

ALLIED ARMADA, A DYNAMIC SOUNDTRACK FOR A REAL-TIME  
STRATEGY COMPUTER GAME

A THESIS IN  
Music Composition

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ABSTRACT

*Allied Armada* is a Real-Time Strategy game, with a Sci-Fi setting in outer space. The soundtrack was composed with a dynamic system that allows it to respond to what is happening within the game; broadly, it can switch back and forth between slower ambient tracks that depict the setting, and action tracks that depict battles when they occur. Each of these tracks also has ways of responding to smaller variations in the level of action at a given moment. This system was implemented using a combination of FMOD and Lua scripting.

There are six tracks that comprise the soundtrack: First, *Nebula*: the majestic track that plays when the player first starts the game, and while they are still using menus to set up a match. The other five tracks play during the action of the game, and have the aforementioned ambient and battle tracks, which are written as a pair. The ambient tracks make up the bulk of the music; they feature many slowly evolving harmonic textures, that range in mood from serene to ominous.

*Ancient Klex Macguffin* features a choir throughout the piece, and uses long

phrases that slowly build in harmonic complexity before tapering back off to a simple interval. *Omnigenetic Codex* uses wind instruments like a keyboard, with the entrance of each accented by a percussion instrument. Sudden bursts of piano cut through the stillness of the texture. *Progenitor of the Musari* uses mirrored harmony and chords of seven or more notes to create a tense, shimmering texture. It builds to a climax of huge, slowly evolving chords. *The Exiled* features four-part, tonal string writing with heavy chromaticism, and has a dark mood that breaks in favor of optimism at the end of the piece. Finally, *Polar Orbit* uses keyboard samples to play repeated pentatonic chords that span the entire range of various keyboard instruments. Additional harmonic elements use pentatonic scales one to three keys apart from the others, creating polychordal dissonance. Despite using samples of acoustic instruments, the track is very much computer music that would not lend itself to live performance.

## APPROVAL PAGE

The faculty listed below, appointed by the Dean of the Conservatory, have examined a thesis titled “Allied Armada, A Dynamic Soundtrack for a Real-Time Strategy Computer Game,” presented by Anderson Hoffman, candidate for the Master of Music degree, and certify that in their opinion it is worthy of acceptance.

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## CHAPTER 1

### OVERVIEW

#### Game Overview

*Allied Armada* is a Real Time Strategy game with a futuristic Sci-Fi setting.

The game was created by a two-man team composed of myself and my brother. I was the artistic lead on the project, and I created the soundtrack, sound effects, 3D models, and 2D textures. I also ended up doing a large amount of scripting, learning the programming language Lua in the process. My partner was the technical lead. He wrote the engine that the game runs on from scratch, including the graphics system and networking code that allows multiple players to play together. He also worked on some artistic aspects of the project, such as the menu screen and user interface. These roles reflected our areas of expertise, but we also worked together and had lengthy discussions about other areas such as the project timeline, marketing, and broad decisions about game design.

In the game, players control a fleet of military star ships and space stations using a third person view. In modes designed for a single player, the player is given a particular military-style mission and scenario to play through. In player vs. player matches, the goal is simply to use your ships to eliminate those of the other team or player. The game is in many ways similar to a board game, where each ship is a piece on the board; however, the “real time” aspect means that there are no turns, and everything

unfolds within a time-based simulation.

Another important aspect of the game is economy and base management. Military ships can be produced from factories, but this requires a certain amount of ore and energy be consumed. Ore can be mined from asteroids by certain ships, while energy requires the construction of power plants. All of these structures must be built around a central space station that can only support a certain number of them. The player will typically build their navy almost entirely from scratch using factories and resources that were collected during the game; quite a bit of strategy goes into what kind of factories and ships the player chooses to build, and how they go about acquiring and guarding ore mining locations.

Eventually, the player will have amassed a usable navy. One of the challenges they face is discovering where the enemy's fleet is. Ships have radar, which reveals the presence of enemy ships in a wide area, as well as a smaller vision radius, in which they can see enemy ships directly. One has no way of knowing what is happening outside of their ships' collective radar ranges, which can make open space feel awfully claustrophobic. This adds a lot of suspense to moving around with a fleet, and to the game's periods of down time in general. When the battles occur, they are fast and often decisive, and players must move quickly to gain a positional advantage, prioritize targets, or use the special abilities of their ships. The pacing of the game is similar to something like a shootout from an old Western movie; the action happens very quickly compared to how long the buildup to it takes.

## Soundtrack Overview

Real Time Strategy games present some interesting challenges to composers, because of how quickly the level of action can shift, and the lack of any script as to how the games will unfold. A dynamic soundtrack has a wider range of possibilities to cover than, say, an adventure game where the player follows a linear path. There are many examples of games in this genre that do not use dynamic soundtracks. *Starcraft II*, created by Blizzard Entertainment in 2010, is a notable Real Time Strategy game that does not use a dynamic soundtrack. The music during a match consists of several tracks of around 5-8 minutes in length that play during the game. Each of the game's factions has about 45 minutes of unique music. These tracks keep a medium level of intensity throughout, so that they can hedge between the different levels of action that might occur in the game. The music for each faction is stylistically quite different, and mostly serves to characterize the faction to which it belongs.

There are also examples of dynamic soundtracks in the genre, however. The game *Sins of a Solar Empire* (developed by Ironclad Games in 2008) is an interesting example because it features a similar Sci Fi space setting to *Allied Armada*, making the two games comparable. *Sins of a Solar Empire's* soundtrack switches between dozens of tracks based on two different dimensions that track what is happening in the game: intensity and mood. Some tracks may be for intense battles that are going well for the player, while others may be for the calm after a defeat. There are also tracks that function more like leitmotifs for different factions or characters in the game. Despite the similar setting, there are significant differences between *Sins of a Solar Empire* and

*Allied Armada* that have implications for the soundtrack. Most importantly, *Allied Armada* is a much faster-paced game, with less time between transitions and more dynamic action. The dynamic scheme I ultimately came up with for the soundtrack of *Allied Armada* works with this faster pace.

For the style of the music, I was inspired by the setting in outer space, which promised stark, beautiful visuals and epic scale that I thought would pair well with patient pacing and gradual dynamic changes. The height of the action can get very intense and frantic, on the other hand, which would require much more intense music to depict properly. This led to the idea of music tracks that consist of an ambient track, which plays by default, and a battle track, which can be transitioned into during action. The ambient and battle tracks are composed as a pair, and are essentially dynamic parts of the same piece or movement.

This requires that the ambient tracks are designed to accommodate being interrupted by the battle tracks. This is achieved in multiple ways. First, there are phrases throughout each track that can enter after silence, whether by a slow fade in or by a sudden crash. This means that the battle music can fade out and the ambient music can reenter at the next of these phrases. Some of the ambient music between where the music left off and where it reenters is skipped when this happens. Each section is at most a minute long, so the amount of music that will be skipped is about 30 seconds on average. The ambient tracks are also designed to have very slow rhythmic pacing, which avoids any kind of rhythmic or metric awkwardness during the transition to a much faster battle track. The ambient tracks also avoid having themes or strong melodic

sections, which wouldn't take well to being cut short. Their textures use long, held notes and conjunct motion as much as possible.

The earliest prototype of the soundtrack suffered from fairly awkward transitions between tracks. Switching from the ambient track to the battle track every time action occurred was jarring, as the periods of ambient track were too short for the listener to engage with before it would change. The predictability of the music changing with every engagement became distracting as well. I wasn't able to solve the problem just by tweaking the threshold for when the music would change, as the ambient tracks didn't quite sound right when small amounts of action were happening. The solution to this was to add dynamic elements that could represent smaller skirmishes without interrupting the flow of the ambient track. The skirmish tracks I came up with are 10-15 second phrases that play on top of the ambient track. They are typically simple, as they need to play on top of the ambient track at any moment and not sound out of place. Some of the ambient tracks have a rather wide range of textures themselves, so mostly coloristic elements are used in the skirmish tracks; this keeps them from clashing with the harmony or doubling instruments that are already present in the texture. The way that the soundtrack was designed to accommodate interruptions meant I also had some leeway in designing skirmish tracks that could play at any moment without sounding strange. Having skirmish tracks then allowed me to make the transition to battle music far more rare, so that it is no longer jarring. Figure A-1 shows the three skirmish tracks from *Ancient Klex Macguffin*.

The battle tracks themselves are somewhat dynamic as well; each has multiple

versions that are slightly modified to provide more or less intensity depending on the size of the battle. Because the battles tend to last between 30-90 seconds, the battle tracks are very short themselves. Some of them are about a minute long and tend to ramp up towards a climax at the end; these provide a payoff for larger battles and high points in the soundtrack. Other tracks draw less attention to themselves, are largely percussion-driven and consist of 30 second loops that set a tempo to the battle. Figure 1 illustrates the network of triggers that determines when and how the music will dynamically change.

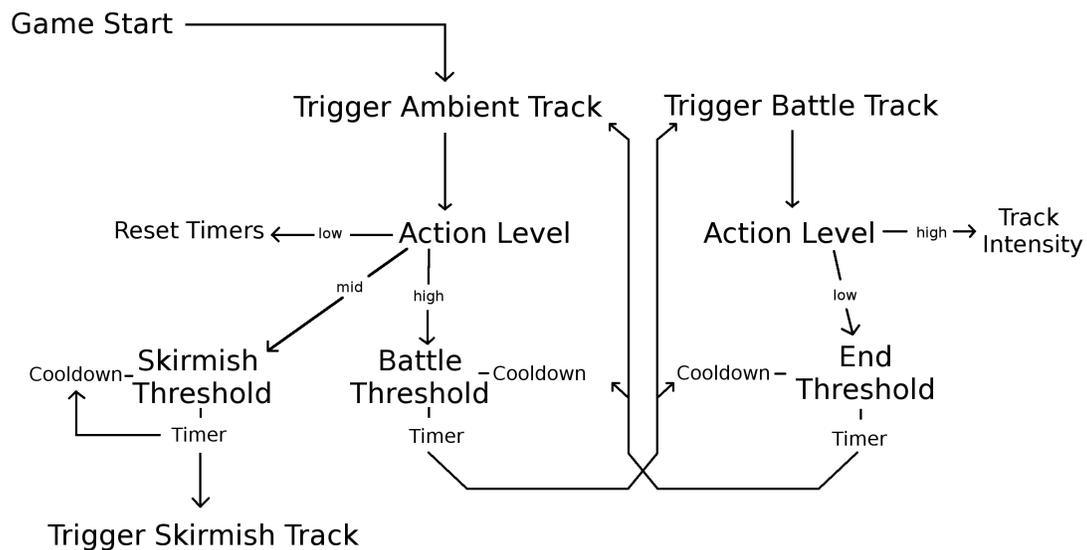


Figure 1 – Flow Chart of the Soundtrack's Programming

The Action Level represents a running count of how many enemies are in view of each player, and assigns more “points” depending on how close they are (i.e. radar, vision, or weapon range) and how large the ship is. Each Threshold in the figure defines when the Action Level is sufficiently high or low for a music transition to occur. Each Timer runs as long as the Action Level stays above the threshold it's associated with. When the timer reaches a certain point, the transition or skirmish track is triggered, as well an associated Cooldown. Cooldowns are a time limit that prevents transition events from happening too quickly in succession, which would be musically awkward. Both the battle music and skirmish music have a 30 second cooldown, meaning after they are triggered it will take 30 seconds before they can be triggered again. In addition, each time one of these events is triggered, the threshold required to trigger it again increases by a small amount. This is because the number of units in play tends to increase as the game goes on, and so the relative impact of the same number of units decreases.

### Audio Overview

Music plays constantly during the game, but it shares audio space with a plethora of sound effects. There are dozens of different sounds of ships taking actions, such as using weaponry or other abilities. These range in length from a split second to several seconds, depending on the duration of the action in question. There are also ambient sounds related to the constant noise created by the internal workings and engines of large ships and structures. For alien structures, these sounds involve complex droning sounds that depict the workings of unknown technology, punctuated by more familiar

mechanical or electrical sounds on a random basis. For human vessels, the droning sounds more like the hum of machinery or electric generators. For engines, these sounds are simply a dull roar. The interface sounds are also important; these include the sounds that accompany certain buttons being pressed, as well as notifications that play when certain events occur.

Each type of sound in the game can be divided into two categories: diegetic and non-diegetic sounds. Diegetic sounds occur in the game world and would theoretically be picked up by a microphone near the perspective of the camera or viewpoint. As with many other visual and aural media, the fact that sound does not travel in space is ignored as a matter of artistic license, due to the amount of information sound conveys and the aesthetic value of being able to hear what is happening. The sound effects related to the ships' actions as well as the ambient sounds are diegetic, and their volume is attenuated based on how far the player's view point is from the source of the sound. The music and interface sounds, on the other hand, are non-diegetic, as they don't occur within the game world itself.

The overall mix of these sounds is based on the third person perspective and large scale of the game. A low pass filter is used to create an impression of distance that matches this perspective. The amount of filtering varies between different sound effects depending on how important or potentially numerous they are. Generally, larger ships that are more important to a battle and cost more of the player's resources to create will have more prominent sounds associated with them. Smaller ships that are likely to be deployed by the dozen have quiet, heavily filtered sounds. During large battles, when

dozens or hundreds of ships are fighting at once, large numbers of small attacks will create an underlying din while the more powerful attacks cut through. Some of the most intense parts of the battle music were composed with these situations in mind. The attack of percussion and brass instruments can cut through the din, which drowns out most other sounds effects or elements of the music.

The non-diegetic sounds, on the other hand, have minimal filtering, which sets them apart in the mix. This is quite nice for the orchestral soundtrack, as instruments such as violins, oboes, trumpets, and glockenspiel can be heard quite clearly, and the attacks of brass and percussion instruments cut through as well. The orchestral samples used provide the natural reverb and frequency attenuation of the concert hall they were recorded in. This makes it easy for the music to be distinguished from other sounds by this characteristics, and also leaves room for the interface sounds to occupy higher frequencies. These consist mostly of electronic effects such as beeps and chirps. They are somewhat similar to narration in storytelling, as a direct communication to the player that provides information about what is happening in the game world. It is also worth noting that there is side chain compression on the music, which lowers its volume when the ambient ship sounds are playing. This helps prevent too much muddiness from occurring between the thick chords of the music and the complex drones of the ships.

### Technical Implementation

The music and audio are implemented partially in FMOD, and partially in the game's script, which is coded in Lua. Figure 2 shows some of the Lua code involved.

The handlers called “skirmish start”, “battle start” and “battle end” directly correspond to the triggers output by the script that is outlined in Figure 1. FMOD and the script work together for both types of transitions, but in different ways. Each music track has two FMOD events associated with it: one for the ambient and skirmish tracks, and one for the battle track. At the start of a match, the script will trigger the ambient/skirmish event, which will start to play the ambient track. An FMOD parameter is used to indicate the time at which the ambient track ends. If the timeline reaches this point, the script will end the event and start the ambient/skirmish event associated with the next track.

```
63 gameContext:addEventHandler( "music_init", function()
64     -- System.Log( 'music_init' )
65     ambientTrack = startMusic( playList[playListPosition].ambient )
66 end )
67
68 gameContext:addEventHandler( "skirmish_start", function( vol )
69     -- System.Log( 'skirmish_start' )
70     ambientTrack:setParameterValue( 'skirmish', vol )
71     skirmishTime = os.time()
72 end )
73
74 gameContext:addEventHandler( "skirmish_end", function()
75     -- System.Log( 'skirmish_end' )
76     ambientTrack:setParameterValue( 'skirmish', 0 )
77 end )
78
79 gameContext:addEventHandler( "battle_start", function()
80     System.Log( 'music event - battle_start' )
81     ambientStopTimeline = math.floor( ambientTrack:getTimelinePosition() )
82     ambientTrack:setParameterValue( 'ambient_timeline', ambientStopTimeline )
83     ambientTrack:setParameterValue( 'battle', 0.99 )
84     battleTrack = startMusic( playList[playListPosition].battle, 999 )
85     battleTrack:setParameterValue( 'battle_level', battSize )
86     battleStartTime = os.time()
87 end )
88
89 gameContext:addEventHandler( "battle_end", function()
90     System.Log( 'music event - battle_end' )
91     ambientTrack:setParameterValue( 'battle', 0.0 )
92     battleEndTime = os.time()
93 end )
```

Figure 2 – Music Event Handlers for *Allied Armada*

When the script decides to trigger a skirmish track, it uses a parameter of the ambient/skirmish event called “skirmish”. This parameter has a range of 0 to 1; it is set to 1 when a skirmish track is triggered, and then reset to 0 when the cooldown for the skirmish track has expired. The parameter timeline for “skirmish” contains a multi-sound with the three skirmish tracks for the track in question. This multi-sound is triggered with the “skirmish” parameter is set to 1, and won't be triggered again until the parameter has been set to 0 and then back to 1 again.

Transitioning into and out of the battle track is more complicated, as the ambient track has to stop playing, wait for the battle music to finish, and then start back up again. When the script decides to transition from the ambient track to the battle track, it will trigger the FMOD event associated with the battle music, which will immediately start the battle track playing. This event has a parameter for the action level that is determined by the game's script. As the battle tracks each have low, medium, and high, intensity versions, the FMOD event one track for each of these versions. The multi-sounds that contain the music files will only trigger for a certain range of the “action\_level” parameter. This parameter is updated by the game's script every frame, so that when the playhead passes these multi-sounds in the timeline, only the appropriate version will play. The battle tracks for *Progenitor of the Musari*, *The Exiled*, and *Omnigenetic Codex* have been divided into two parts, so that midway through the track a second set of multi-sounds will trigger the second half of the track, providing a transition point where the battle can respond to the action level having changed. The battle track will loop until the action level calculated by the script falls below a certain

level. Markers and jump points are used to achieve this looping. The use of multi-sounds allows for the sound files to carry over past the point where the track has looped, as audio triggered by a multi-sound will always play until it finishes.

The ambient/skirmish event does not stop when the battle music begins. The script retrieves the timeline position of this event from FMOD and stores it. This information will be used when the music transitions from battle track back into the ambient track. The script also changes one of the event's parameters, called "battle". This parameter ranges from 0 to 1, just like the "skirmish parameter. The FMOD project for *Allied Armada* uses Buses to allow the volume of the ambient and battle music to be controlled via snapshots. The "battle" parameter's timeline uses a snapshot that quickly raises the volume of the battle music while slowly fading out the ambient music. This is achieved by sending the ambient and battle tracks each to their own Bus; these Buses are then cross-faded by the snapshots. A jump region runs the length of the event timeline, which sends the playhead to 0 if the "battle" parameter reaches 1. The playhead will remain locked at this point for the duration of the battle music.

When the script decides to transition back into the ambient track, a parameter called "ambient timeline" receives the timeline position that was stored when the battle transition happened. As mentioned in the previous section, the ambient tracks are designed with many silent moments between phrases, which provide natural places for the ambient track to reenter. Each of these starting points is labeled with a marker in the event timeline, and a set of jump points is placed just before the start of the ambient music in the event timeline, one for each marker. These jump points are set to trigger

based on a range of the ambient timeline parameter, such that they point to the entrance after the section that the ambient track was playing when the battle transition happened. The playhead reaches these jump points soon after the “battle” parameter reaches 0. By giving each jump point its own transition timeline, I could set a unique time delay for each entrance; for instance, some entrances sounded better fading in while the battle music was still fading out, but others (such as the piano and harp bursts in *Omnigenetic Codex*) really needed to be preceded by a bit of silence. After about 15 seconds, the battle music will be completely muted and the FMOD event for it can safely be terminated.

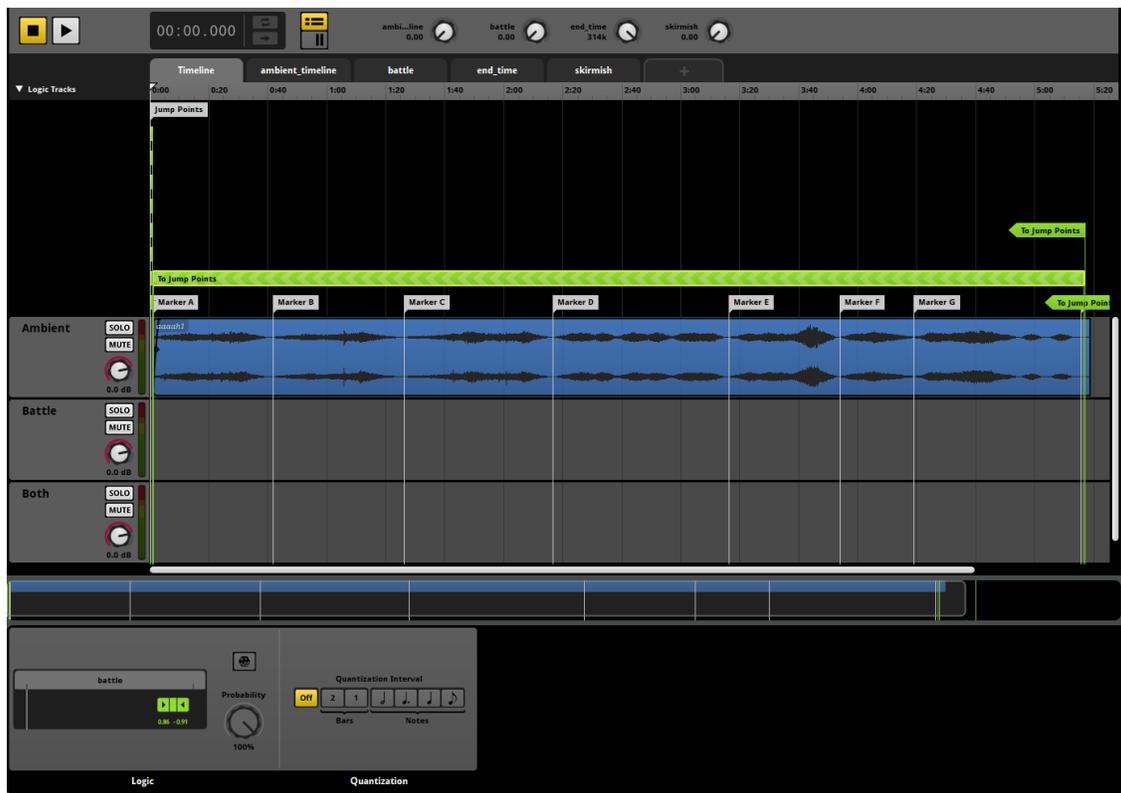


Figure 3 – FMOD Event Timeline Showing Markers and Jump Points

The music tracks were made using a variety of a sample libraries, with Sonar Home Studio being used as the DAW. The majority of the orchestral sounds come from the EastWest Hollywood Orchestra library, using the built-in PLAY 5 engine as a sampler. Additional sounds (particularly percussion and keyboard instruments) came from the EastWest Symphonic Orchestra library, using Kontakt 5 as a sampler. The track *Polar Orbit* contains some patches that were creating using the built-in effects of these samplers on orchestral patches such as harp. For *Polar Orbit's* battle track, Omnisphere 2 was used to create patches is a similar fashion, using both acoustic and raw wave samples from its library along with effects and modulation using its built-in synth engine.

## CHAPTER 2

### TRACK DESCRIPTIONS

#### *Nebula*

Most of the discussion so far has been about the kind of music that occurs during a match, while the game's simulation is active and the player is interacting with it. However, the experience of the game begins with the menus, which allow the player to set up a game or scenario, reveal post-game information such as players' scores, and generally frame the experience of playing the game with a nice, user-friendly interface. *Nebula* is the track that plays on the game's menu screen. It sets an epic tone for the game with big, sweeping polychords of stacked 5ths, which clash in the cross fade of different groups of instruments. Each group crescendos and decrescendos on their chord; as one group reaches its peak, the previous fades into silence and a new one begins to crescendo. Drum and cymbal hits accent some of these peaks, while rolls help outline a phrase structure beyond each individual swell. Tension is built as the relations between adjacent chords get further and further apart, and the timing of entries gets somewhat out of sync. At the climax, the rules are altered: some of the instrument groups enter at fortissimo, and change chords at the peak of a crescendo. This creates a sudden sense of motion and resolves the natural tension that so many slow crescendos creates.

The theme of the menu screen is that it is a hologram projector in a museum or

archive, where you might find records or analyses of historical battles. There is a military theme to the visual style, with stars and chevrons evoking rank symbols. Although *Nebula* is not explicitly a march or hymn, the wind-heavy instrumentation and grandiose tone would not be out of place coming from a military ensemble. After the climax, the piece reprises with different instrumentation; this time a choir, accented by various metallic keyboard percussion. In this form, it sounds a bit like a hymn, albeit one adapted to blend well with the sparse textures of the game's ambient tracks. The game is not meant to be overly dark, gritty, or serious. The track's positive tone reflects this, as well as the fact that the military metaphors are not overt.

#### *Ancient Klex Macguffin*

This track represents space as a place of awe and wonder, but also danger. Slowly evolving choral harmonies are used to evoke a grand scale. Most phrases have some kind of orchestral accent, which helps to create timbral variety and serves to highlight certain tensions and resolutions within the harmony. Additionally, low brass accents help create an ominous tone, although the harmony accomplishes this as well.

Each phrase begins with a single note or a two part harmony, and slowly adds parts until the texture is relatively thick. Most phrases taper off into a thin texture towards the end, although some of them are more linear, building towards a final big chord. The way that voices enter the texture, as well as how they move from one note to another, creates most of the development and progression in this track. The first three long phrases follow a similar structure to each other; voices enter one by one, and for

the most part they also change one at a time. This creates a shifting harmonic texture that doesn't change from chord to chord so much as it slowly morphs from one harmonic area to another. Figure 4 illustrates one such phrase. Audio for all excerpts can be found at <https://soundcloud.com/anders-hoffman-946497669>.

Figure 4 - Reduced Score Showing a Typical Phrase from *Ancient Klex Macguffin* (*Ancient Klex MacGuffin – Ambient*, 3:14)

In the middle of the piece, this scheme changes. In the first phrase of the second section, there is a staggered entry of two notes at a time, each in a different register, building into a rather dense harmony. The next phrase is the first in which all of the active voices are changing notes at the same time, which creates much more of a sense

of movement for this section of the piece. Following a reorchestration of the opening phrase, the final section of the piece involves long phrases that are more similar to the first section, but with far more simultaneous movement of voices than before. The end of the piece uses an uncharacteristically monophonic texture, which serves to smoothly transition into other tracks more than anything else.

The skirmish tracks utilize brass and percussion swells with minor second and major seventh harmonies to create an ominous accent to any small battle that may occur. The first skirmish track uses only a single note, while the second and third skirmish tracks use minor second and major seventh harmonies to create more tension. Although the harmonic nature of the ambient track may seem to conflict with the idea of having these harmonies played at random times during the track, the cluster harmonies and slowly morphing texture accommodate these interruptions quite well. In addition, the goal of these tracks is so create more tension, so any unintended dissonances actually support that goal.

The battle track utilizes polymetric drum patterns to create a hypnotic, yet energetic mood that matches the highly intense nature of battles in the game. Low strings and distant sounding choirs create ominous accents that add structure to the tumultuous drum patterns. Each higher layer of the track adds more active drum parts and additional notes into the chords, maintaining a similar feel but with differing levels of intensity. Figure 5 illustrates the drum texture for each of the three levels of intensity. This is one of the 30 second battle tracks; it doesn't draw much attention to itself and bears repetition easily.

The image displays a musical score for a track titled "Ancient Klex Macguffin - battle". The score is organized into three sections based on intensity: "Lowest Intensity Version", "Middle Intensity Version", and "Highest Intensity Version".

- Lowest Intensity Version:** This section features five staves. The top staff is labeled "Metal Bridge" and contains a single note with a long sustain. The four drum staves (Frame Drum 1, Frame Drum 2, Frame Drum 4, and Bass Drum) show sparse, rhythmic patterns with long rests.
- Middle Intensity Version:** This section continues with the same five staves. The drum parts become more active, featuring more frequent rhythmic patterns and some melodic lines, though still maintaining a minimalist feel.
- Highest Intensity Version:** This section shows the most complex and dense drum patterns. The Frame Drum parts feature intricate, overlapping rhythms, while the Metal Bridge and Bass Drum parts remain relatively simple, providing a steady foundation.

Figure 5 – Minimalist polyrhythm with Three Levels of Intensity  
*(Ancient Klex Macguffin – battle)*

### *Omnigenetic Codex*

This track represents space as vast and serene, having a certain amount of harshness but an overall positive mood. It is characterized by slow phrases, long pauses, and occasional sudden punctuations that cut through the stillness.

Wind instruments in this track are often played like keyboard percussion instruments; with their entry accented by pitched percussion, they hold a single note and slowly decrescendo into silence. Melodic motion comes from several of these percussion-like hits in succession, resulting in several different wind instruments holding out a chord. These sections develop a motif that is two of these hits, the second one a major second higher than the first, resulting in a slightly grating major second harmony that lingers after the others sounds have died out.

A combination of low woodwinds, strings, and timpani forms a rumbling bass line that shifts timbre as these instruments enter and exit the texture. In order to stay in

character with the static texture of the wind parts, it frequently drones on the same note for long periods of time, and typically moves by fourths, fifths, or major seconds, so as not to shift the harmony too dramatically.

The other major motif of the piece is made up of sudden bursts of harp and piano that appear out of silence. The harmony of these parts is made up of pleasant clusters of major seconds and thirds. While this does provide a lot of textural contrast to the very slow wind sections, the timbre and harmony as they ring out reinforces the serene mood. The harmony of these phrases is largely non-functional. They get their direction from the timbre and register, as well as the melodic motion of the highest note. The low register in particular creates various types of muddy sounds as the rumbling piano mixes with the mellow and full harp. Although most of the elements of this track are serene and pleasant, there is an underlying harshness created by the lingering dissonances of the wind lines that prevents the tone from being too one-dimensional. Figure A-2 shows the opening measures of the track, with examples of both main motifs.

The skirmish tracks mostly consist of tam tam and bass drum swells, which complement the raspy timbre of the low woodwind instruments. *Omnigenetic Codex's* ambient track has the most silence of any in the soundtrack, and these swells do well at accenting a small battle even if they occur during a silent moment. A few other accents such as voices or piano can be heard sticking out as the percussion fades into silence.

The battle music features large Taiko drums playing at a medium pace that evokes a tense standoff. The drum part features a sort of “stream of consciousness” structure, playing with small, constantly evolving rhythmic ideas and never quite

repeating. The muddy, low chords on piano and harp get layered in before the beat picks up in intensity as the low brass enters. Low brass and woodwinds then play three big harmonic swells that utilize the major second motif from the ambient track. Figure A-3 is a reduced score of this track.

### *Progenitor of the Musari*

This track depicts space as a harsh and inhospitable wasteland, utilizing relatively dissonant, atonal harmony and a slow, methodical pace. Tremolo strings play lines in mirrored harmony that begin on a unison before diverging. These lines mostly end by converging back to the same unison. As these phrases develop there are multiple, independent, mirrored groups playing in polyphony with each other. These rigid string phrases are followed by more gestural phrases of wind instruments holding chords, with accents created by rhythmic percussion motifs, the entry of new instruments, or the re-articulation of parts already playing. These elements create a patient pace and harsh tone that depicts a difficult trek across dangerous terrain.

The gestural wind interludes (and the percussion parts that accent them) set up the motif of a sudden chord hit followed by a responding percussion instrument, which is fully realized by the section at 1:50, where the same chord repeats three times; this repetition becomes part of the motif at this point. The motif also appears in the cluster chord at 3:04, the brass arpeggios at 4:02 to some degree, and then is really emphasized in the penultimate section of the piece, in which repeated chords create a slowly shifting timbre and harmony (Figure A-4).

The other primary motif that the piece deals with is mirrored harmony that begins and ends on a single unison. This motif is developed through the increasing complexity of these phrases, although the final and most dramatic statement of it occurs in trumpets towards the end of the track. The way that these phrases begin and end on a single note caused them to get somewhat repetitive by the middle of the piece, which is why part of the track's coda focuses entirely on the other motif. Given the suspenseful nature of these phrases, leaving them out towards the end does lend the end a bit of a calm resolution. The section at the end is also an homage to Schoenberg's "Farben", a movement from 5 Orchestral Pieces that uses the timbres of different combinations of instruments and gestural accents in lieu of melodic or contrapuntal motifs.

The battle music creates a chaotic texture using a motif of repeated staccato brass notes connected by sustained chords. The motif varies by the number of repeated notes, accent patterns, and chromatic movement, with increasing amounts of polyphony as the track goes on. It also varies between triplet rhythms (the dominant rhythmic feel in the track) and sixteenth note rhythms. The harmony mostly consists of augmented triads and other chords built on them, with some of the background parts using the mirrored harmony style from the ambient track. The opening measures of this track are shown in figure 6. There is a considerable harmonic shift about halfway through the track, as a fanfare-like section has brass instruments entering with mostly fourths, fifths, and major second harmonies, as tremolo strings play mirrored harmonies in the background. This smooths the transition to the final chaotic section, where chromatic movement quickly shifts through consonance and dissonance amid seemingly random

rhythms from the brass. Depending on the size of the battle, the final bars are either fortissimo, dissonant brass chords, or a rhythmic decrescendo that reestablishes the pulse before the track repeats.

Figure 6 - Opening Measures of the Battle Track for *Progenitor of the Musari* (*Progenitor of the Musari – Battle*)

### *The Exiled*

This track uses three- and four-part polyphonic string writing in long, slowly evolving phrases. The minor key harmony and chromaticism strikes an ominous and melancholy mood, characterizing space as unknown and full of danger. This is the most melodic track in the soundtrack, but the slowly unfolding phrases and smooth transitions

into and out of silence give it an ambient feel that is consistent with the others.

The opening phrase (Figure 7) repeats two more times throughout the track, creating a rondo form. The first episode is very short, but it introduces an element that returns subtly throughout the piece: soft, out of key vibraphone notes and chords. The next episode features minor key harmony with chromaticism similar to the opening phrase, but with much more use of the raised 7th scale degree. The climax of this section is cut short by an unexpected augmented harmony, after which it fades into the third statement of the opening phrase. The final episode features lush seventh chords and suspended harmonies; this section transitions from aeolian to mixolydian, giving the track a triumphant climax and ending. There is an evolution of timbre throughout the piece as well. The opening phrase and first episode feature only strings playing in the mid register. The second statement of the opening phrase, adds choir to the timbre, giving this section and the second episode a rich and dark quality. The third statement of the opening phrase adds brass instruments into the mix, just before the rest of the wind instruments join in the coda.

The image shows a musical score for five string instruments: Violin I, Violin II, Viola, Cello, and Contrabass. The music is written in 4/4 time with a key signature of two flats (B-flat and E-flat). The score is divided into two sections: the first section is marked 'accel.' and the second section is marked 'a tempo'. The Violin I part starts with a rest followed by a series of eighth notes. The Violin II part features a long, sweeping melodic line. The Viola, Cello, and Contrabass parts provide harmonic support with various note values and rests. Some notes in the Violin II part are enclosed in parentheses, indicating a variation from the second episode.

Figure 7 - The Subject of *The Exiled*. Notes in parenthesis are a variation from the second episode. The tempo varies in each episode. (*The Exiled – Ambient*)

The skirmish tracks consist of snare and bass drum flourishes. These are ametric and with shifting pulse, to prevent them from implying a tempo for the ambient track; they are just a bit of noise that cuts through the din of battle but also fades easily back into the slowly shifting chords. Harmonic content was mostly avoided due to the tonal nature of the ambient track, but there are some soft string harmonics that add eeriness to tail end of the skirmish tracks.

The battle opens with pizzicato strings playing constant 8th notes, which together with rhythmic accented notes and timpani hits creates a driving feeling to the music. With this being the most melodic of the ambient tracks, this battle track provided the best opportunity to include some of the exciting, contrapuntal brass writing that is stereotypical in space soundtracks. Halfway through the brass instruments are

introduced, playing some simpler melodic and contrapuntal phrases to build up to the final, exciting contrapuntal phrase (Figure 8). Although this section seems to unfold unusually quickly, the pace of battles in the game matches it.

The image shows a musical score for five instruments: Horn, Trumpet, Trombone, Tuba, and Timpani. The score is in 4/4 time with a tempo of 120 beats per minute. The Horn part is in the treble clef, while the other four instruments are in the bass clef. The music is polyphonic, with each instrument playing a different melodic line. The score includes dynamic markings such as *ff* (fortissimo) and *p* (piano). The piece concludes with a double bar line and repeat signs.

Figure 8 - The Polyphonic Brass Ending of the Battle Track for *The Exiled*  
(*The Exiled – Battle*, 0:46)

### *Polar Orbit*

This track breaks the orchestral paradigm of the rest of the soundtrack. Although it still largely consists of orchestral samples, they are used here as electronic instruments; this track would not be playable by real players and instruments. Each part of the track is built on keyboard percussion instruments playing repeated pentatonic chords that span the full playable range of the sample. There is a lot of interesting sound

that comes from the interaction of notes ringing out, especially in the low register. Due to quirks of the sampler and possibly the DAW, the attacks are all somewhat different, and some of the notes seem to drop out on some of the chords. This actually creates a much more rich and interesting texture than the sheer repetition of notes might imply.

The ambient track is broken up into two short movements. The first uses an accent pattern on repeated quarter note chords to create a sort of long compound meter. The scheme is as follows: The first bar contains an accented note followed by an unaccented note. Each following bar begins with an accented note and adds one additional unaccented note, up to five, before repeating back to one; and then up to six the second time. Each time the scheme repeats, the pentatonic chord shifts to a different key. Other rhythmic elements enter and exit the texture in order to create polyrhythms, and punctuate the driving, hypnotic push of the main ostinato. The muddy clashes of the low, accented harp notes fading out create a lot of textural movement in this part of the track. Figure 9 shows each element of the polyrhythm.

The figure displays three staves of musical notation. The top staff is labeled 'Harp Samples' and features a tempo marking of ♩ = 160. It consists of two systems of music, each with a treble and bass clef. The notation includes various rhythmic patterns with accents (>) and rests, indicating a complex polyrhythmic structure. The middle staff is labeled 'Piano Samples' and starts at measure 10. It shows a series of chords with accents, creating a steady, driving texture. The bottom staff is labeled 'Marimba Samples' and starts at measure 12. It features a series of chords with accents, providing a rhythmic accompaniment to the piano samples.

Figure 9 – Metrical Pattern and Rhythmic Elements in *Polar Orbit*

The second movement increases the rhythm of the pentatonic chords to 16th notes, and has no accent pattern. Whereas the first movement focused on the ringing out of samples, this one focuses on the attack. The lack of accent pattern causes the sense of meter to essentially disappear, despite the steady rhythm, giving it an appropriately ambient feel. The instruments playing these rapid notes are cross-faded in and out and panned around throughout the movement, causing the texture to constantly shift. Once again the main pattern is punctuated by elements that fade in and out, in this case pentatonic chords that clash to varying degrees with the chords from the 16th notes.

The skirmish tracks for *Polar Orbit* are the only ones in the game that needed to be quantized, due to the underlying rhythm of the ambient track. They utilize a pulsing moog bass swell as well as various plucked string samples that blend well with the harp and piano sounds of the ambient track. Much like the other skirmish tracks, they are fairly simple and serve to create an ominous undertone.

The battle track makes use of quantized delay effects to create rhythmic patterns. The large pentatonic chords of the ambient track can be heard faintly in the background, in the form of humming voices and marimba samples with distortion and tempo delay. The focus of the track is a patch based on a bodhran drum sample with heavy distortion, compression, reverb, and delay. Variations on this sound were created by two main methods. First, using different registers and velocities created timbral variations within the patch. Second, copying the patch and altering the effects created different, but related sounds. Cross-fading between different versions of the patch keeps the sound from getting too repetitive, while the use of different registers helps to create phrases

and counterpoint. The rhythmic intensity of this part builds up slowly towards the end of the track, creating a sense of direction. There is a bass line consisting of saw and sine waves that uses chorus, multiple notch filters, and a bass amp simulator to create a smooth, shimmering sound. The line follows a tone row, although the notes are somewhat hard to make out. It still provides a bit of harmonic and rhythmic interest, contrasting the chaotic drums with steady changes in harmony every measure. The dissonant timbres and distorted drums, when combined with the consonant background harmony, creates a focused intensity that mirrors the player during a battle in the game. Figure 10 is a score showing the midi data of the track. Each note of the drum track triggers a delay effect, creating several echoed hits in 8th note rhythm.

The image displays a MIDI score for the Battle Track of *Polar Orbit* (medium intensity version). The score is organized into several tracks:

- Bodhran with Effects 1:** Features a main patch version and an add less-filtered patch version. Dynamics range from *mp* to *mf*.
- Bodhran with Effects 2:** Features a less-filtered patch version. Dynamics range from *pp* to *mf*.
- Filter Sweeps and Noise:** Includes a *mp* dynamic.
- Synth Bass:** Includes a *mp* dynamic.
- Harmonic Elements:** Includes dynamics *ppp*, *cresc.*, *p dim.*, *pp*, *cresc.*, and *mp*.
- Bodhran FX 1:** Includes a *f* dynamic and a 'fade back to main patch version only' instruction.
- Bodhran FX 2:** Includes dynamics *mf*, *pp*, *mf*, *pp*, *mf*, and *pp*.
- Noise:** Includes a *f* dynamic.
- Bass:** Includes a *f* dynamic.
- Harm.:** Includes a *pp* dynamic.

Figure 10 – Score of the Battle Track of *Polar Orbit* (medium intensity version)

## CHAPTER 3

### REFLECTION

*Allied Armada's* soundtrack manages to achieve significant dynamic range while having graceful transitions when necessary. It strikes a compromise between a completely static RTS soundtrack such as the one in *Starcraft II*, and the dynamic soundtrack of *Sins of a Solar Empire*, which switches between various short tracks regularly. The *Allied Armada* soundtrack is a roughly 25-minute long ambient loop that can continue uninterrupted, with dynamic skirmish elements, and five different battle tracks with variable intensity that occur at the periods of highest action. It manages to keep some of the narrative drama that comes from longer, composed pieces while also responding dynamically to the action.

However, the soundtrack doesn't accomplish its goals perfectly, and there are some changes I would like to try if I were to repeat the project from the ground up. There are moments when the music system causes an awkward series of transitions. For instance if the player hears the start of an ambient track, a skirmish, and a battle track all in quick succession, it can be confusing to hear. This kind of issue is inherent to a system that changes tracks; I mitigated this to a large degree using the skirmish tracks, but it still happens occasionally.

I also think some of the tracks could have been conceived with all parts of the track (ambient, skirmish, and battle) forming a more cohesive whole. Although the tracks do work together and the transitions sound appropriate, the sharing of motifs is

much loser than it could be, which represents some missed potential. The ambient tracks were mostly composed as self contained pieces, whereas in practice it is somewhat rare for one to play out entirely without any interruptions. I could have relied more on the parts working together and made them more connected.

To that end, a transition-free aleatoric style might have worked better.

Admittedly, I am not very experienced in aleatoric composition, but it's uniquely suited to video game music due to the ability to have it respond to trackable in-game variables. It also allows for smooth transitions in the form of gradual tweaking the parameters to which it responds. There is a potential for something like that to have very good dynamic range, close mapping to the onscreen action, motivic unity and smooth transitions all at once. If I were to write a soundtrack for a similar game, I might try such an approach, although it would be out of my comfort zone as a composer.

Overall, I am happy with the way the soundtrack works with the game. It hits the major beats I had hoped for, while mostly avoiding the obvious pitfalls. It backs up both the space scenery and climactic battles without having too much trouble transitioning between them.

# APPENDIX

## Full Score Excerpts

*♩* = 80

This musical score excerpt is for the piece "Three Skirmish Tracks of Ancient Klex Macguffin". It is written in 4/4 time with a tempo of 80 beats per minute. The score includes parts for the following instruments: Flute, Oboe, Clarinet, Bassoon, Horn, Trumpet, Trombone, Tuba, Timpani, Concert Bass Drum, Cymbal, Tambourine, Soprano, Alto, Tenor, Bass, Violin I, Violin II, Viola, Cello, and Contrabass. The music features a variety of dynamic markings such as *mp* (mezzo-piano), *f* (forte), *p* (piano), and *fz* (forzando), along with accents and slurs. The woodwinds and brass sections have melodic lines, while the percussion and strings provide rhythmic and harmonic support. The score is divided into three measures, with a key signature change to one flat (B-flat) in the second measure.

Figure A-1 – Three Skirmish Tracks of *Ancient Klex Macguffin*

*♩ = 45*

Flute *mp pp mp*

Oboe *mp pp*

Es Clarinet *p mp pp*

Bb Clarinet *p p < mp pp p mp*

Bass Clarinet *p mp pp p mp*

Contrabass Clarinet *p mp pp p mp*

Bassoon *p mp pp p mp*

Contrabassoon *pp mp pp p mp*

Horn *pp mp pp*

Trumpet *p p*

Trombone *p*

Tuba *p*

Timpani *pp < mp > pp*

Marimba *mp mf mp f mf*

Glockenspiel *p*

Harp *p mp f mf*

Piano *mp mf f*

Violin I *p*

Violin II *p*

Viola *p*

Cello *p mf pp*

Contrabass *pp p pp p pp p pp*

Figure A-2 – Opening Measures of *Omnigenetic Codex*  
*(Omnigenetic Codex – ambient)*

♩ = 140

Edge Hit      Edge Flam

O Daiko 

Hira Daiko

O Dko. 

O Dko. 

Orc. 

O Dko. 

Orc. 

O Dko. 

Orc. 

Figure A-3 - Reduced Score for the Battle Track of *Omnigenetic Codex*  
(*Omnigenetic Codex* - Battle)

The image displays a detailed musical score for a section of the piece "Progenitor of the Musari". The score is written for a large ensemble, including woodwinds, brass, percussion, and strings. The tempo is marked as  $\text{♩} = 47$ . The key signature is one sharp (F#), and the time signature is 3/4. The score is divided into systems, with each instrument or group of instruments having its own staff. The instruments listed are: Flute, Oboe, Clarinet, Bass Clarinet, Bassoon, Horn, Trumpet, Trombone, Tuba, Orch Chimes, Triangle, Suspended Cymbal, Wood Blocks, Timpani, Concert Toms, Bass Drum, Violin, Violin II, Viola, Cello, and Contrabass. The score features a variety of dynamic markings, including *pp*, *mp*, *p*, *mf*, and *f*. The music is characterized by slowly evolving harmonies and a rich palette of timbres, with a focus on sustained notes and complex textures. The percussion section includes a "let ring" instruction for the triangle and various rhythmic patterns for the cymbal, wood blocks, and drums. The string section provides a harmonic foundation with sustained notes and some rhythmic movement.

Figure A-4 - Section from *Progenitor of the Musari*, featuring slowly evolving harmonies and timbres. (*Progenitor of the Musari - Ambient*, 4:38)

## VITA

Anderson Aaron Hoffman was born on October 21, 1988 in White Plains, New York. He started learning composition in high school, studying books by great composers such as Schoenberg's *Theory of Harmony*. In 2007 he won the Pathfinder award for Instrumental Music, an award program that encompasses several South Florida schools.

In 2011, Anders completed his undergraduate degree in Music Composition at the University of Miami, studying under Lansing McLoskey. While in Miami, he began taking classes in computer programming. Between 2011 and 2013, he worked in the Martin County School system as a substitute teacher while beginning the first creative work on the video game *Allied Armada*.

After enrolling at the University of Missouri-Kansas City, he began doing programming and artistic work for *Allied Armada*, which would be a secondary focus of his throughout his stay at the University of Missouri-Kansas City.