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The Composition of Game Music

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Contents

1 Introduction

The issue of creating music for computer games is highly complex, ranging from the effect game music can have on the listener in contrast to music from other media to the technical requirements imposed on a composer during the process of writing video game music. This seminar, however, concentrates on two major opposing approaches to creating game music. In this case, opposition does not necessarily signify mutual exclusion. Both approaches can be used in the soundtrack for one single computer game. What renders them oppositional are the ways in which they are created and in which they operate in the game. These approaches are respectively called linear and interactive music.

2 Linear Music in Games

In contrast to interactive music, linear music exists in a fixed state. Since the duration of gameplay itself is not fixed but depends entirely on the player, linear music is either composed as a loop, a 'stinger', which is a short musical phrase triggered by recurring events, or a 'one-shot track', which plays only once at a specific moment in the game. These three types of linear music are presented in this chapter.

2.1 Linear Loops

'Repetition fatigue' is a commonly used term to describe the feeling of annoyance and boredom a piece of music can engender if it is repeated too often. The main goal of a linear loop is to hide the fact that the music is looping precisely in order to avoid repetition fatigue. In her book, Phillips compares a linear loop to a walk through a forest, where only after a long while you begin to notice that you've been walking in circles.[1] The forest needs to be interesting and mesmerizing enough to distract you from the repeating path but not too interesting to draw attention to the fact that you've been here before. The same can be applied to the music. If it's too 'plain', the risk of being repetitive is considerably higher. On the other hand, if there are very distinctive patterns or melodies, they can become "landmarks",[2] which are highly noticeable when repeated.

Furthermore, unlike traditional musical pieces, linear loops have no beginning, no middle, and no end. They have to present a continuous flow of music to adjust to the

[1] Winifred Phillips. *A composer's guide to game music.* The MIT Press, 2017, p. 158.

[2] Ibid., p. 158.

unpredictable length of gameplay. To successfully create a loop, Phillips offers several solutions, all of which have their own strengths and weaknesses and are suitable for various different settings and situations. A selection of those solutions will be outlined in the following paragraphs.

2.1.1 Perpetual Development

Since it has a high recognition potential, which can easily serve as a landmark, the use of a theme or a distinctive melody can be risky within a loop. However, 'perpetual development' describes a technique to use a melody that is continuously present within the loop, but constantly changing. It can evolve into a new melody, return to its original state, and then spin out again in a different way. In Phillips's forest metaphor, perpetual development is described as "a veil of ornately growing ivy that rises up on either side (of the path), always interesting and varied in shape and texture and yet always presenting a single identity."[3]

The constant change this technique offers is a great advantage for video games. If linear music is deployed, the composer does not know what happens at specific moments during gameplay, meaning that the score cannot react to changes or events. Thus, linear music tends to be either too static or at times even inappropriate when it suddenly changes without any indicator from the gameplay. Using perpetual development, the composer can instil a certain sense of constant change that might fit perfectly in some gameplay situations while not being suddenly irritating in others.

Perpetual development has been a known technique in classical music for centuries. Johann Sebastian Bach, for example, has made use of it in his *Toccata and Fugue in D Minor*.[4] A more recent example can be found in the soundtrack for the video game *Spore Hero*[5] written by Winifred Phillips. Both examples feature a melody that is constantly disappearing and reappearing in a slightly different way.

2.1.2 Compositional Dynamics

Another way of adding some interesting variation to the loop without creating landmarks is afforded by the 'compositional dynamics' technique. Basically, it adds a sense of movement to the music through a string of small musical events. Those events have

[3] Ibid., p. 160.

[4] MovieMongerHZ. *Toccata and Fugue in D Minor (Best Version Ever)*. https://youtu.be/ho9rZjlsyYY?t=161. Accessed on 2019-11-09. 2010.

[5] Sethis Zurlo. *Spore Hero Music Ancient Grounds*. https://youtu.be/fod2dNb0oYQ?t=23. Accessed on 2019-11-09. 2009.

to rise logically from the music so as not to be overly surprising and distracting. To return to the forest metaphor, these events would represent weather and wildlife, the sound of a wind breeze, an eagle cry or a buzzing swarm of flies. This technique is especially suitable to support the overall ambience of the game.

Frequent uses of compositional dynamics can be found in the *Star Wars* Franchise, for example in the game *Star Wars: The Force Unleashed*,[6] where the music seems to imitate sound effects such as laser blasters and explosions.

2.1.3 Succession of Variations

This technique describes the creation of one or more themes and several variations of those themes. Since this requires a significant amount of original music, 'succession of variations' should only be used for loops lasting longer than five minutes. The longer the loop, the easier it is to hide the repetition of the themes and their variations. In terms of the forest metaphor, Phillips compares the themes to spectacular sights such as a rare species of lizard or an ancient oak tree. After walking for a short while, another different lizard appears as well as a different ancient oak. After seeing a range of magnificent sights, one does not immediately notice passing the first lizard again.

This technique allows noticeable changes in key, tempo and style, thus broadening the range of possibilities for the composer. As Phillips points out, "a track of this nature would give the impression of taking a musical tour of a highly interesting landscape" while "subtly overload(ing) the listener, causing the sections to blend together in the mind and become less readily recognizable".[7]

2.1.4 Repeating Figures

In contrast to succession of variations, 'repeating figures' is a technique suitable for short loops. Based on an unchanging root note, a single structural pattern is used as the loop's core and is only slightly varied. The structural pattern can be a bass line, a rhythmic pattern or a short tone sequence. Due to its limited variety, this loop technique is unlikely to produce landmarks. However, using it in a longer loop can quickly produce the aforementioned repetition fatigue, which is why this technique is best suited for short, recurring loops. A gameplay example using such a loop could be a recurring mini game within the game such as a lock picking, hacking or puzzle

[6] Crimson Knight. *Star Wars: The Force Unleashed music - Raxus Prime 5*. https://www.youtube.com/watch?v=ZEGNi6bKr6w. Accessed on 2019-11-09. 2017.

[7] Phillips, *A composer's guide to game music*, op. cit., pp. 164/165.

sequence. Such mini games often require a heightened concentration level without any distraction, a task which repeating figures accompany very well.

2.1.5 Slow Textures

Another technique to support the game ambience are 'slow textures'. They consist of "chord or tone clusters that gently swell and fade",[8] according to Phillips. Due to the repeated swelling and fading, the music tends to blend with the environment sounds, subconsciously strengthening the mood and the conveyed emotions of the game. This is an especially useful method for dark, moody or thoughtful games that focus on the game's look and feel instead of complex or hectic gameplay. The game *Journey*[9] uses slow textures successfully to strengthen the game's overall atmosphere.

2.1.6 Creating Loop Points

As this chapter has shown, there are several different approaches to creating a linear loop, all of them useful for different gaming situations. Something all loops have in common, though, is that they have to end the same way they begin.
The so-called 'loop point' describes the point where end and beginning meet to form the loop. To create a smooth, unnoticeable loop, the loop point has to be concealed by the music. Some of the methods mentioned by Phillips to achieve this effect are discussed in the following paragraphs.

Vamp A 'vamp' defines a "rhythmic or chordal pattern" as a "musical background".[10] Usually, it repeats only at the beginning and end of the piece to enclose the loop point, but as this might draw too much attention, it may be repeated a few times in the middle of the loop as well. Figure 1 shows an example of such a chordal pattern from Phillips's book.

[8] Ibid., p. 166.

[9] Journey Soundtrack. *Journey Soundtrack (Austin Wintory) - 01. Nascence.* https://www.youtube.com/watch?v=TLfj3pAlrs4. Accessed on 2019-11-09. 2012.

[10] Phillips, *A composer's guide to game music*, op. cit., p. 169.

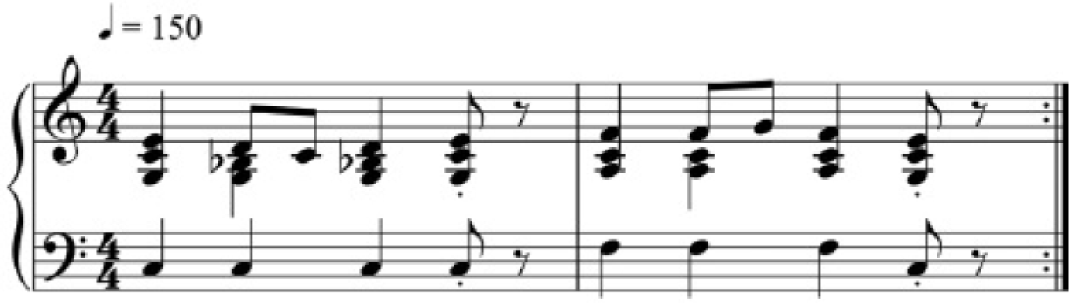


Figure 1: Vamp chord progression

Answer-Question-Format In this method, the composer uses two matching musical patterns that can be described as a question and the resulting answer. The loop starts with the answer, which on its own has an introductory feel to it, and ends with the question, so that the answer follows logically. As an example, Phillips uses the well-known nursery rhyme "Old MacDonald", where the phrase "Old MacDonald had a farm" represents the question with the "Ee-Eye-Ee-Eye-Oh" following as the answer.[11]

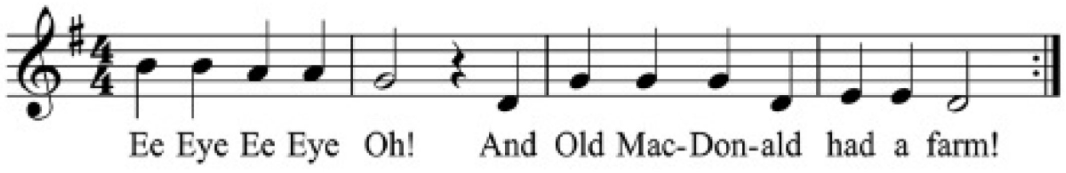


Figure 2: Answer and Question in Old MacDonald

Interrupted Progression As described by Phillips, a progression is a "series of chords creating a sense of movement and change within a musical work".[12] They can be used as a build up to a new theme, a key or tempo change, or any other shift in the music. Applying the 'interrupted progression' technique, the progression is cut down in the middle, the last half being placed at the beginning and the first half at the end of the loop. Similar to the answer-question format, the end of the progression serves as an introduction, whereas the beginning logically joins the end at the loop point to complete the progression.

[11] Ibid., p. 169.
[12] Ibid., p. 170.

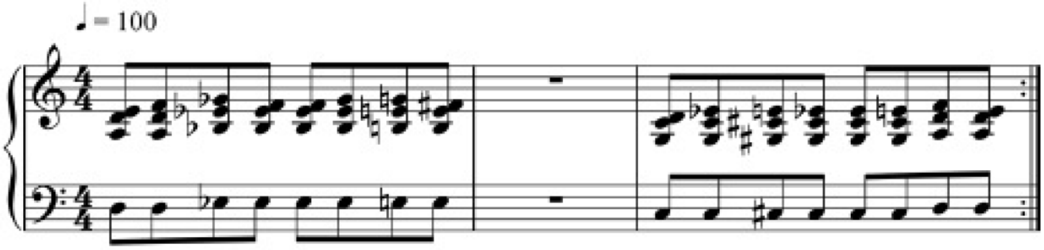
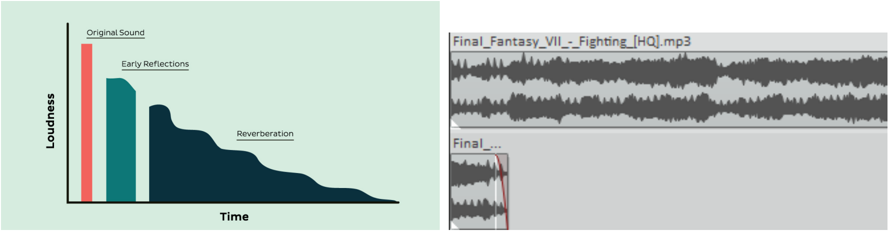


Figure 3: Interrupted Progression

2.1.7 Technical Challenges

Having examined the methods to design a linear loop, this section focuses on the challenges a composer will likely encounter when creating a loop. Although they are far from being the only ones, Phillips focuses on the following two challenges.

Reverb Tail Every sound needs a certain time to “ring out” naturally. The ‘reverb tail’ is, according to Phillips, “the time it takes for the last sonic event of the loop to fade away to silence”.[13] If the reverb tail were simply cut off at the end of the loop, the sensitive human ear would notice the missing reverberation, at least subconsciously, and the result would feel unnatural. A simple workaround would be to copy the reverb tail from the end and paste it into a new audio channel at the beginning of the loop.



(a) Sound reverberation (b) Reverb tail in FFVII fighting loop

Figure 4: Reverb Tail

Zero Crossing Point Audio editing software such as *Audacity* or *Reaper* usually depicts audio data as waveforms, as shown by Figure 4(b) in the reverb tail paragraph. Zooming in on this waveform, one can see that it consists of a single line running up

[13] Ibid., p. 172.

and down, frequently crossing the centre line of the waveform, which is the ‘zero decibel point’ or ‘zero crossing point’.

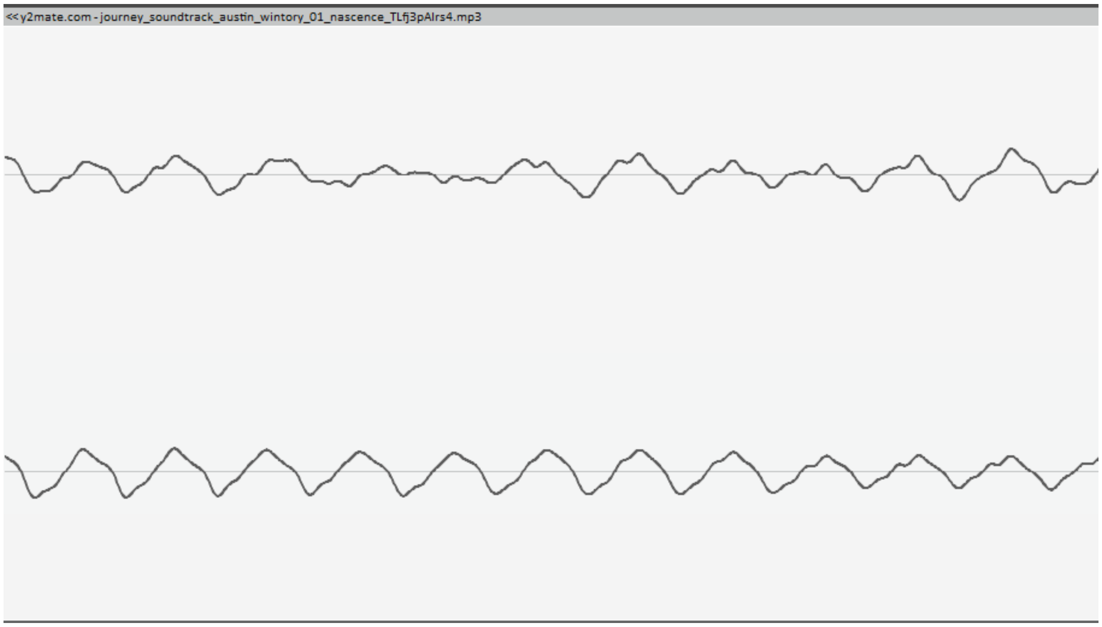

<<y2mate.com - journey_soundtrack_austin_wintory_01_nascence_TLfj3pAlrs4.mp3

Figure 5: Stereo waveforms crossing the zero decibel point

In stereo audio, there are two parallel asymmetrical waveforms. To create a seamless loop, the loop point should be placed exactly at a time when both waveforms pass the zero crossing point. Due to the waveforms’ asymmetry, finding an ideal point might be quite difficult, so in some cases the composer has to use fade outs to bring both waveforms to zero decibel.

2.2 Stingers

Another important part of linear music in games is the ‘stinger’. It refers to short musical phrases that are triggered by events such as victory, defeat or death, or are used to hint at something in the game. The stingers should fit in with the rest of the soundtrack, so as to complement the music and not to irritate the player while playing. A combat victory stinger, for example, should use the same instruments and the same overall dynamic of the fighting soundtrack, whereas a hint stinger, which is usually triggered while exploring, should rather fit the ambient environment music.
A well-known example is the victory stinger from *Final Fantasy VII*.[14] In contrast to

[14] Cloud183. *Final Fantasy VII - Victory Fanfare [HQ]*. https://www.youtube.com/watch?v=-YCN-a0NsNk. Accessed on 2019-11-09. 2008.

that, we have the example of a defeat stinger from *Halo:Spartan Strike*.[15]

2.3 One-Shot Tracks

The last feature of linear music that is often needed in games is the ‘one-shot track’. It is the generic term for a piece of music of different but definite length with a clear beginning, middle, and end. One-shot tracks are used for cinematics and cutscenes, for scripted events or in-game to accompany the gameplay. Using an in-game one-shot track poses the same difficulties as the linear loop, since, in contrast to a cinematic or cutscene, the composer does not know what happens at any moment during gameplay and thus has to write the music to “accommodate any activity that may occur”,[16] as Phillips states. Scripted events, however, are easier to predict. Although the player is able to act and interact during a scripted event, which makes dramatic timing rather difficult, the event itself follows a given pattern for which music can be composed in a similar manner as for a cinematic or cutscene.
A famous example for the use of a theme in a cutscene is from Assassin’s Creed II, where the hero Ezio and his brother climb onto the highest roof of Florence and watch the city from above, while the well known piece *Ezio’s Family*[17] is playing.

3 Interactive Music in Games

Having dealt with linear music and its composition, this chapter delves into the techniques of interactive music in games. Interactive music describes the art of creating music that adapts itself to gameplay variables. The music needed for this can either be rendered audio files or raw music data. Both methods have their own advantages and disadvantages, which will be discussed in the following paragraphs, along with a variety of techniques to use them to create interactive music. Although all techniques can be applied to both rendered music files and raw music data, they are assigned to the type with which they are most effective.

[15] Bizarchivist. *Halo: Spartan Strike In-Game Music - Defeat Stinger*. https://www.youtube.com/watch?v=PvF0VU3WkHM. Accessed on 2019-11-09. 2015.

[16] Phillips, *A composer’s guide to game music*, op. cit., p. 182.

[17] DavidRolandRoly. *Assassin’s Creed 2: Opening Scene(HD)*. https://www.youtube.com/watch?v=BJshVVtEyso. Accessed on 2019-11-22. 2010.

3.1 Rendered Music Files

When using software to compose music, the composition usually consists of separate tracks containing the music data of different instruments or different melodies, which can be separately tweaked and modified. If the composition is finished, it can be rendered as a single audio file such as WAV or MP3. As Phillips states, this rendered file "has the potential to embody the music's most ideal state, with every nuance impeccably highlighted and every musical element perfectly balanced".[18] Although this allows the highest possible quality, it also makes all the small pieces and tracks of which the composition is comprised inaccessible, which inevitably restricts the possibilities of interactivity. Therein lies the difference between rendered music and raw music data, in which all those small fragments stay independent and can be used and reassembled without being rendered as a finished composition.

One method to use rendered files for interactive music is to compose "component parts that are meant to operate together but can be presented in many different configurations",[19] as described by Phillips. These 'component parts' are written to fit any possible combination which results from certain game predicaments. For example, one of the components always plays as a reaction to a certain game variable falling below a certain threshold, such as the player's health falling below 10%. Another component might be added whenever the player shoots a gun. Thus, the player directly or indirectly determines the musical score through his actions. In the following, two ways of using component parts are described.

3.1.1 Horizontal Re-sequencing

The idea of interactive music can be traced back to the 18th century, when a musical dice game was popular among the nobles. Composers such as Mozart crafted musical pieces in the form of the aforementioned component parts, usually consisting of six components matching the six faces of a dice. The nobles would then throw a dice to determine which component would be played. Similar to this is the 'horizontal re-sequencing' method, excluding the aspect of chance. The components are written to be played in any possible order which is then determined by the gameplay. To ensure smooth transitions, the components contain 'digital markers' that "indicate convenient and logical points at which the game engine may switch between that music segment and another in the collection".[20]

[18] Phillips, *A composer's guide to game music*, op. cit., p. 185.

[19] Ibid., p. 187.

[20] Ibid., p. 188.

This video clip[21] shows an example of this technique from the game *Speed Racer*, a car racing game encompassing several fast paced racing music tracks. In the game, players can trigger and enter a special 'zone mode' lasting about 15 seconds in which cars become faster and invincible. To have the music blend naturally, each racing track has its own distinctive zone mode track in the same rhythm and the same style as the respective racing track. The digital markers are set on the downbeat of each measure. Thus, if the player starts the zone mode, the zone mode track commences seamlessly at exactly the next downbeat. Instead of digital markers, the composer can also use transition segments for each component, a technique demonstrated in this video.[22]
Although horizontal re-sequencing might not seem different from linear loops at first, in practice it is very different indeed. For linear music, the composer writes one finished loopable piece that is used during a specified time or at a specified place in the game. For horizontal re-sequencing, however, the composition consists of a large number of very short music files, sometimes not longer that a few bars of music. During gameplay, those pieces can be reassembled much more frequently and interactively than linear music, being able to "quickly react[] to every dramatic moment" (Phillips), which is something a linear loop cannot do. A great disadvantage of this technique, however, is the significant restriction to tempo, key and instrument changes, as every piece, however short, must be able to fit after any preceding piece. Furthermore, this technique restricts the creation of a theme or melody, since the separate pieces are usually too small to encompass a theme.

3.1.2 Vertical Layering

In contrast to horizontal re-sequencing, the components for 'vertical layering' are meant to be played simultaneously in any combination. This means that the components are usually far longer than in horizontal re-sequencing, which eliminates the two major disadvantages of that technique.
Vertical layering works in a similar way to how bands record and mix their songs. The goal is one finished song, but each instrument is recorded separately and the resulting tracks are then tweaked and put together using audio software. In contrast to this method, the tracks for vertical layering can consist of several instruments. Each track or component works individually as a piece of music, while still fitting to the other

[21] DyllonStej Gaming. *Speed Racer Wii Class 3 Championship 9 Race 1 in 6:44:43e*. https://youtu.be/VA1mbY-cTAc?t=77. Accessed on 2019-11-08. 2015.

[22] Rui Claro. *Horizontal Re-Sequencing Project - Game Music Composition*. https://www.youtube.com/watch?v=FPs2YFdn5wc. Accessed on 2019-11-08. 2018.

ones, so that all components can be played in any desired combination. This highlights another important difference: In so-called 'stem mixing', which is the technique that bands use, all tracks are meant to be played together, whereas in vertical layering, all tracks can play by themselves.

This video[23] shows Winifred Phillips demonstrating the vertical layering system from her composition for the game *The Maw*, using three layers. Another example,[24] also from Phillips, is from her work for *LittleBigPlanet*, wherein she demonstrates the use and interchangeability of six layers.

3.2 Music Data

As mentioned before, music data describes the unrendered 'fragments' of the music. There are several different formats for raw music data, of which the most common ones for games will be treated in this chapter.

3.2.1 MIDI

The acronym MIDI, defined in 1983,[25] stands for "Musical Instrument Digital Interface" and it refers to a communications protocol for the exchange of music data between electronic instruments, computers, and other MIDI-enabled devices. With the MIDI format, the composer can record what they are playing and send the data containing information about note events, pedal use, sonic adjustments and other input to the computer, where it is stored as a MIDI file. In return, such a MIDI file can be sent back to the keyboard, which can transform the data back into music and play the piece by itself. Thus, the MIDI format enables the composer to store an entire performance comprised of several different instruments and parts in a digital state on a computer. A frequently used way of depicting MIDI data is in the form of the 'piano roll' (Figure 6).

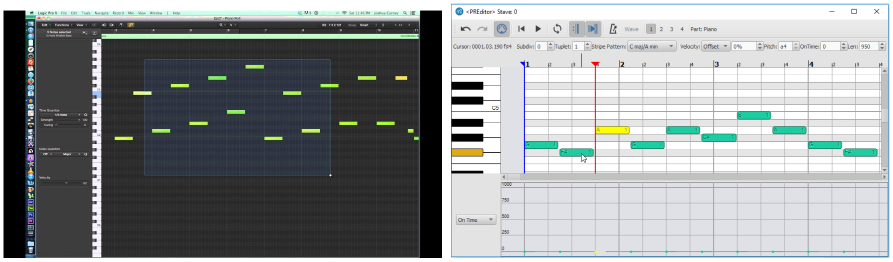
According to Phillips, "MIDI is used in video games to store note events and music data together with the library of musical instrument sounds that are triggered by the accompanying data in the MIDI file".[26] In general, those files require less memory than rendered music files. The actual memory, however, depends greatly on the sound

[23] GameMediaPR. *Pt. 1 Vertical Layering - A Composer's Guide to Game Music*. https://www.youtube.com/watch?v=plVLJ1OXAiE. Accessed on 2019-11-08. 2014.

[24] GameMediaPR. *Pt. 2 Vertical Layering - A Composer's Guide to Game Music*. https://youtu.be/3cReeJBSjGQ?t=109. Accessed on 2019-11-08. 2014.

[25] Karen Collins. *Game sound an introduction to the history, and practice of video game music and sound design*. MIT Press, 2008, p. 50.

[26] Phillips, *A composer's guide to game music, op. cit.*, p. 205.



(a) LogicProX (b) MuseScore

Figure 6: Piano Roll

libraries. While it is possible with MIDI to trigger built-in sounds from the gaming device (eg. *Game Boy*) to save memory, the results are rather poor compared to a large high-quality sound library.

One of the major advantages of the MIDI format are the great possibilities of interactivity. The music data in a MIDI file can be directly accessed and adjusted by the game engine, which means that game variables can cause the music to change key without also changing the tempo, or to switch from one instrument to another while the music keeps playing by simply telling the MIDI file to use a different part of the sound library. This makes it possible to create a soundtrack that fits every aspect of the gameplay perfectly.

3.2.2 MOD

The MOD file format, initially created for the 'Amiga computer' by Karsten Obarski in 1987,[27] works quite similar to the MIDI format, storing music data in the form of note events, pedal use, etc. The main differences are, however, that the music data and the sound library can be saved into one single file. As a consequence, the composer can create music data and choose (or create) the perfect sound library for it, causing the music to sound always exactly as intended. Additionally, the MOD file can be comprised of detached numbered music snippets which can be accessed directly by the game engine, enhancing interactivity even further.

A great disadvantage of the MOD file format is its creation software called 'trackers'.[28] Being unable to record and store musical performances the way MIDI allows, the composer has to manually enter the notes and other music data with a computer keyboard.

[27] Collins, *Game sound an introduction to the history, and practice of video game music and sound design*, op. cit., p. 58.

[28] Phillips, *A composer's guide to game music*, op. cit., p. 208.

This technique is considered very user-unfriendly and requires a lot of practice as well as computer affinity. A video game example[29] can be found in the game *Unreal* by GT Interactive from the year 1998, wherein the entire soundtrack is composed in the MOD format.[30]

3.2.3 Generative Music

A special case of MIDI-based music is the 'generative music' approach. It refers to the concept of music creating itself through mathematical algorithms, probability rules or purely through chance. If, for example, the current music is composed in the C major key with a B as the last note, then a probability rule could state that the probability for the next note is 80% for a C, 15% for a G, and 5% for an A. The program then uses those probabilities to initiate the next note. Instead of using MIDI files, generative music can also be based on short rendered music files whose order and application are in turn determined by algorithms, probability or chance.

Although the possibilities of interactivity and originality are vast with generative music, the concept is still highly untested and seldomly used. Furthermore, the question remains whether the resulting music can be considered "good" or "interesting" music or whether it sounds simply strange and unfamiliar.

4 Conclusion

Having examined and contrasted linear and interactive game music, it is evident that the biggest advantage of linear music is its potential for high-quality, distinctive music featuring epic, recognizable themes and melodies as well as highly atmospheric tracks. Interactive music, on the other hand, excels in the possibilities of fluctuating, adjustable music that perfectly fits every aspect of the game play, simulating that players create their very own, personal game experience.

As mentioned in the introduction, a game can contain both linear and interactive music. Every game, for example, needs a theme song, usually a one-shot track, either to be used in a game trailer, for a cutscene or in the game menu. Making it interactive would entirely miss the point of a theme song, which is supposed to be memorable and easily recognizable. For games that feature a lot of exploring and wandering, however,

[29] Michail Alvanos. *Unreal 1998 Soundtrack - 01 Flight Castle*. https://www.youtube.com/watch?v=fAB78sZARB4. Accessed on 2019-11-08. 2015.

[30] Mirsoft. *Unreal (Epic Megagames): Game rip*. http://www.mirsoft.info/gmb/music_info.php?id_file=OTcy. Accessed on 2019-11-08. 2019.

interactive music would be a good option to avoid repetition fatigue and to bring life to game passages that would feel too static accompanied by a linear loop.

To conclude, both linear and interactive music offer various possibilities for different needs of the game, and it is the composer's task to deploy either technique where it is most suitable.

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[2] ibid., p. 170

[3] ibid., p. 171

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(b) Screenshot, Software: Reaper

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[6] (a)MusicTechHelpGuy. *Logic Pro X - Video Tutorial 27 - MIDI Piano Roll Editor, part 1.* https://www.youtube.com/watch?v=Jf-SrVhcxiU. Accessed on 2019-11-09. 2014

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