Odyssey of Undulating Horizons

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ABSTRACT

The goal of this project is to come up with a unique orchestral composition, made possible by using top-notch orchestral sample libraries and genuine musician recordings. The project involves several steps, including composing, transcribing, recording, arranging, mixing, and mastering. When it comes to mixing and mastering, I first use artificial intelligence technology to create a starting point. From there, I make additional tweaks and add my own creative ideas to get the sound I'm aiming for.

1. INTRODUCTION

For my capstone project, I chose to compose an original orchestral piece using sample libraries while incorporating audio recordings of real musicians. Inspired by my favorite composer, Yu-Peng Chen, my goal was to create a composition suitable as background music for a video game. To accomplish this, I transcribed and analyzed his composition "Stories of Remote Antiquity," as referenced in [1], and merged some of his techniques with my own throughout the composing process.

During the production process, I utilized the BBC Symphony orchestras [18] and Appassionata Strings [19] to lay the foundation of the song. To enhance the track with virtuosic performances, I hired a professional violinist friend and recorded him at the recording studio at Snell. His contribution added a layer of authenticity to the piece and made it stand out.

Overall, this project has allowed me to combine my passion for orchestral programming and audio engineering to create a composition that I am proud of.

2. BACKGROUND

2.1 Musical

As this project is inspired by my favorite composer Yu-Peng Chen, I would like to apply and adapt some of the techniques he used in his composition to combine with my own ideas. The vision of this project is to compose an orchestral song used for video games; therefore, I transcribed and reconstruct “Stories of Remote Antiquity” composed by Yu-Peng Chen, which the musical analysis will be based on. Additionally, I examined “Decayed in the Darkness,” a composition by Qian Ding as in [17], in an effort to explore various techniques from a different perspective.

2.1.1 Structure

The structure of [1] primarily consists of an introduction, four distinct parts, and an outro. Within the four sections, each part features varying layers of instrumentation and its own unique main melody. The main melody is frequently passed among different instruments to extend the musical phrase. I aimed to incorporate this technique in my piece, as it enlivens the melody and creates the impression of a shared story told by different characters. In the introduction of [17], the composer initiates the piece with solid piano block chords, which are later accompanied by strings to enrich the texture. The strings contribute additional notes within the same chord alongside the piano. I aspired to integrate this technique into my composition to generate tension and captivate the listener's interest.

2.1.2 Techniques

As Yu-Peng Chen explained in the interview [2], sequencing played a significant role in much of his music, facilitating continuous emotional development and the progression of storytelling. This technique involved slight variations of the same musical idea, often transitioning it to a different key to leave a strong impression on the audience. I aimed to incorporate this technique with more than just one melody to sequence.

In work [1], Part B (measures 21-34) ingeniously employed the same piano melody with a parallel shift. This shift produced a distinct sound texture that maintained the same interval distance between notes while driving the piece forward. I applied the same technique but experimented with additional possibilities for shifting the melody through key changes.

In work [17], the composer cleverly blended piano and harp to present the main motif of the piece to the listener. This was achieved by utilizing the piano to perform the high melody line, accompanied by the harp's ethereal sonic qualities during measures 9-16. I chose to employ this technique in my composition to enhance the delivery of the main melodic motif in certain passages.

2.1.3 Articulation

Yu-Peng Chen extensively employed articulation techniques to enhance the narrative. In the introduction of [1], he utilized tremolo on strings to establish a somber atmosphere. This mirrored his approach in [3], where the tremolo on strings evoked feelings of coldness, discomfort, and unease, effectively supporting the intended mood. In the outro of [4], he employed quiet pizzicato on strings as a substitute for the piano chords featured in the previous section. This provided an ideal conclusion and contrasted the louder, sustained notes that began the piece. A similar articulation technique can be found in [17] between measures 17-20, where the composer transitioned from the harp to pizzicato strings to maintain the musical role. This method generated interest and cleverly capitalized on the pizzicato's characteristics, as it shared a comparable plucked effect with the harp. I utilized various articulations to support the main melody and manipulate the emotional tone of the narrative I aimed to convey.

2.2 Production

The production of this project was completed in Logic Pro X utilizing sample libraries such as BBC Symphony Orchestra Professional and Appassionata Strings. MIDI was widely used to control the sample and apply MIDI continuous controller parameters to humanize the musical phrases, as described in [5]. The MIDI CC transformed the performance of the samples into a more realistic rendition by controlling the expression and dynamics to emulate the fluctuations found in live performances.

2.2.1 Mic Signal

BBC Symphony Orchestra and Appassionata Strings provides a wide option of mic signals. To achieve a wider, larger sound, a standard way to do it is to create a mixture of the close mic, Decca tree, and outriggers mic as in [6]. However, for solo instruments, I would like to experiment with close-mic mixing

combined with spill-mic techniques to create a focused sound for the solo while still preserving the natural reverb of the performance space.

2.2.2 Reverb

While the sample library includes its own reverb controls, I aim to blend it with various reverb plugins using sends for creative purposes. I employed minimal built-in reverb or utilized mic signals that convey a strong sense of reverberation, such as spill/tree mics, to generate a more natural sound, as these represent the original environment in which the samples were recorded. Furthermore, I experimented with impulse response reverb (e.g., Space Designer) and algorithmic reverb (e.g., Valhalla Room, Valhalla Vintage Verb) plugins, as described in [7], to explore the unique sounds I could create.

2.2.3 Saturation

Saturation can make a significant difference in the mix. In [8], the audio underwent processing through various saturation hardware and plugins to enhance the harmonic content. The impact of increased harmonics on the audio was also demonstrated in [9]. This is a common technique employed by professional mixing engineers to create a fuller sound. Sometimes, they would route the audio through an analog device to subtly color it with low harmonics and distortion without adjusting any parameters. I tested this approach using the Oxford Inflator during the mixing process.

2.3 Recording

The recording process took place at Northeastern University's Snell Library Recording Studio, where I leveraged their acoustically optimized environment, extensive microphone selection, and high-quality analog preamps that enriched the character of the incoming audio.

2.3.1 Microphone

In [10], the author detailed methods for recording acoustic string instruments in a moderately sized space. Utilizing a small diaphragm condenser microphone proved to be a better option for this project, as I recorded a violin that played in a high register throughout the piece. Compared to large diaphragm mics that pick up more low-end frequencies, small diaphragm mics can more accurately capture higher frequencies. In this project, I positioned a pair of Rode NT5 microphones as overheads to record the violin performance.

2.3.2 Preamplifier

In reference [11], the same guitar audio was processed through API 512c, Rupert Neve 511, and Maag PreQ4. The Maag PreQ4 produced a more natural, uncolored sound compared to the other two, while the air band module enhanced high harmonics without introducing harshness or artificial byproducts. Fortunately, our studio was equipped with all three preamps, and I had prior experience working with API and Neve. In this project, I experimented with the Maag PreQ4 to enrich the high-end tones of the violin recording.

3. PROJECT DESCRIPTION

3.1 COMPOSITION

3.1.1 Theme & Ideas

The central concept of the composition involves utilizing a robust melodic theme as a recurring motif throughout the entire piece, which serves as the driving force propelling the music forward. Each time the melody is reintroduced, subtle variations are incorporated to maintain interest and prevent excessive repetition. Moreover, as the emotional tone of each section shifts, corresponding key qualities are employed to introduce diverse melodies.

In order to infuse the composition with a range of emotional dynamics, I incorporated numerous key changes, alternating between major and minor, which effectively transformed the emotional ambiance. Moreover, by allocating the melody to various instruments and sections, I enhanced the overall auditory experience, creating a rich tapestry of sound.

3.1.2 Structure

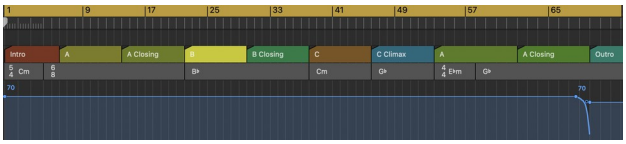

Figure 1: Structure, Key, and Time Signature

As demonstrated in figure 1. The structure of the song comprises an intro, followed by sections A, B, and C, with a return to section A, and finally concluding with an outro. Sections A and B can each be further divided into an opening and closing segment, characterized by a heightened emotional intensity achieved through the addition of instrumental layers, an increase in register, and an acceleration of rhythmic pace.

In Section C, the song reach it's climax, striking the highest register and exhibiting the most powerful dynamics. Subsequently, the piece revisits Section A, though in a distinct key and with an altered time signature, to reintroduce the opening melody in a fresh context.

Finally, the song concludes with an outro featuring woodwind long notes and a ritardando piano ascending in pitch, accompanied by the delicate tones of a glockenspiel.

3.1.3 Key & Time Signature

The song begins in c minor with an odd time signature of 5/4, imbuing a sense of foreboding and melancholy that establishes the song's atmosphere and leaves a lasting impression on the listener. Later, in Section A, the time signature transitioned to 6/8, signaling the end of the intro and continuing throughout Section C until its end.

In Section B, the key shifts to B-flat major, marking the initial transition between major and minor keys. This facilitates the development of novel melodic content and provides the listener with a refreshing variation in the musical experience.

Afterward, the song returns to C minor in Section C, reintroducing the melodic motif with variations and accompanied by a distinct chord progression. This serves to heighten intensity and emphasize the song's climax in the latter half of Section C. The climax is reached when the song modulates to G-flat major, offering an emotional contrast and surprising the listener with an abrupt shift in tonality. Despite the sudden change, the transition remains smooth and seamless.

Following the climax, the song revisits Section A, commencing in E-flat minor with a 4/4 time signature. The familiar melodic motif reappears, played by and passed between various woodwind instruments. As the melody transitions between instruments, the key shifts to E-flat minor's relative major, G-flat major. The song maintains both G-flat major and the 4/4 time signature through to the conclusion of the outro.

3.2 PRODUCTION

3.2.1 Sample Libraries

The choice of sample libraries for this project was determined by the desired tone and quality. As outlined in [12], the optimal approach to initiating a composition involves selecting the appropriate tools and sounds, thereby minimizing the need for excessive processing to mold the audio into the intended result.

Serving as the driving force throughout the entire piece, I opted for an intimate grand piano, known for its gentle,

personal, and authentic sound, captured from a vintage Steinway Model A grand piano. The reverb is programmed based on the actual room reflections where the piano was recorded, which effectively accentuates the instrument's unique characteristics. This allows the piano to stand out, either as a solo element or as a seamless accompaniment within the composition.

For the string sections, I employed the Appassionata Strings library, renowned for its advanced legato algorithm that eliminates the artificial imperfections often noticeable in other sample libraries during note transitions. The vibrato in this library also sounds more realistic and natural, as it activates slightly after the note is played, closely resembling the performance style of real musicians. These attributes make it an invaluable tool for performing melodic lines or functioning as a layered accompaniment that harmonizes with the foreground elements.

Lastly, for the rest of the orchestral instruments, I decided to use the BBCSO Professional library to establish a solid foundation for the piece. The BBCSO library encompasses a full orchestra, featuring an extensive range of authentic instruments recorded at London's Maida Vale Studios. The wide array of articulations enables greater compositional freedom, resulting in a richer musical experience. Additionally, the extensive microphone positioning options allow me to craft my own mix, blending the room mic, outrigger, and tree mics' reverberation with other reverb plugins to produce a distinctive sound.

3.2.2 Hardware

The hardware utilized in the creation of this project includes the Novation Launchkey 61 MK3 61-key Keyboard Controller and the Arturia MiniLab 3. The piano parts were recorded using the Launchkey for several reasons. The weight of the Launchkey's keyboard is remarkably realistic, closely resembling that of an actual piano, which greatly assists a pianist like myself in transitioning from an acoustic instrument to digital music production. Its sensitivity to velocity detection makes it easier to produce humanized content with minimal manual editing. Additionally, the expansive 61-key range simplifies the recording process by eliminating the need for octave switching during performances.

For the orchestral instruments, I depended on the Arturia MiniLab 3 for its portability and the inclusion of faders, which serve as the primary tool for programming orchestral instruments. The 2-octave keyboard allows me to carry it with ease, enabling me to work more efficiently without being constrained by space. I spent considerable amount of time to program the orchestral parts in the library and recording studio, which allows me to enhance the quality of my production by leveraging the high-end gear available at the studio.

3.2.3 Techniques

The primary technique employed in nearly all orchestral parts is the use of faders to control both dynamic and expression parameters. The dynamic parameter pertains to the varying levels of volume and intensity in a musical performance. By adjusting these levels, we can manipulate the flow and crescendos of the music. The expression parameter enables control over the overall technique and emotion infused into the performance, primarily affecting the timbre and intensity of vibrato. To humanize the orchestral library, it is crucial to establish continuous automation for these two parameters, mimicking the performances of real musicians and imbuing the virtual instruments with expression and realism.

Another technique employed when using virtual instruments is the application of pre-delay. As the sample library utilizes recorded content from real musicians' performances, it is natural for players not to begin playing precisely at the start of every note. Consequently, aligning every MIDI note perfectly to the grid may result in unwanted delays that throw off the tempo and disrupt synchronization between instruments. To avoid this issue, it is crucial to listen with a metronome and ensure the performance is on tempo by adjusting the appropriate amount of pre-delay, moving the MIDI notes slightly ahead to fit the tempo accurately.

3.3 RECORDING

3.3.1 Space

The recording process took place at the Snell Library recording studio, which features a control room equipped with high-quality preamps, an Avid S4 mixing board, and an audio room where performers play their instruments.

The audio room is relatively small in size, resulting in a close, dry recording sound. This offers several advantages, such as flexibility, which allows for greater adaptability during the mixing process since we are working with the most raw content. Consistency is also maintained by not introducing any artificial room-generated soundscape. Moreover, better control is achieved by generating less room noise and minimizing elements that might require fixing during the mixing process.

The audio room is equipped with acoustic panels designed to absorb sound waves. These panels effectively reduce reflections and reverberations within the space, resulting in a clearer and more focused sound environment. Additionally, they contribute to lowering the overall noise level in the room, creating an optimized setting for high-quality audio capture.

3.3.2 Setup

Figure 2: Violin recording session

Two microphones were utilized to enable the final mix as a stereo track, which, compared to mono, delivers a heightened sense of spatial imaging and enhances depth and dimension. Following the 3:1 rule for microphone placement as shown in Figure 2, also demonstrated in [13], phasing issues that

commonly arise when using multiple microphones to capture a single sound source in close proximity can be reduced. This principle advises placing the second microphone no closer than three times the distance between the first microphone and the source. Adhering to this guideline also helps maintain a balanced and coherent sound when blending signals from different microphones.

3.3.3 Microphone & Preamplifier

The microphones employed to record the violin performance were a pair of Rode NT5s. These microphones are exceptionally well-suited for recording violin for several reasons. Firstly, the Rode NT5 is a small-diaphragm condenser microphone, renowned for its accuracy and ability to capture the nuances of acoustic instruments. This makes it a popular choice for orchestral recordings as an overhead microphone. As demonstrated in [14], the performance took place in a space similar to the audio room, where the instrument's sound and acoustic characteristics were precisely captured, resulting in a solid overall sound without any processing. Secondly, the NT5 is sensitive in the upper midrange and high frequencies, which happen to be the range where the harmonic content and detailed nuances of the violin are most prominent. Lastly, the cardioid pattern of the microphone excels at focusing on the sound source while minimizing unwanted background noise and room reflections.

Figure 3: Maag PREQ4

The preamplifier used in the session was the Maag PREQ4. Renowned for its signature “air gain” feature, this preamp can enhance the high-end of the incoming signal without introducing any unpleasant artificial pops or clicks. As shown in Figure 3, the preamp is equipped with several knobs, allowing for control over the frequency of the air band, the amount of gain applied to the air band, and a high-pass filter that helps eliminate room noise.

3.3.4 Experimentation & Communication

Recording is a creative process in which the communication between the recording engineer, composer, and musician is crucial to producing the final product. Once the musician received the score, we conducted several test runs to determine whether the original idea was effective or if we could devise something better. It is not uncommon for the same content played by sample libraries to sound or function quite differently when performed by a real player; this is one of the most significant discoveries made during the recording process. Ultimately, we made minor adjustments to dynamic fluctuations and articulations to ensure that the performance better complemented the context of the rest of the song.

3.4 MIXING

3.4.1 Mixing sample libraries

Since the sample libraries are already properly mixed by the manufacturer, they are ready to use and do not require further editing. However, I still made some adjustments based on artistic purposes and the actual needs.

The primary task involved volume balancing and automation, but I also applied compression to individual instruments with more pronounced dynamic bursts, including piccolo and brass, to create a cohesive sound and smoother transitions. To clean up the mix, I applied necessary EQ adjustments to prevent frequency clashes and create enough space for all the instruments. I utilized the "unmask" feature in Neutron 4, which ducks the signal of the track it's inserted on while reading the side-chained track, ensuring clarity as explained in [20]. This technique is used between the harp and piano, tuba, tenor trombones, and horns due to the competition in their primary frequency ranges.

I assigned instruments of the same parts to summing tracks, which enables me to edit the entire part by working on the track stack alone. This is particularly useful for balancing volume between parts or working with group buses. I used the SSL G-Master Bus Compressor on all summing tracks to apply group compression, and I also activate the "analog" signal in the plugin to introduce a vintage analog flavor, adding more character to the track.

3.4.2 Mixing recorded audio

The recorded audio included the violin solo, which is the product of the recording session introduced prior.

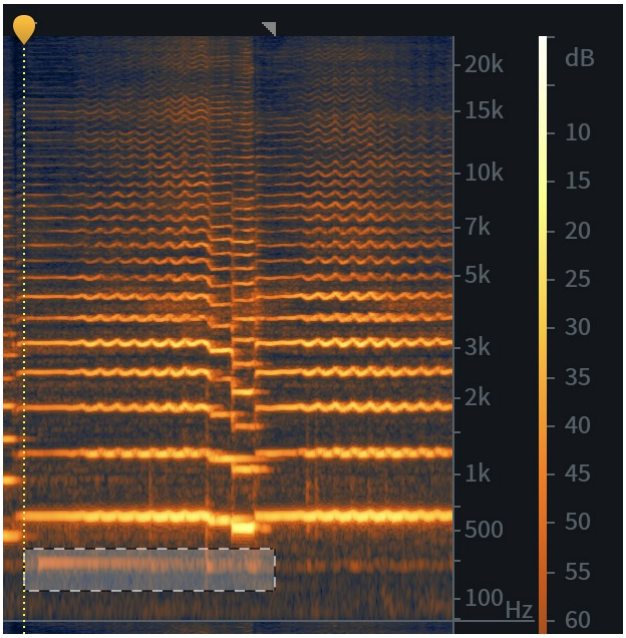

Figure 4: RX10 Visual Spectrum

RX10 is a powerful tool for cleaning up audio and removing specific components embedded in the audio that cannot be eliminated using EQ alone. Using the De-click module, I removed noise caused by the player accidentally hitting the instrument's body, stepping on the floor, or touching the music stand. I then examined the visual spectrum further to delete portions where the musician unintentionally produces notes when lifting their fingers off the strings, as shown in Figure 4.

After cleaning up the audio in RX10, I imported it into the project and began mixing with plugins. The first plugin in the chain is Melodyne, which I used to fine-tune the pitch and adjust the timing of each note to align more closely with the grid. However, I applied only a subtle amount of correction to avoid making it sound artificial and to preserve the natural, human quality of the performance.

Secondly, I experimented with the reference feature in Neutron 4 introduced in [20], where the plugin uses AI algorithms to analyze and apply the same mixing process as the reference audio. I used the programmed sample library violin solo audio, which I intended to replace with the recorded audio, as the reference to obtain a good starting point provided by Neutron 4. In line with my own aesthetic preferences, I boosted the high end using an analog high shelf at 1551 Hz by 0.4 dB to further emphasize the smooth air gain added by the Maag PREQ4. Additionally, I incorporated the exciter module at the end of the chain in Neutron 4 to add some excitement to the sound.

Finally, at the end of the processing chain, I inserted the Oxford Inflator to add the appropriate amount of saturation, enriching the signal content with extra harmonic distortion. While this enhances the sound, it also inevitably increases the track's volume. To maintain balance in the mix, it's crucial to apply volume compensation, ensuring the audio remains at the same level as before the saturation was applied.

3.4.3 Parallel Processing

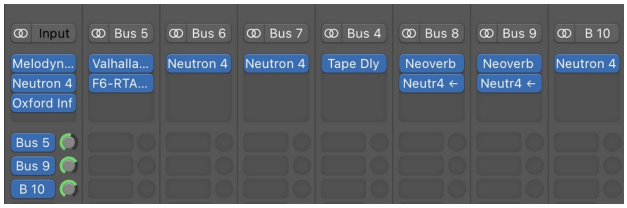

Figure 5: Busing & Parallel Processing

The reverb and some of the compression in the mixing process was done by parallel processing, which means the original signal is sent to a parallel track through a bus to add effect complementing the original as shown in Figure 5.

Parallel compression is the technique to blend the original signal with a compressed version of the original. This provides several benefits such as having greater control over the dynamics of the audio without overly attenuating the vitality of the performance, and to preserve the original transient while enriching the tone of the track. I set the compressor to short attack and long release to make sure the compression is applied all the time on the parallel track so it can properly complement the original without over pushing it. It is demonstrated as Bus 10 in Figure 5.

To add a long reverb tail without muddying the original track, I employed the technique introduced in [15]. By sending the track to an aux track via a bus, I added a reverb with a long decay on the aux track to ensure a pleasing, extended tail. After the reverb, I placed an EQ to keep the reverb focused in the center using high and low shelves. Lastly, I added a compressor with a quick attack and long release, side-chained to the original track, which causes the reverb to duck whenever the original track is present. This technique is demonstrated as Bus 9 in Figure 5.

3.4.4 Panning

Figure 6: Orchestra Seating

In orchestral production, panning can be configured to mirror the actual spatial arrangement of instruments. In this project, I panned each instrument according to the setup depicted in Figure 6, with the goal of placing the listener in the conductor's position. As illustrated and discussed in [16], the purpose of individually panning instruments is to assign each its own space, expand the stereo field, and create a sense of realism, rather than having all sounds originate from the same direction.

When panning, it is also essential to choose the appropriate panning algorithm. In Logic Pro X, the default panning setting is "Balance," which reduces the volume of one side of the signal, making the other side sound relatively louder as the signal is panned in the opposite direction. To optimally preserve the audio information in the stereo track, the panning mode should be changed to "Stereo Pan". This adjustment ensures that the signal is moved to the other side instead of being reduced.

3.5 CONCLUSIONS AND FUTURE WORK

In summary, the creation of this project involved composing, score analysis, orchestral programming, recording engineering, communication, mixing, and mastering. The composing stage proved particularly challenging for me, as I had no prior experience in this area. However, by analyzing successful scores, composing with careful planning, and conducting thorough background research, I ultimately completed this demanding project.

This project offers an outstanding opportunity for me to work with industry-standard sample libraries, such as BBCSO Professional and Appassionata Strings, as well as advanced plugins like RX10, Neutron 4, and Ozone 10. By learning to utilize the AI features in these plugins as an assistant, I can improve my workflow and work more efficiently.

I always enjoy collaborating with talented musicians and showcasing their performances in my work. The recording studio at Snell provides me with the opportunity to learn about recording engineering, signal flow, audio hardware, and effective communication with musicians. This project encapsulates my experiences thus far and highlights the career paths I am passionate about pursuing, whether as a composer, recording engineer, or audio engineer.

4. ACKNOWLEDGMENTS

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