use of repetitive patterns. Those patterns are meant to be recorded live in front of the audience and used throughout the piece as an accompaniment part for the cello solo.

In this piece the concept of duality is represented on multiple layers: the combining of an acoustic instrument with electronics, the use of percussive and melodic ideas performed simultaneously, and the division of the piece itself into two contrasting sections.

2.4. Technical requirements and setup for the performance

Unlike other works from this paper, Duality does not require a computer setup. All the required effects and fixed media tracks can be performed by using loop station Boss RC-300. Besides the pedal, a condenser microphone with an XLR cable, headphones, and a stereo pair of loud speakers are the only equipment required for its performance. As an option, the fixed media track can be activated by an assistant from separate device, which is connected to the PA system directly or through AUX input of the pedal. The composer also provides a patch for Max MSP, which can be used to activate the fixed media tracks. I would like to add, that to assure a better synchronization during the recording of the loops I used the RC-300 built-in metronome that can be heard by the performer through the headphones.

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2.5. Notation

For notation of his piece *Duality*, Wilson uses systems with two connected staff lines connected. Similar to previously discussed *Xenon*, the top line carries the cello part, while the bottom represents the part of electronics. I would like to note, that the bottom line includes notation of both fixed media files and overdubbed loop tracks. See figures below for visual representation in figures 2.3 and 2.4.

![Figure 2.3. Duality, solo cello (top staff), fixed media (bottom staff).](image)

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For better visual representation, I suggested to create designated markings in the score for indication of all the actions related to the manipulations with live and fixed electronics. Symbols $\bullet$, $\triangleright$, and $\blacksquare$ are used for indication of functions record, play, and stop, paired with the numbers 1 and 2 that represent the track on the loop station. Symbols $\triangleright \bullet$ combined together are used for indication of overdub. See examples in the figure 2.5.

Figure 2.5. *Duality*, Notation for control over the loop station.
From left to right: track 1 - record, track 1 - play, track 1 – overdub, track 1 - stop, track 2 - record, track 2 - play, track 2 – overdub, track 2 – stop.

To indicate the cues for activation of each from the three fixed media tracks, Thomas uses letters A, B, and C.

Figure 2.6. *Duality*, Indication to activate fixed media track 1 (left), track 2 (center), track 3 (right).

To notate the knocking and tapping of the percussive part of *Duality*, the composer uses the “x” headed notes. The position of the those notes on the staff represent the frequencies of the desired pitches (figure 2.7). I would like to note that the frequencies are not meant to be
interpreted exactly, rather as a suggestion of the frequencies in relation to each other. Even though in the program notes Thomas suggests to use the back of the cello, through collaboration, he approved hitting multiple areas of the instrument to create the desired effect.

![Figure 2.7. Duality, m. 18: Example of percussive notation.](image)

2.6. Capturing the loops

One of the challenges that I faced during the performance of this piece was capturing the loops. Thomas writes two complex polyrhythmic phrases that need to be recorded in front of the audience. Once recorded those short phrases serve as an accompaniment for the solo cello through continued repetition. Each of them consists of both percussive and pitch material. Although, the performance entire part is not so difficult, I found it more efficient to record the percussive part first, and then overdub the recording with pizzicatos.

2.7. Analyses

_Duality_ is a piece for solo cello and electronics realized through use of loop station Boss RC-300. Seemingly, it is written in extended binary form with introduction and coda, where measures 1 through 16 is an introduction, measures 17 through 89 is the section A, and measures 90 through 151 is the section B, followed by the coda in measures 152 through the end.

The piece opens with a single note “A4” held by the cello for a duration of almost 15 measures, with a slight pause in measure 8. While the cello sustains a single note, the part of electronics is activated by the performer (or the assistant) in measure 2. The electronics produce the series of harmonies, which affect the perception of the sustained sound by the listeners.
Using microtonal adjustments in the part of the prerecorded electronics, Thomas makes the held note appear more and less “in tune” while the performance of the note in fact does not change. For the first seven measures, the cello plays dynamics of pp, while at the end of measure eight it changes to f and continues until the prolonged rest in measure 16.

After the introduction we arrive at the section A of the piece, that consists of two subjects. Section A itself is written in the form of double variations. It starts from presenting the accompaniment part first. In measure 17 through 20, the cellist assembles the loop in “C” that will serve as an accompaniment for the first subject of the first variation.

![Figure 2.8. Duality, mm. 17-20: Loop in ‘C.’](image)

Once the first loop in “C” is captured, the cello starts to elaborate the subject of the first variation. That subject build on the material presented in the introduction. We hear a melodic line that chromatically moves over the course of sixteen measures. At first it descends from “E4” to “C#4” and then raises to “Ab4” (see mm. 21-36 in the score). Variation theme one is characterized by long notes in melodic line and the accompaniment in the electronic part, centered around “C”.

In measure 36, the loop in “C” suddenly stops. Same as the first one, the second variation theme starts from created a loop with polyrhythmic accompaniment pattern. That pattern is centered around “Eb” (see figure 2.9).

The solo part of the second theme sounds more agitated. It consists of multiple passages which sound almost improvisatory (see figure 2.10). The cello part frequently refers to “E4”,

45
which creates an additional dissonance with reappearing “Eb” in the looped accompaniment.

In fact, I discovered that the composer shifts constantly between neighboring or relative modes. Ionian mode is followed by Aeolian in the next measure, and sometimes Locrian is introduced. These shifts play into the duality of a section not existing in a single key.

Figure 2.9. Duality, mm. 37-40: Loop in “Eb.”

Figure 2.10. Duality, mm. 40-45: Second theme.

Both of the accompanying loops consist of complex polyrhythmic patterns produced by use of pizzicato and the extended technique of knocking on the instrument. Their main difference
from each other the pitch content: Loop for the first theme consists of repeating “C” and “G”,
loop of the second repeating “Eb” and “Bb”. As shared by the composer, those patterns were
inspired by the improvising street musicians that could be seen in cities like of New York, U.S.
or Melbourne, Australia. Those cities are known for their culture of street performers.20

After the second theme has stated itself over the course of 16 measures, we proceed to the
variation on the first idea, which is accompanied by the loop in “C”. Not unlike its first
appearance, it is also based on the chromatic movement over the course of several measures.
Although, this time the both ideas start to blend with each other. The elongated notes are now
interrupted by burst of short passages between them (see mm. 57-64). On the same manner in
measure 65 metamorphosis occurs with the fast material of the second subject. While the fast
passages are still predominating, the variation on the second subject settles the original
statement.

Once each of the ideas went through changes affected by one another several times, the
section A of the piece is leading to a conclusion. Now, starting from the measure 72 and through
measure 85, the performer begins to overdub both the of the loops with layers of tremolo,
pizzicato, and percussive sounds, such as knocking and tapping on the body of cello. In measure
86, the cellist starts to execute a slow fade out by using the expressive pedal on the RC-300 until
the recorded tracks fade completely.

The B section starts at measure 90. The form of that section can be viewed as through-
composed. It’s built on the development of ascending and descending motion that follows the
modal patterns. The whole section is written in an alternating compound meter and consists of
straight and dotted eight notes (figure 2.11).

20 Wilson, Thomas L (composer of Duality), in discussions the author. June 22, 2021.
Figure 2.11. *Duality*, mm. 90-91: Opening of Section B.

After playing solo for four measures in measure 94, the cello is joined by the electronics. The entrance of electronic part is indicated by [B]. The part of electronics consists of the synthesized piano chords. Each of the chords, performed by electronics in the section B, has been microtonally adjusted by the composer. Throughout this section, the pitch of electronics is quarter tone sharp in relation to the tuning of the cello (A=440Hz). Starting from measure 94 the intonation of the chords that are raised by the quarter tones is meant to create sense of tension between cello part and electronics, while performed provided with instruction to “ignore electronics tuning” (figure 2.12).

Figure 2.12. *Duality*, m. 94.

In measure 99, composer writes an instruction to “match pitch when sensible” (figure 2.13). That means that the cellist must attempt to adjusting the pitches that are creating the most dissonances with the adjusted intonation of the electronics.
In measure 103 an instruction to “match all” indicated that the performance must attempt to adjust all of the pitches to match the electronics (figure 2.14). That instruction stays active until the end of the section in measure 115. As a performer’s tip I would like to point that no “open” strings should be used for the fingering.

Over the course of section B dynamics of both cello and electronics gradually increasing. Starting from pp in measure 90 it growing to mf in measure 99, then to f in measure 103, ff in measure 110, and finally the last dynamic indication is ffff at the end of measure 115.

While the solo part excessively moves across the fingerboard through section B, overall register is rising from being between “A2” and “G#4” (mm. 90-91) to being between “A4” and “F5”.

In measure 117, after general pause, starts the coda. Same as in the introduction, the cello holds a single pitch “A4” accompanied by the electronics. The part of electronics in coda
consists of the chords, that are imperfect palindrome to those presented in the opening of the piece. Toward the very end of the piece, long lasting $p$ in cello part breaks into a forceful crescendo and finishes $ff$ on the first beat of measure 124. With reverse repeating of the opening material at the final moments of the piece, Thomas creates an organic conclusion of the *Duality* that creates a sense of conclusion.
2.8. Duality: Complete score and notes by the composer 21

Duality

for solo cello and stereo electronics

Music by Thomas L. Wilson

Commissioned by Eduard Teregulov

2020

cia. 7’-8’

**Instrumentation**

Solo cello and loop pedal

**Program notes**

*Duality* reflects the pulling directions the composer has experienced. Throughout the work, many seemingly opposing elements occur simultaneously or back to back, but in apparent calm. As the composer struggled with their own place in the world, they wondered if there was a single answer or if it were *Duality*.

**Performance notes**

Two loops are employed, denoted with numerical 1-2 with accompanying symbols. Repeated passages with these boxed numbers denote the sections that should be performed at least twice until captured accurately. If the performer decides that pre-recording the loop is more useful in the performance environment. The pre-recorded loop should be played at least twice.

The symbols accompanying the numerical loops 1-2 are shown and described below:

- ● - record the numbered loop
- ► - begin playback of the specified loop
- ■ - stop the denoted loop

Three pre-recorded tracks are employed, denoted with alphabetical A-C. The provided Mac patch will allow these to be performed by a space bar press at the appropriate section. These can be cued by the include Max patch, a phone on the performer's stand, or any other playback method the performer desires. Since these tracks and the performer are not rhythmically aligned, a technician may also cue the parts.

Knocking “pitches” represent the frequencies of knocks/taps on the back of the cello.
Duality

Lento $\dot{d} = 65$

LH Pizz on Open G, D, A to Beat

Maestoso $\dot{d} = 65$

Knockings to Beat

Lento $\dot{d} = 65$

Gradually Fade Out the Loop
Until the Room is Silent
Chapter 3. Austin Franklin and *Bloom*

3.1. Introduction

*Bloom*, a composition for cello and electronics was written in Baton Rouge, LA by composer Austin Franklin. I commissioned this work from him in January 2021, and it was completed in June 2021. As with the work by Thomas Wilson, my collaboration with Austin was launched through the Constantinides New Music Ensemble. His String Quartet *Lanterns* was previously selected for CNME program of 2020-2021 season. In addition to being the composer of this work, Austin also was one of the TA’s responsible for the recording process for the online performances during the Covid-19 pandemic.

3.2. Biography

Austin Franklin “is an internationally recognized composer and sound artist based in Baton Rouge, LA. His interests include music involving processes such as algorithmic composition, generative music, and music incorporating machine learning technologies. His self-released album, *Four Idols*, has been described as “an elegant, artistic statement that demonstrates the flexible possibilities of electronic music.”

Austin Franklin was born in 1995 in Longview, TX. He grew up in non-musical family where his father, Ricky Franklin, was working as a Plant Manager at Louisiana-Pacific Corporation and his mother, Cathy Franklin, was a stay home mom. Even though Austin had shown some interest in music before, his first experience as a musician didn’t begin until high school, where he was a member of a marching band. During those four years he developed a passion for percussion instruments, which led him to pursue Bachelor’s in Music at Lamar

University in Beaumont, TX. During his time in Lamar, Austin co-founded a student led jazz quartet, *The Lunch Combo*, that still exists. On his second year at Lamar University an unfortunate injury forced Austin to switch his concentration from performance to composition. After finishing his Bachelor degree, Austin attended Louisiana State University where he received his Master’s degree in Music Composition under the tutelage of composer, Dinos Constantinides. Currently Austin Franklin is pursuing a Ph.D in Experimental Music and Digital Media from Louisiana State University.  

![Austin Franklin at the LSU Digital Media Center recording studio.](image)

Figure 3.1. Austin Franklin at the LSU Digital Media Center recording studio.

Austin has studied with and participated in masterclasses by a number of internationally recognized composers such as Yotam Heber, Shuying Li, Edgar Bardahl, Nick Rissman, Jennifer Jolley, David Maslanka, Michael Daugherty, Dinos Constantinides, Jessy Allison, Stephen Beck, and Mara Gibson. In 2016, Franklin participated at the UMKC Summer Composition Workshop where he worked with Jim Mobberley, Christopher Biggs, and Paul Rudy.  

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23 Ibid
24 Ibid
Austin Franklin is a recipient of awards and commissions at the First Annual LSU Composition Competition, CNME Call for Scores, PARMA Winter Call for Scores, and the Dead Resonance Call for Aleatoric Scores. His music has been performed in Europe, Asia, North America, and South America. Several of his pieces for percussion were published through C Alan Publications. Austin’s works were selected for festivals and conferences such as the Society of Composers Incorporated, Alba Music Festival, Workshop on Computer Music and Audio technology, The Collaborative Piano Institute festival, and Yes We Cannibal. One of his late compositions, String Quartet *Lanterns*, was aired in 2020 on the Viva 21st Century 50/50 Marathon on Classical Discoveries with Marvin Rose.  

Currently, Austin Franklin serves as an instructor of MUS 2745 Intro to Computer Music course at Louisiana State University, where he teaches undergraduate level students on topics such as “using digital audio workstations, electroacoustic music history, and the principles of sound design and digital audio”. At the same time Austin serves as an associate editor for the blog that is dedicated to the new art music, The Sybaritic Singer.  

### 3.3. Origin of the piece

I approached Austin in January 2021 with the request to write an original composition for cello and electronics. During our conversation we discussed initial ideas for the piece and I specified that I was looking for the works where the performer would be able to control and interact with electronics during the performance although, the nature of those interactions and tools of control were to be left to the composer. Austin was immediately interested in the idea

25 Ibid.
27 Franklin, Austin (composer of *Bloom*) in discussions with the author, June 29, 2021.
of creating an electroacoustic piece with interactive electronics and began work on this new composition.

*Bloom* takes its inspiration from nature. As Franklin stated in his program notes, it uses “the metaphor of a blooming flower as the basis from which the musical material and form are derived.” 28

3.4. **Technical requirements and setup for the performance**

Performance of *Bloom* requires the following equipment: acoustic or electric cello, computer, microphone, audio interface, and a stereo set of speakers. The part of electronics utilizes Max MSP software, which can be download online. In order to perform the piece one can download a free version of the software, which will allow a file to open and run the patch created by the composer. When the software is activated, the performer or audio engineer (if there is one) must set input and output devices accordingly to the interface that is used. It is possible to perform the piece with only one speaker, however, since the patch does provide stereo output, it is recommended to use at least two PA speakers to provide a complete experience for the audience. Unlike other compositions presented in this papers, the electronic part of *Bloom* does not require scene changes. That means that no additional manipulation is required during the performance after activating the patch. Instead, the patch is controlled by the parameters of sound created by the acoustic instrument. 29 For more information see the following part of the paper.

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29 Ibid.
3.5. Brief description of the patch

The electronic portion of the piece is controlled via live input into the visual programming language Max MSP. As the violoncello performs the piece, a microphone feeds the audio into the patch, where it is analyzed and used to process itself before being output through loudspeakers for an audience. No controllers such as foot pedals or MIDI keyboards are used in an attempt to make the electronic processing autonomous. In particular, there are two musical parameters that are analyzed: amplitude and frequency (Hz). These were chosen not only because they are standard musical parameters for which notation systems already exist (dynamic markings and pitch), but also because a large number of algorithms already exist that analyze the amplitude and frequency of an audio signal.

When the signal is initially fed into Max, the frequency of the signal is analyzed using a Ztx-based pitch detection algorithm (figure 3.2, a). This returns a floating-point number that represents the approximate frequency of the incoming signal (figure 3.2, b). These values are then clipped at a minimum and maximum frequency of 98 and 440 Hz, meaning that any frequency that is higher than 440 Hz will output 440.0, and any frequency that is lower than 98 Hz will output 98.0 (figure 3.2, c). This minimum and maximum output range is used to control a variable delay time on three copies of the original signal. Clipping the maximum value range to 440.0 means that the delay time will not increase unless the analyzed frequency is below 440 Hz. An output of 440 has no effect on the delay time, so this is a way of “evolving” the electronics sounds over time as the pitch content of Bloom trends downwards as the piece progresses.

Before setting the delay time this value is multiplied by three separate values, resulting in a different delay time for each copy. These three copies are the ones that are processed and ultimately heard during the performance (figure 3.3).
Figure 3.2. Patch for *Bloom*, shows detection algorithm (a), frequency of incoming signal (b), and frequency filter (c).

Figure 3.3. Patch for *Bloom*, shows the block of objects responsible for multiple delays.

On the longest delayed copy of the signal, an FFT algorithm is implemented that performs pitch shifting on all incoming audio down by a perfect 5th (figure 3.4, a). A *onepole* lowpass filter with a cutoff of 880 Hz is immediately applied to remove frequencies above the
cutoff, resulting in a lower pitch being heard only when the pitch in the score drops below A5 (Figure 3, b).

Figure 3.4. Patch for Bloom, shows pitch shifting algorithm (a), a onepole lowpass filter (b).

At the same time, the peak amplitude of the audio signal is analyzed on a scale from 0.0 to 1.0 where 1.0 is equal 44.1kHz.

Figure 3.5. Patch for Bloom, shows the block of objects that analyzes the peak amplitude value on scale from 0.0 to 1.0.

This number is used for several different purposes. First, it is used to control the effective sampling rate of the signal. As the amplitude reaches 1.0, the sampling rate for one of the copied signals reaches 0.35. The lower the sampling rate, the lower the quality of audio and the more
noise that is introduced into the signal. This is heard as high frequency “glitter” throughout the piece.

Figure 3.6. Patch for Bloom. Shows sample rate of signal on a scale from 0.0 to 1.0 (a) and control sample rate of signal (b).

Next, the amplitude is used to control the panning speed of the three copied signals in the stereo field. When no sound is present the signals will not pan from left to right, but as the amplitude reaches 1.0 the panning speed reaches its maximum. This is controlled by a sin wave, the frequency of which is the amplitude value unscaled. So, an amplitude value of 1.0 will result in a panning speed of 1 Hz. See figure 3.7.

Finally, the amplitude value is used to control the reverb decay time of all three audio signals. The decay time is at its maximum when the amplitude value is at 1.0, which also effects the clarity and brightness of the down sampling, panning, and pitch shifting effects that have been previously applied. See details on figure 3.8.

It is also worth mentioning that these amplitude and frequency tracking algorithms are extremely noisy when implemented alone. They often return values that result in large leaps or change more rapidly than aurally is apparent. Because of this, these values were smoothed by taking an average of values over time rather than jumping between them. This algorithm was applied at many points along the signal chain to increase the smoothness of values and to assure that all audio effects gradually grew and diminished.
Figure 3.7. Patch for *Bloom*, Shows the block objects that is responsible for a panning the processed signal.

Figure 3.8. Patch for *Bloom*, Shows the reverberation block (a) and limiter (b).

Finally, these three processed copies of the signal were routed to gain sliders along with the original dry signal. These are used to control the volume balance between the processed audio and the unprocessed audio and are ultimately what is output for an audience during a live or recorded performance. Presented on figure 3.9.
3.6. Analysis

*Bloom* is a piece for solo cello and interactive electronics. The majority of the piece is written with the use of natural and stopped harmonics. The piece is through composed and it consists of four major parts with introduction. The structure of the work is inspired by a metaphor of blooming flower. To better imitate the unrestricted flow of time in nature Franklin does not use time signature or bar lines. The rhythmic notation should be treated as a suggestion for the rhythms and the general directions that must be interpreted by the performer. Nonetheless, the pitch notation is to be followed precisely. I would like to mentions that overall the performer should keep the flow of the piece moving forward and avoid extending the time of the rests. Those rather should be treated like short breath marks with exception of the rests accompanied by *fermata*.

Since Austin did not use a traditional measure system, to facilitate the navigation throughout the piece I suggested assigning a number for each line of music. In this paper they will be referred as systems.

The introduction of the piece starts with a simple four chord melodic idea that is executed with use of the harmonics and tremolo in the left hand. Marked *Emerging*, in the beginning of
the piece we are introduced to the harmonies that will be developed throughout the piece and serve as a “seed” from which the music will derive.

![Figure 3.10. Bloom, Opening idea.](image)

On the second system we see the first accented note with fp dynamic instructions. It is important, that in order for electronics to respond correctly the performer has to ensure the execution of the dynamics presented in the piece. If the louder dynamics are not loud enough, the effects that respond to the amplitude of the sound might not be triggered.

![Figure 3.11. Bloom, System 2: Accented tremolos.](image)

The following section continues the “emerging” idea presented in the introduction. However, now the musical material starts to unfold. It increases the dynamic range and creates sense of forward motion with fast moving arpeggios across all four strings.

![Figure 3.12. Bloom, System 4: Forward moving arpeggios introduced in section A.](image)
The climax of section A is reached towards the end of system five where the first full *forte* dynamic in the piece is reached. If executed properly that will trigger a large amount of distortion in the part of electronics, which is referred to by the composer as “glitter”.\textsuperscript{30}

![Figure 3.13. Bloom, System 5: Climax of section A.](image)

Figure 3.13. *Bloom*, System 5: Climax of section A.

Through the transition, that is presented at the end of section A, we arrive to the section B. The composer’s mark, *With a sense of unrest*, suggests transition to the next stage of blooming. The metaphorical flower is now getting ready to start opening and showing the signs of movement inside of a bud. Continuous tremolo is now changed to the regular triplets that imitate the movement flower’s stem fluttering by the wind currents.

![Figure 3.14. Bloom, Systems 7-8: Transition to and beginning of section B.](image)

Figure 3.14. *Bloom*, Systems 7-8: Transition to and beginning of section B.

\textsuperscript{30} Franklin, Austin (composer of *Bloom*) in discussions with the author, June 29, 2021.
Section 8 introduces some new techniques that are enriching the part of electronics. In systems ten, thirteen, and fifteen we see the upward glissando that end with the arrow shaped notehead pointed up (figure 3.15).

![Musical Notation]

Figure 3.15. Bloom, Upward glissando in Systems 10 (a), 13 (b), and 15 (c).

The arrow shaped notehead suggests a “highest possible note” on the fingerboard. An interesting effect is observed during that action. As the movements of the left hand ascend the frequencies produced by the cello are actually descend. It can be explained by the engagement of non-harmonic sounds on the strings. Those events trigger the reverberation and a pitch shifting algorithms in the electronics.

Another technique that is introduced in the section features the arpeggiated *staccato*, that is executed by “throwing” the bow on the string IV and allowing it to continue bouncing during the *arpeggio* (figure 3.16). During the discussion with the composer it was specified that the percussive sound of this gesture must dominate over the pitch that is getting produced. Such gesture is planned by the composer to interact with algorithms responsive for amplitude of sound.
At \( \boxed{\text{C}} \) we approach the part of the piece that can be characterized the most dramatic. Here composer is attempting to depict the remarkable moment from the live cycle of flower – its complete unfolding. This aleatoric part of *Bloom* is the most active and represent the climax of the entire piece. The composer invites the performer to improvise with extensive use harmonics, glissandos, ricochet, and tremolos. He also provides a graphic notation that suggests, but does not limit the directions of the movements and the nature of the created sounds. However, the indicated time frames for each of the phrases is expected to be followed as closely as possible. In the original edition of the piece those improvised sections were alternating with set material in the middle register of the instrument (figure 3.17).

However, after revision and consulting with me Austin has changed it to engage open strings. This change has increased the amount of interaction with the electronics and helped to convey the dramaticism of the depicted event. See figure 3.18.

We finally arrive to the last part of the piece - section \( \boxed{\text{F}} \). It is marked *In Full Bloom*. The metaphorical flower is now fully open and presented in its final form. Austin refers to the opening melodic idea, but now it is enriched with the use of open strings (figure 3.19).
The enriched idea now engages with the electronics on a deeper level than it did during the introduction. According to the program notes by composer it concludes with “the most mature statement of the original melodic idea, which signifies completion of the flowering process.”

Figure 3.17. Bloom, Part C, original edition.

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Figure 3.18. *Bloom*, Part C, final edition.

Figure 3.19. *Bloom*, Beginning of the part D.
3.7. Bloom: Complete score and notes by the composer

Bloom

for violoncello and live electronics

Music by Austin Franklin

Commissioned by Eduard Teregulov

2021

c.a. 8’

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Instrumentation

Cello and live electronics

Program notes

A flower does not use words to announce its arrival to the world, it just blooms. — Matshona Dhliwayo

*Bloom* is a piece for violoncello and live electronics that explores tension, using the metaphor of a blooming flower as the basis from which the musical material and form are derived. The work begins with a very simple melodic idea using natural harmonics. These harmonics are developed throughout the piece, eventually blurring the line between pitch and noise, meter and aleatory, and acoustic and electronic elements. The electronic element of the pieces is realized using live input from the cello only. This relies on specific musical parameters (namely amplitude and frequency) to control how the input is processed. The piece concludes with a quasi-recapitulation of the opening, this time incorporating non-harmonic tones. This is the most mature statement of the original melodic idea in the piece, which signifies completion of the flowering process.

Technical notes

*Bloom* uses a Max MSP program (or patch) by which to process and transform the audio. The patch contains instructions on how to set up, operate, rehearse, and finally perform the piece. Please email the composer for the patch after purchasing, or if you have any questions directly at austinalexanderfranklin12@gmail.com.

Performance notes

Ord. – ordinario (normal manner of playing)

OP – apply bow pressure to distort pitch, but not remove it completely

↑ – highest possible pitch on the given string(s)

The electronic sounds used in the piece come solely from the live input to the microphone. There are no triggers for the individual sections, and no MIDI keyboard or instrument is required. Instead, the processing is controlled via specific musical parameters. The resulting sound is not notated in the score since it will sound different for repeat performances. However, the musical parameters and their general effects on the input are described as follows:

- A the loudness increases, the reverb decay time is increased. Brightness, or “glittery-ness” is also increased via down sampling on the signal.

- As lower pitches are performed, a variable delay time is increased. There are three separate delay lines in total, each with independent delay times that are determined by pitch. Frequencies below ‘A’ 440 Hz are also pitch shifted down a perfect 5th.

- As the rate of discrete pitch change increases the location of a sound in the stereo field is varied more rapidly.
With the exception of the improvised section at letter C, the pitches and dynamics should be taken as literally as possible because they exhibit the most control over audio processing.

The notation provided at the improvised section should be used as a guide, considering the way the electronics operate. This section may be performed as written or may be changed to incorporate more percussive elements (knocking on body of instrument, snap pizz, etc.). However, the overall length of the section should be mostly left unchanged. The electronics during this section should also be at their most active.
Bloom

[Musical notation]

> C Violently unfurling

Improvise with harmonics and glissandos for the given duration, incorporating small pauses and ricochets throughout each phrase.

6-8'

> 8-10'

mf

83
Bloom

In Full Bloom

84
Chapter 4. Alex Shanafelt and waveForm

4.1. Introduction

In December of 2020, a University of South Florida alumnus and an Indianapolis based composer Alex Shanafelt approached me regarding writing a piece for cello solo. During our initial conversation I suggested that he write a piece for cello and electronics instead, to which he gladly agreed. After several months, Alex completed WaveForm in June 2021, written for cello and interactive electronics.

4.2. Biography

Alex received his Bachelor of Music degree in Music Composition at Butler University in Indianapolis, IN, where he studied with Michael Schelle, James Aikman, and Frank Felice. After graduating from Butler University, Alex did his graduate studies at the University of South Florida in Tampa, FL, where he received his Master of Music in Music Composition under the mentorship of Benjamin D. Whiting and Paul Reller, along with Jazz instruction from Chuck Owen.

Figure 4.1. Photo of Alex Shanafelt.
Alex Shanafelt is an emerging American composer. As stated on his website, he “constantly discerning new influences to help integrate contemporary, popular, and Jazz languages into his music. He often looks for methods to incorporate improvisation and performer agency in his music, questioning and altering the role of the composer and of notation.”  

Shanafelt has written a repertory varying from small chamber groups and symphony orchestra to electroacoustic music. As a composer, he participated at the Nief-Norf Summer Festival, the Atlantic Music Festival, the Charlotte New Music Festival, and the Wintergreen Sumer Music Academy, where he was commission to write original works, such as *Current.ly* for percussion and electronics, *Locomotive* for tenor and piano *Seven Haikus* for flute, clarinet, violin and cello, and *Cartoon for Loadbang* for baritone voice, trumpet, trombone, and bass clarinet. Shanafelt was also commissioned to write for organization such as Fresh-Squeezed Opera Company and Hypercube. In 2020 Alex Shanafelt became a finalist at the ASCAP Foundation’s Morton Gould Young Composer Awards Competition. Currently Alex is working closely with Indianapolis-based Ballet INitiative on creating the new works that involve dance and electronics.  

Shanafelt and trumpet player, Kent Hickey, have co-founded a Jazz nonet that performs on the jazz and new music scenes of Indiana, including venues such as The Cat, McGowan Hall, The Jazz Kitchen, and Merriam’s Playhouse. Alex Shanafelt is also one of the co-founders of the Contemporary Art Music Project (CAMP). CAMP is an organization that “promotes innovative new music by collaborating with living composers and performing artists from around the world.”

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34 Ibid.
35 Ibid.
Alex Shanafelt was born in New Haven, CT in 1997, but has lived nearly his entire life in Indianapolis, IN. Here, he started piano lessons at a young age, and, although his musical journey began early, it was considered more of a casual pursuit rather than a passion. In middle school, Alex joined the band program on trumpet, which soon became his primary instrument. Playing on the horn sparked a new inspiration for music, as he was exposed to new solo, large ensemble, and jazz literature. Soon after, Alex became interested in and started experimenting with composition, largely on his own and without guidance, independently teaching himself about key signatures and harmonic progressions through Mozart sonatas. His early compositions were simple, short tunes for solo piano, but during his time in high school, he attempted compositions for concert band and orchestra, as well as jazz band. As he independently studied composition, he felt most influenced and moved by composers: Ravel, Messiaen, and Bartok. Shortly after, John Cage rose to the top of that list, and has since been a primary influence on Alex’s music and compositional style. Over time, his interest in music performance shifted towards a passion for music composition, inspiring him to study the field at Butler University as his undergraduate major. Being involved in a variety of ensembles in high school (concert band, marching band, orchestra, jazz band, backup band, and pit orchestra) developed in him a broad and diverse taste in music with a breadth of materials in his toolchest. Alex’s time at Butler was defined by consistent growth in his technical ability as a composer, as well as a new fascination with chamber music. His exposure to Crumb, Ligeti, and Ives were massively influential in transitioning a primarily romantic compositional style into music that was more performative, systematic, and theoretical. While at Butler, Alex was involved with a multitude of collaborative projects, such as co-composing an opera Winesburg, IN, scoring a dance piece Spectrum, and co-founding the group the Hickey-Shanafelt 9ollective with his friend and musical colleague,
Kent Hickey, where he acts as the composer and conductor of the group. His involvement with these collaborations cemented him as a composer not just of contemporary classical music, but as a flexible composer who was capable of writing in multiple styles and drawing on many influences. However, it was Alex’s time at the University of South Florida where he experienced his greatest musical growth. During the pursuit of his Master’s degree, Shanafelt was exposed to a massive amount of composers, musical history, and electronic music. His compositional taste and style became greatly refined and focused, and he discovered an exciting new fascination with electronic music. While at USF, minimalism rose as a source of inspiration, as well as a reaffirmation of the philosophies of the New York School.\textsuperscript{36}

Today, Alex’s music is defined by a fascination with form and performer agency. He looks to write music that’s living; in other words, music that changes and evolves with every performance, depending on who’s performing it: it’s not just retold, it’s remade. When writing a piece, he often begins with a concept related to its performance. For \textit{waveForm}, it was the influence the musician has on the length and timing of the formal structure. Other examples include \textit{pre diction} for soprano and “found” metals, where the performer draws and organizes playing cards to determine form, and \textit{Two-Step and Game Sounds}, where performers literally pick and choose the music they play. Additionally, Alex has a deep fascination with notation, stemming from a life-long interest in the differences between graphic/aleatoric music and ‘ultra-complexed’ music: although the notations are drastically different, often the aural result is uncannily similar. He often seeks for methods to combine unorthodox notation with concepts of performer agency in his compositions. His aesthetic is often based in thick, interwoven textures in juxtaposition with simplistic elements, often rooted in the tertian harmonies of jazz and

\textsuperscript{36} Shanafelt, Alex (composer of \textit{waveForm}), in discussions with the author, July 7, 2021.
typically avoiding rhythmic complexity. His influences today include Louis Andriessen, Glenn Branca, Hiatus Kaiyote, and, of course, John Cage.37

4.3. Origin of the piece and composition technique 38

To write composition waveForm Alex Shanafelt used the mathematical method of composition known as *data-driven*. He created a data base from the geographical locations of 200 major capitals in the world, such as Tokyo, São Paolo, Moscow, Shanghai, Yerevan, etc. Their coordinates on the world map were used to generate the pitch and rhythmic content of the cello part, where latitude and longitude were respectively used to determine pitch and duration. To calculate the pitch content within, Alex took a 24-tone system where each number represents one of the 24 quarter tones within an octave. For example, the location of Tirane, Albani is 41.18N latitude, and 19.49E longitude. Shanafelt used the mod 24 calculation out of number 41.18, ignoring the decimal place, resulting in the number 14 (figure 4.2). The number 14 in the 24 tone is equal to pitch class “G”.

\[
4118 - (24 * 171) = 14
\]

Figure 4.2. Shows example of mod 24 calculation.

To define the duration of the note, Alex used operation mod 32 out of number 1949, which is refers to the longitude, also ignoring the decimal place. Each calculated number represent a 32\textsuperscript{nd} fraction of a whole note (figure 4.3).

37 Ibid.
38 Ibid.
Figure 4.3. Show example of mod 32 calculation.

The calculated number 29 is equal to a dotted half noted tied to an eighth note tied to a thirty second note. For a better representation please see figure 4.4.

![Example of mod 32 calculation](image.png)

Figure 4.4. Shows the resulting duration of number 29 in the context of 32 mod calculation.

Originally, Alex intended to organize the pitches based on the relation of the geographical location of the cities to one another. However, that method did not result in the desired outcome. Instead, Shanafelt decided that he was going to organize them intuitively. I would also like to add that the calculated values of the notes are not presented in the score exactly, but instead used to define the distance between the notes with the intent to be interpreted by the performer.

### 4.4. Notation system

In the work *waveForm* Alex Shanafelt uses spatial organization of the musical material. According to the performance notes by the composer “the cellist may decide to take two or thirty seconds [for each line]... Regardless of the time taken…the material within the system must be performed proportionally in regards to its literal position.”

This means that during the performance, the cellist has complete freedom to decide the duration of each system individually,

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however once the system has started, the speed of flow (or tempo) has to remain the same, until
the next system.

In addition to the spatial organization, Alex differentiates the length of individual notes
by using a system similar to traditional rhythmic notation (figure 5). Nonetheless, the note
indications do not carry any consistent length by any given notehead and do not affect the time
between the pitches. Rather, it gives a rough idea to a performer how long individual pitches
should be performed in relation to each other. The composer refers to those notehead indications
as rhythmics ‘ghosts’, where the closed notehead with a double beam is considered to be the
shortest duration, and the open notehead with a dot mean to be the longest. The connection of the
notes through a single beam line is used for indication of musical phrasing. In the composer’s
words “notes beamed together should be considered as a coherent gesture or phrase.” 40

Figure 4.5. waveform, Rhythmic ‘ghosts’

The pitch notation remains traditional, with the inclusion of quarter tone alterations
(figure 6). In addition, I would like to mention that all the quarter tone alteration symbols affect
the note by exactly 50 cents in each direction. It means that there should be no difference in
tuning between both “C♯” and “Db”, as well as “B♭” and “C♯”, etc.

Figure 4.6. Used symbols for quarter tone alteration

40 Ibid.
4.5. Analysis and brief description of the patch

The *waveForm* can be considered as a polyformal work. Due to its aleatoric nature the piece is meant to vary greatly from one performance to another. As mentioned in the section above, the timing in the cello part is to be interpreted by the performer in the process. The same idea can be applied to the electronics. Most of the electronics contain a random element that does not depend on the actions of the cellist.

The part of electronics is designed and written on a platform for audio synthesis and algorithmics composition, known as *SuperCollider*.

*WaveForm* consists of 40 scenes that utilize a combination of 20 different effects. The processes can be divided into two main types - live processing and synthesizers.

4.5.1. Live processing

This type of processes is programmed to receive and modify the existing sound of the instrument. Therefore, these processes are not capable of producing sounds without receiving the audio signal from an acoustic instrument. Below is a brief description accompanied by an example of the code for each live processing effect used in *waveForm*:

*Pad* is a simple reverb process that stays active throughout the work to add a little more body to the cello’s natural, acoustic sound;

```plaintext
38 NDef(‘pad’, { 39 var in; 40 var out; 41 | 42 in = SoundIn.ar; 43 out = NHall.ar([in, in], 0.75, 0.8, 50, hiFreq: 6000, earlyDiffusion: 0.6, lateDiffusion: 0.35, modRate: 0.05, modDepth: 0.05));
```

Figure 4.7. *Pad*, Code lines 58 – 64.

*Grain* is a simple granular process that’s applied to the incoming cello’s sound;

```
Dual is a granular process with variable grain size and mix. Arguments ‘inMix’ and ‘gMix’ determine the presence of the raw cello output and the granulized output, respectively. The granulized output is also pitch-shifted up 3 octaves (line 85 – inGrain…) with the intention of augmenting cello’s sound;

Amped is a distortion process using a default SuperCollider process called “CrossoverDistortion” (line 99). After being slightly granulized, the input is fed into the distortion process, then into a minor reverb to create the effect of an electric amplifier;

Duo

Figure 4.8. Grain, Code lines 66 – 74.

Figure 4.9. Dual, Code lines 77 – 89.

Figure 4.10. Amped, Code lines 92 – 104.

93
*Streson* is a reverb process using a default SuperCollider process called “Streson.”

Streson is a tool that’s intended to mimic the sonic qualities of string instruments, such as their spectral content. Multiple instances of Streson are called and layered on each other, each with unique values that affect panning, delay time, and resonance to create a dynamic and unpredictable reverb process;

```c
Tdef('streson', {
    Ndef('streson').play;
    Ndef('streson1').play;
    Ndef('streson2').play;
    Ndef('streson3').play;
    Ndef('streson4').play;
    Ndef('streson5').play;
    Ndef('streson6').play;
});
```

Figure 4.11. *Streson*, Code lines 286 – 294.

*Shimmer* is a simple reverb process that almost exclusively reflects higher frequencies;

```c
Ndef('shimmer', { arg amp=1;
    var in, out;
    in = SoundIn.ar;
    in = PitchShift.ar(in, 0.01, 3.1, 0.2);
    out = JPVerb.ar(in, 0.2, 0, 0.6, 0.99, 0.5, 10, 0.0001, 0.01, 0.999, 6000, 7000);
    out = JPVerb.ar(out, 0.2, 0.01, 2, 0.95, 1, 10, 0.0001, 0.01, 0.999, 6000, 7000);
    out*amp;
});
```

Figure 4.12. *Shimmer*, Code lines 312 – 320.

*Metal* is a distortion process that calls multiple delays of the input, resulting in a metallic output. The input’s frequencies are additionally limited within particular boundaries to enhance this effect;

*PitchReverb* is a reverb process that dynamically increases the level of reverb depending on the frequency of the pitch. Modulating the arguments (‘degree’, ‘lo’, ‘hi’) will affect the sensitivity and intensity of the applied effects;


*LoVerb* is a simple reverb process that limits the input to its lowest frequencies and focuses its reflections on lower frequencies;

Figure 4.15. *LoVerb*, Code lines 357 – 363.
Delay is a simple delay process that instances four delayed outputs. The pan position of each delay is randomized;

```plaintext
475  Ndef('delay', {
476      var in, out;
477      var d1, d2, d3, d4, d5;
478      var d10, d20, d30, d40, d50;
479      in = SoundIn.ar;
480      in = BBandStop.ar(in, 400, 3);
481      d1 = CombL.ar(in, 0.3, 0.15, 0.5);
482      d10 = Pan2.ar(d1, Latch.kr(Dust2.kr(500), Impulse.kr(1)));
483      d2 = CombL.ar(in, 0.3, 0.25, (-0.5));
484      d20 = Pan2.ar(d2, Latch.kr(Dust2.kr(500), Impulse.kr(0.5)));
485      d3 = CombL.ar(in, 0.5, 0.4, 0.7);
486      d30 = Pan2.ar(d3, Latch.kr(Dust2.kr(500), Impulse.kr(2)));
487      d4 = CombL.ar(in, 1, 0.45, (-0.7));
488      d40 = Pan2.ar(d4, Latch.kr(Dust2.kr(500), Impulse.kr(0.8)));
489      d5 = CombL.ar(in, 1, 0.45, (-0.7));
490      d50 = Pan2.ar(d5, Latch.kr(Dust2.kr(500), Impulse.kr(0.8)));
491      out = Mix.ar([d10, d20, d30, d40]);
492  });
```

Figure 4.16. Delay, Code lines 475 – 493.

4.5.2 Synthesizers

Synthesizers, also known as synths, are the processes that generate the sounds based on the algorithms that are programmed by the composer. Those processes are self-sufficient and do not depend on, nor are affected by the cello part. Below are descriptions of the synthesizing processes of the patch and examples of the code:

GenOne is a chaotic synth that utilizes the default SuperCollider audio generator called Gendy. As described in the program’s documentation, Gendy is “an implementation of the dynamic stochastic synthesis generator conceived by Iannis Xenakis and described in Formalized Music (1992, Stuyvesant, NY: Pendragon Press) chapter 9 (pp 246-254) and chapters 13 and 14 (pp 289-322)” 42 This synth is built from a number of complex functions

with a few alterable variables. In GenOne, collections of values, called ‘arrays,’ are
defined/generated. Values from these arrays are randomly chosen and fed through multiple
“Choose” functions that select/trigger other values based on the input from the arrays. The
resulting values are thus randomly generated at an exponential level and fed through the Gendy
process to create an aperiodic chaos synth;

```plaintext
Ndef('genOne', { arg amp=1;
  var ampDist, durDist, dD, freq;
  var trig, freqTrig, array, arrayT, arrayP, mod;
  var out, pos;

  array = [50, 100, 150, 200, 250, 300, 350, 400, 450, 500];
  arrayT = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10];
  arrayP = Array.fill(100, {arg i; (((i+1)/(i+1))-2)+(0.02*(i+1))});
  trig = Pulse.kr(50);
  durDist = Latch.kr(WhiteNoise.ar, trig);
  ampDist = Latch.kr(TRand.kr(0, 6, trig));
  mod = SinOsc.kr(0.1);
  mod = SinOsc.kr(mod);
  mod = SinOsc.kr(mod);
  dD = SinOsc.kr(mod, add: 1);
  freqTrig = TChoose.kr(trig, arrayT);
  freqTrig = (freqTrig-11)*[-1];
  freq = TChoose.kr(freqTrig, array);
  out = (Gendy4.ar(ampDist, durDist, 1, dD, freq, ((freq*(freq/50))+1), dD, dD)*amp;
  pos = TChoose.kr(trig, arrayP);
  Pan2.ar(out, pos);
});
```

Figure 4.17. *GenOne*, Code lines 107 – 128.

*GenTwo* is a chaotic synth utilizing “Gendy.” Here, the shape of a sawtooth wave is
combined with the chaos of the Gendy synth, where each are alternatively fed into the other
multiple times. This kind of exploitation creates a unique, periodic chaotic output;
Figure 4.18. GenTwo, Code lines 131 – 143.

GenThree is a chaotic synth utilizing “Gendy.” First, an array of values is randomly generated and ordered. After generation, they are constantly altered by a random and changing amount. These values are periodically selected to be inputted into the Gendy synth at varying degrees, the output sound being proportionally panned across the stereo speakers based on the selected value.

Figure 4.19. GenThree, Code lines 146 – 159.

Noise is a chaotic synth utilizing a default SuperCollider process called “Crackle”. Crackle is a random noise generator, similar in function to a white noise machine. Three different instances of Crackle are called upon, each with modulating values operating at different degrees of intensity;
Wash is a simple synth with the core sound being pink noise. The noise is fed through a sine-shaped envelope with varying lengths, producing a sound similar to tides:

```lisp
92 Ndef('noise', { arg amp=1, rate=1.5, pitch=1;
93   var mod, mod1, mod2;
94   var n, n1, n2;
95   var pos, pos1, pos2;
96   var out;
97   mod = TRand.kr(0.95, 1.95, Impulse.kr(rate));
98   mod1 = TRand.kr(0.95, 1.95, Impulse.kr(rate*1.15));
99   mod2 = TRand.kr(0.95, 1.95, Impulse.kr(rate*1.5));
100  pos = SinOsc.kr(0.01);
101  pos1 = SinOsc.kr(0.02, 0.2, mul: (-1));
102  pos2 = SinOsc.kr(0.008, 0.5);
103  n = Pan2.ar((crackle.ar(mod.lag(rate.reciprocal)), pos);
104  n1 = Pan2.ar((crackle.ar(mod1.lag(rate.reciprocal)), pos1);
105  n2 = Pan2.ar((crackle.ar(mod2.lag(rate.reciprocal)), pos2);
106  out = Mix.ar([n, n1, n2]);
107  out = PitchShift.ar(out, pitchRatio: pitch);
108  out*amp;
109
110 });
```

Figure 4.20. Noise, Code lines 162 – 184.

Slender is a simple synth that dynamically changes the frequency and pan position of a sawtooth synth. The range of frequencies is defaulted between 25 and 85 hertz, but the high end can be changed to create a greater degree of chaos:

```lisp
297 Ndef('wash', {arg amp=1;
298   var env, trig, modTrig, mod, noise;
299   var out;
300   modTrig = Impulse.kr(15.reciprocal);
301   mod = TRandom.kr(modTrig, [5, 7, 9, 11, 13]);
302   trig = Impulse.kr((mod+1).reciprocal);
303   env = EnvGen.kr(Env.sine(mod), trig);
304   out = Pan2.ar(PinkNoise.ar);
305   out = out*env;
306   out = NHHall.ar(out, 6.8, 1, 100, 1.5, hiRatio: 0.3, modRate: 0.9, modDepth: 0.9);
307   out*amp;
308
309 });
```

Figure 4.21. Wash, Code lines 297 – 309.

Slender is a simple synth that dynamically changes the frequency and pan position of a sawtooth synth. The range of frequencies is defaulted between 25 and 85 hertz, but the high end can be changed to create a greater degree of chaos;
Figure 4.22. Slender, Code lines 366 – 376.

*Pulse* is a simple synth that produces a near subtone sine wave that is fed into a manual envelope similar to a sine shape, outputting a low tone that ‘pulses’ in and out of the texture;

```plaintext
Ndef('slender', { arg amp=0.7, hi=85, rate=100; 
var out; 
var trig, freq, pos; 
trig = Dust.kr(rate); 
freq = TRand.kr(25, hi, trig); 
pos = TRand.kr(-1, 1, trig); 
out = Saw.ar(freq); 
out = Pan2.ar(out, (pos).lag(0.1)); 
out*amp; 
});
```

Figure 4.23. Pulse, Code lines 379 – 387.

*Drips* is a synth comprised of layered sine synths. The frequencies of each sine wave are randomly generated but dependent on each other, creating momentary, unique harmonic spectra. These tones are gated. The gate opens and closes at a random rate. The gate’s rate, as well as the frequency content, can be altered;

```plaintext
Ndef('pulse', { arg amp=1, rate=0.44, peak=1.2; 
var gate, env, sig, out; 
gate = Impulse.kr(rate); 
env = EnvGen.kr(Env([0.1, peak, 0.1], [(rate.reciprocal)-0.3, 0.3], 4), gate); 
sig = Mix.ar([SinOsc.ar(59, mul: 0.7), SinOsc.ar(59.4, mul: 1.2)]); 
out = sig*env; 
out.dup*amp; 
});
```
Clicks is a synth with two parts. The first is a synth that generates a series of harmonics based on an input value. This input value is steadily modulated by a sine wave, producing a drone with evolving formant content. The second part is similar in concept to Drips: a sawtooth wave is gated and sounds at random intervals. Relatively, however, the time the gate is open is significantly shorter. The spectral drone is optional and can be removed.
Slides is a synth that, once again, is similar in concept to Drips. However, the tones in this synth are always pitch modulated in a way that mimics the shape of a sine wave. The rate of the gate can be influenced and, in doing so, one also affects the frequencies of the tones, their lengths, and the degree of their pitch shift.

```
Ndef('clicks', { arg amp=1, baseWidth = 40, widthRate = 0.08, lo=0.01, hi=3, droneMix=1;  
  var out;  
  var drone, width;  
  var rate, trig, env, gate, sig;  
  var v;  
  width = SinOsc.kr(widthRate, mul: 0.96, add: 1);  
  width = baseWidth/width;  
  drone = (Formant.ar(30, 300, width, 0.8)).dup;  
  trig = Impulse.kr(5);  
  v = TRand.kr(100, 350, trig);  
  sig = SyncSaw.ar(v, v*pt(\w/70));  
  rate = TRand.kr(lo, hi, trig);  
  gate = Impulse.kr(rate);  
  env = EnvGen.kr(Env.perc(0.001, 0.1), gate);  
  out = Mix.ar([sig, drone*droneMix]);  
  out*amp;  
});
```

Figure 4.25. *Clicks*, Code lines 425 – 445.

```
Ndef('slips', { arg amp=0.5, lo=2, hi=3, flo=100, fhi=3000; //try with a high 'hi'  
  var env2, sigl, sig2, sig3, sig4;  
  trig = Impulse.kr(hi);  
  rate = TRand.kr(lo, hi, trg);  
  gate = Impulse.kr(rate);  
  env1 = EnvGen.kr(Env.perc(0.01, hi.reciprocal(2)), gate);  
  env2 = EnvGen.kr(Env.sine(hi.reciprocal(2), 0.5), gate);  
  v = TRand.kr(flo, fhi, trg);  
  sigl = SinOscF8.ar(v*env2, 0.5);  
  sig2 = SinOscF8.ar(v*(v-Z)*env2, 0.8);  
  sig3 = SinOscF8.ar(v-(v/3)*env2, 1.1);  
  sig4 = SinOscF8.ar(v-(v/4)*env2, rate);  
  out = Mix.ar([sigl, sig2, sig3, sig4]);  
  out1 = DelayN.ar(out*env2, 0.01, 0.01);  
  out2 = DelayN.ar(out*env2, 0.025, 0.025);  
  out = Mix.ar([out, out1, out2]);  
  out = Limiter.ar(out, 0.7);  
  out*amp;  
});
```

Figure 4.26. *Slides*, Code lines 448 – 472.
4.7. *waveForm*: Complete score

*waveForm*

for cello and electronics

Music by Alex Shanafelt

Commissioned by Eduard Teregulov

2021

c. N/A

---

Instrumentation

Cello and live electronics

Program notes

This work sounds as an ever-evolving melody, a mass of gestures without a reference point, a progression removed from a linear, tangible trajectory. Just as the ripple becomes lost amongst the waves, so does the music fold upon itself.


Performance notes

In waveForm, material within systems is organized spatially. However, the time taken to perform any particular system is variable – the cellist may decide to take two seconds or thirty seconds. Regardless of the time taken, though, the material within at system must be performed proportionally in regards to its literal position. While noteheads and dots suggest a rhythmic ‘ghost,’ durations are ultimately determined by the performer. With this in mind, an open notehead with a dot is considered to have the ‘longest’ duration, while a closed notehead with a double beam is considered to be the ‘shortest.’ Furthermore, the distance between notes will vary from stave to stave. In other words, there is no consistent ‘length’ for any given notehead. Above all, as established, musical material must be performed proportionally in regards to its spatial placement in the system. Notes beamed together should be considered as a coherent gesture or phrase.

Lines attached to notes indicate glissandi and/or pitch bends. If there is no notated arrival pitch, then it is undefined. Dashed arrows above staves represent a steady gradual change from the current bowing technique to another. Boxed numbers indicate electronic cues in the SuperCollider file. Cues are advanced by depressing a MIDI pedal or executed externally.
waveForm
for Eduard Teregulov
Alex Shanafelt

Score

Cello

jeté
1 pizz.
ff

ord.
jeté

pp — f

pp — f

(f)

3

pf

f

4

S.P.
jeté

mf

ff — p

ff — pp — ff

jeté

pizz.
arco S.P.

5

pp — ff
waveForm
waveForm
Summary

Despite its relatively young age, in comparison to the library of traditional repertoire, Western Art Music already has a vast catalogue of electroacoustic compositions that is still growing exponentially. Thanks to many enthusiastic composers and innovators of the twentieth and twenty first centuries it is now have become a self-contained musical genre whose application differs from traditional recitals and its use in movie productions to now being presented, performed and discussed at national and worldwide conferences and festivals.

The material in this paper provides documentation of collaborative work with composers Paul Lewis, Thomas Wilson, Austin Franklin, and Alex Shanafelt, in the creation of original compositions. I hope that this paper and resulting new compositions will encourage my fellow performers to collaborate with the living composers as well will give a better understanding to composers of the important nuances of working with the performers.
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Vita

Originally from Ufa, Russia, Eduard Teregulov is a cellist, conductor, and contemporary art-music advocate residing in Baton Rouge, Louisiana. A recipient of the Beth and Butler Fuller Scholarship (2020) and Charlie and Carole Lamar Scholarship (2019), Mr. Teregulov has been a laureate in local and international competitions, including the 4th Interregional Youth String Competition (Russia, 2004), the International Music Competition “Citta Di Barletta” (Italy, 2012), and the NOLA Chamber Competition (New Orleans, Louisiana, 2019).

Eduard holds a Bachelor of Music degree in Cello Performance and Music Education from Ufa State Academy of Arts, as well as a Master of Music degree in Music Performance from the University of South Florida. He is planning to receive his Doctor of Musical Arts degree at Louisiana State University in December 2021.

Mr. Teregulov is the Artistic Director and a founding member of Homegrown New Music Ensemble, as well as a member of the Constantinides New Music Ensemble, based at Louisiana State University.