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Programmed Baroque 'n' Roll

Composition Techniques for Video Game Music on the Nintendo Entertainment System

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CONTENTS

INTRODUCTION

The goal of this thesis is to explore the correlation between the advantages and limitation of the NES[1] sound chip, and the released video game music. It appears that many musical scores of NES games rely on contrapuntal and polyphonic composition techniques akin to music from the Baroque and Classical period. The question is to what extent the sound chip's limitations are the reason why NES video game composers used those composition techniques.

Many musicological studies on music in video games, most notably those by Karen Collins (especially her monograph *Game Sound*),[2] have focussed on the reception and interaction of video game music, i.e. how the music affects the player and how the player's game input triggers the music: studies that are of benefit to video game designers. However, few studies are focussed on the video game music itself. How does the video game hardware affect the video game composer's options to compose? While studies have been done on the music hardware of game consoles—especially Collins's *Game Sound*[3] and Melanie Fritsch's *History of Video Game Music*[4]—they mainly answer the technological aspects of video game music, not the compositional aspects. This thesis wants to address the questions unanswered.

Chapter One will give a short introduction to the abilities and limitations of the NES sound chip. Each ability will be regarded as a tool for video game composers. Furthermore, the development of the sound chip and its purpose will be discussed between a deterministic and voluntaristic view on technology.

Several composition techniques that are possible on the NES hardware will be

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[1] NES is an abbreviation for Nintendo Entertainment System, which can be pronounced either spelled out ("any-yes") or as an acronym ("ness").
[2] Karen Collins, *Game Sound: An Introduction to the History, Theory, and Practice of Video Game Music and Sound Design* (Cambridge: MIT Press, 2008).
[3] Ibid.
[4] Melanie Fritsch, "History of Video Game Music," *Music and Game Perspectives on a Popular Alliance* (Berlin: Springer, 2013), 11–40.

pointed out in Chapter Two, by giving musical examples of a selection of NES music. The composition techniques will give an overview of the counterpoint and harmony that is possible on the NES.

In Chapter Three, I will also discuss the remediated nature of writing new or pre-existing music for the NES and if NES music can be regarded as an abstraction of what their composers would have wanted it to be (similar to playing a piano reduction of a symphonic piece) or that the NES sound chip can be regarded as an instrument in itself.

All the musical examples will include harmonic analyses and all the NES music that has been analysed will be available in the Appendix. After all the selected NES video game music has been thoroughly analysed, compositionally as well as stylistically, this thesis will close with a conclusion gathered from the research.

CHAPTER ONE

The NES Music Hardware

At the start of the 1980s, the 8-bit era of video games, music in video games was only present sparingly. Neil Lerner goes into great detail about the development of video game music during this period in "The Origins of Musical Style in Video Games, 1977–1983."[5] In the article, Lerner discusses the popular 1980s game *Pac-Man* (1980)[6] and that it has only very short musical cues that play before a level starts and during a cutscene (a non-interactive scene that usually develops the storyline of the game).[7] Even the sound effects were very basic, consisting mainly of beeping sounds.[8] The way video game music and sound effects sounded at the time can now be considered to have a 'video game aesthetic.' For instance, the French music duo Daft Punk used this early 1980s video game sound for their film score for *Tron Legacy* (2010),[9] to convey a surreal environment of a computer world wherein the story takes place. However, Karen Collins points out that the video game sound of the 1980s came into being not as a result of "an aesthetic decision, but . . . of the limited capabilities of the technology of the time."[10] Thus, the sounds and music for a video game were very dependent on the hardware that the video game used and on how skilled the video game music composer was in both understanding and using said hardware.

This chapter will give a brief explanation of the capabilities and limitations of the NES sound chip to explain why the video game composers relied on the composition techniques discussed in Chapter Two.

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[5] Neil Lerner, "The Origins of Musical Style in Video Games, 1977–1983," *The Oxford Handbook of Film Studies* (Oxford: Oxford University Press, 2013), 319–347.
[6] *Pac-Man*, Tokyo: Namco, 1980), Arcade Video Game.
[7] Lerner, "The Origins of Musical Style in Video Games," 331–333.
[8] Collins, "Push Start Button: The Rise of Video Games," in *Game Sound*, 8–9.
[9] *Tron: Legacy*, written by Daft Punk, (Burbank: Walt Disney, 2010), CD.
[10] Collins, "Push Start Button," 9.

The NES Sound Chip and Its Capabilities

The NES uses a Ricoh sound chip, the 2A03.[11] Music could be created out of:

1. three tone channels: two pulse wave channels, one triangle wave channel,
2. one percussion channel:[12] the noise channel,[13]
3. one sample channel: delta modulation channel (DMC).

The DMC supports samples to be used for either sound effects and percussion or music, but obviously the samples first have to be built for it to work. Sunsoft was one of the notable companies who used the DMC for adding a sampled bass sound.[14]

Timbre

The timbre of a pulse wave can be affected by changing its duty cycle; this is called pulse width modulation (PWM). The 2A03 has three different duty cycles: 50%, 25%, and 12.5% (*figure 1*).[15]

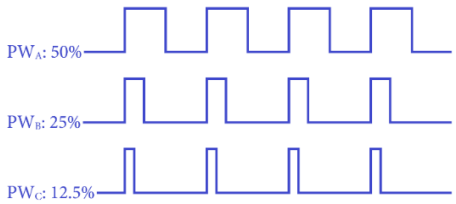

Figure 1: Visual example of how each optional duty cycle looks.

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[11] NES consoles for countries that use the PAL TV system have a different processor. This difference does not have any influence on this thesis's research, so it will not be discussed. See *NesDev*, Wiki, accessed January 22, 2016, http://wiki.nesdev.com/w/index.php/2A03.

[12] The percussion channel will not be discussed in this thesis, because it adds little to the research that is mostly tone-based.

[13] Although the noise channel is primarily used for percussion, since its metallic presets can sound like musical tones, they can be used as an extra voice, i.e. "Quick Man" from *Mega Man 2* (see Appendix).

[14] "NES Audio: Sunsoft Bass and Melodic Samples," demonstrated by Bucky, Video Clip, posted March 16, 2012, accessed January 22, 2016, *YouTube*, https://youtu.be/LEgoYUzwabI.

[15] Technically, the 2A03 also has a fourth duty cycle option: 75%. However, this pulse wave is an inversion of that of 25%; practically they will sound exactly the same. See "Research in Game Music: The Difference Between Pulse Waves and Square Waves," in *Classic Gaming*, Weblog, posted May 15, 2012, accessed February 4, 2016, https://classicalgaming.wordpress.com/2012/05/15/research-in-game-music-the-difference-between-pulse-waves-and-square-waves.

More partials of the overtones will stay effective, the nearer the pulse wave's duty cycle reaches 0% (*figure 2*).[16]

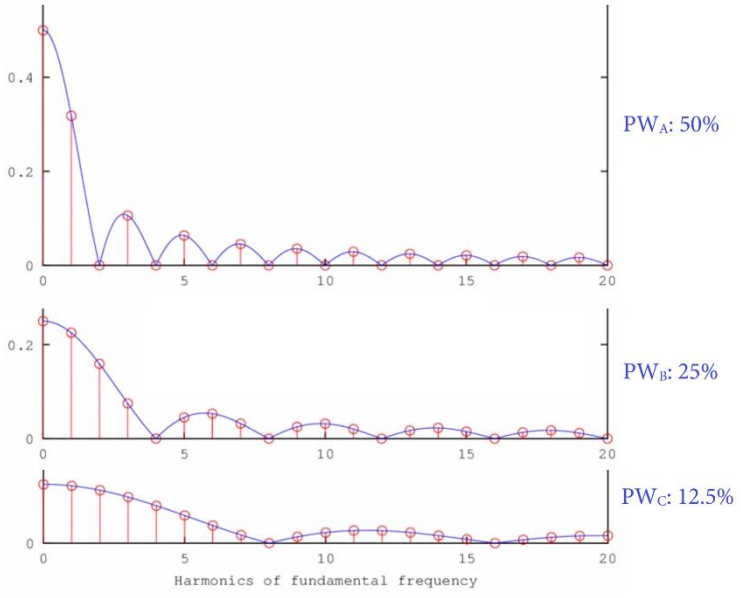

Figure 2: Visual example of the active harmonic partials and their amplitudes of PW_A, PW_B, and PW_C.

This means that the lower the duty cycle of a pulse wave is, the sharper but thinner the timbre will become, as Gordon Reid points out.[17]

A pulse wave's attack, decay, sustain, and release (ADSR) can be altered by changing its duty cycle while the wave is performed.[18] Although one of the pulse wave settings can sound very woody (PW_A), the triangle wave has an even darker timbre. For example, it is used to mimic a flute in *Dragon Quest* (1986).[19] The triangle wave is not so flexible when it comes to volume, however. The pulse waves can change volume in 16 gradual steps, while the triangle wave cannot at all;[20] it is either on or off.[21] The triangle

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[16] "Duty Cycle and Spectrum," demonstrated by Mik81, OGG Theora Video File, posted July 27, 2014, accessed January 23, 2016, *Wikipedia*, https://en.wikipedia.org/wiki/File:Duty-Cycle-and-Spectrum.ogv.

[17] Gordon Reid, "Synth Secrets, Part 10: Modulation," in *Sound on Sound*, Website, accessed January 22, 2016, http://www.soundonsound.com/sos/feb00/articles/synthsecrets.htm.

[18] "NES Audio: Duty Cycle Modulation," demonstrated by Bucky, Video Clip, posted March 11, 2012, accessed January 22, 2016, *YouTube*, https://youtu.be/kl9v8gtYRZ4.

[19] "Fairy Flute," written by Koichi Sugiyama, from *Dragon Quest* (Tokyo: Enix Corporation, 1986), NES Video Game, from WiiGuy's 8-BitStereo, "Dragon Warrior (NES) Soundtrack - 8BitStereo." Video Clip, posted June 17, 2013, accessed January 16, 2016, *YouTube*, https://youtu.be/WqdpKnx6TfY?t=13m.

[20] Brad Taylor, "2A03 Technical Reference," in *NesDev*, Website, accessed January 21, 2016, http://nesdev.com/2A03%20technical%20reference.txt.

[21] Limited control is possible with some trickery: "Other Uses" in *NesDev*, Website, accessed

wave's limited control combined with its dark timbre, makes it very ineffective to use for melodies. It is also the reason why it mainly functioned as a bass channel in many NES games. The pulse waves could be used far more expressively and therefore they were mainly used for melodies.

Determinism vs. Voluntarism

> The reification and fetishization of technology has resulted in assumptions about technology that can be characterized as usually falling on one of two poles. The first is the familiar voluntarism argument: technology is a tool that people use, nothing more, and is thus essentially neutral; it is only good or bad depending on its use. The second is the position known as technological determinism, in which technology is assumed to transform its users directly.
>
> – Timothy D. Taylor[22]

Taylor sheds an interesting perspective on technology—one which changes the view on the possibilities that have been mentioned about the NES sound chip in this chapter. A deterministic view gives the reason for technology being made in the first place: to fulfil a purpose. In the case of the NES, its sound chip's purpose is for the NES console to be able to produce sound. A voluntaristic view shows what people actually do with technology, which could stray away far from its intention. To give an example, being able to play back NES music separately from the game, by extracting the musical code from the game itself and containing it as an NSF file,[23] is something the NES developers certainly did not intend to happen; neither that NES music could stand alone as a medium of its own, similarly to how film soundtracks have been released separately from their motion pictures.

As discussed in the beginning of this chapter, describing the possible sounds of video game consoles as a particular sound aesthetic was not the intention of the first video game sound designers to become so. It was a development that could not have been

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January 27, 2016, http://wiki.nesdev.com/w/index.php/APU.

[22] Timothy D. Taylor, "Music, Technology, Agency, and Practice," in *Strange Sounds: Music, Technology & Culture* (New York: Routledge, 2001), 26.

[23] Kevin Horton, "Official NSF Specifications," in *NSF Collection*, Website, accessed February 4, 2016, http://www.kevtris.org/nes/nsf.html.

predicted. Video game sounds and music can not only be regarded as representing real-world sounds (i.e. the triangle wave channel representing a cello), but as "being" real-world sounds (i.e. the triangle wave channel being its own instrument). A compositional deterministic view makes the NES sound chip a medium for representing existing real-world music and sounds, while a compositional voluntaristic view makes the NES sound chip part of real-world music and sounds. Chapter 2 and Chapter 3 will constantly swing between one of the two perspectives regarding the ontological status of the NES sound chip.

CHAPTER TWO

Composition Techniques: Counterpoint vs. Harmony

Because the NES has only three tone channels at its disposal combined with a limited range of timbres, video game composers used different composition techniques to write memorable rich tunes. Some music styles are more suitable than others. Baroque music, for instance, is enriched with musical texture mostly by horizontal layers of melodies, which can be achieved by two voices alone. Koichi Sugiyama demonstrates this in his score for *Dragon Quest*, where most tracks of the game are written with only two voices, such as "Château Ladutorm."[24]

Harmony on the other hand—vertical enrichment—can essentially only be implied. A block chord needs all three tone channels, so that is not an option, because then there would not be any room for a melody or a bassline. This means that composers needed to be very creative with their composition techniques to get the most out of the system.

This chapter will examine the composition techniques that are necessary for giving my arguments for my thesis. Musical cues of NES games will demonstrate how effective each technique can be. The scale degrees with figured bass will be included to show the reader a quick overview of the harmony that can be achieved by a given composition technique or a combination of several.

[24] "Château Ladutorm," written by Koichi Sugiyama, from *Dragon Quest* (Tokyo: Enix Corporation, 1986), NES Video Game, from WiiGuy's 8BitStereo, "Dragon Warrior (NES) Soundtrack - 8BitStereo," Video Clip, posted June 17, 2013, accessed January 16, 2016, *YouTube*, https://youtu.be/WqdpKnx6TfY?t=2m22s.

All the discussed musical pieces in Chapter Two and Chapter Three have their respective musical scores available in the Appendix section so that every piece can be completely examined both audibly as well as visually. Major triads are represented with uppercase roman numerals; minor triads by lowercase roman numerals. The following diagram (*figure 3*) shows what symbols I will be using for all the different diminished chords.

Name	Symbol	Formula	Also Known As
half-dim. 7	$i^{\emptyset}$	1 ♭3 ♭5 ♭7	Minor Seventh Flat Five
dim. 7	i^{o7}	1 ♭3 ♭5 ♭♭7	
double-dim. 7	i^{oo7}	1 ♭♭3 ♭5 ♭♭7	German Sixth (normally in $\frac{6}{5}$)
hard-dim. 7	$I^{\heartsuit 7}$	1 3 ♭5 ♭7	Italian Sixth (normally in $\frac{6}{3}$) French Sixth (normally in $\frac{4}{3}$)

Figure 3.

Arpeggios and Arpeggiator Effects

Arpeggios are the most efficient way to create harmony on the NES, since only one channel is enough to create them. In an episode of *Polderpioniers*—a documentary film series about Dutch people who pioneered in technological development for the Netherlands—Jeroen Tel demonstrates how he applies arpeggios as a means of overcoming the limitation of tone channels on the Commodore 64, a game console with similar hardware limitations to the NES (*figure 4*).[25]

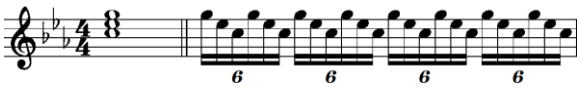

Figure 4: Jeroen Tel's example of representing a block chord by using an arpeggio.

Nobuo Uematsu's "Prelude"[26] from *Final Fantasy* (1987) creates a wide musical texture by simply having very wide arpeggios (*figure 5*). A second channel imitates the main

[25] Mark van der Kruit, "Polderpioniers: Jeroen Tel en de opkomst van gamemuziek," *Tweakers* (8 November, 2015), 8:21–8:58, Documentary, accessed January 10, 2016, http://tweakers.net/video/11064/ polderpioniers-jeroen-tel-en-de-opkomst-van-gamemuziek.html.
[26] "Prelude," written by Nobuo Uematsu, from *Final Fantasy* (Tokyo: Square, 1987), NES Video Game, from WiiGuy's 8BitStereo, "Final Fantasy (NES) - 8BitStereo," Video Clip, posted November 25, 2012, accessed January 29, 2016, *YouTube*, https://youtu.be/0SXhnT9RQ4Q.

arpeggio an eighth later, emulating a delay effect (see Delay and Reverb Effects in this chapter) to strengthen the sound.

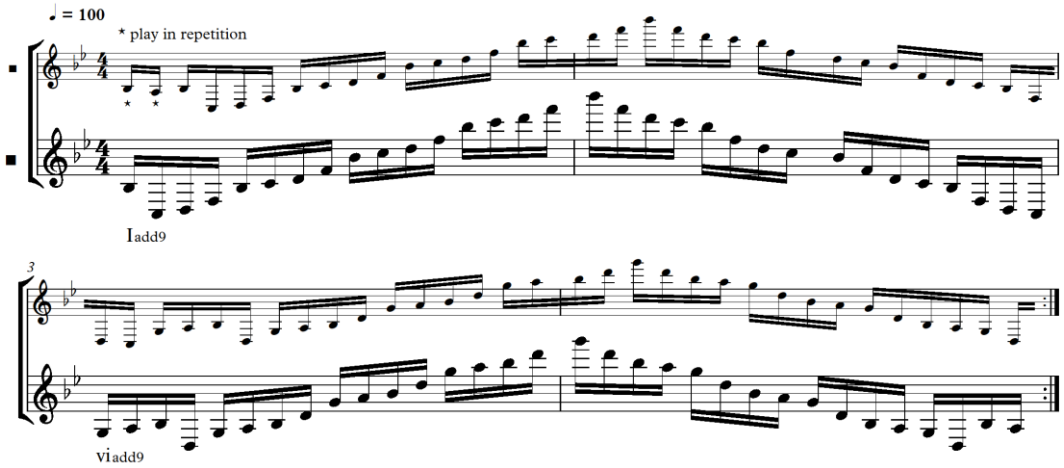

Figure 5: Excerpt of "Prelude" from *Final Fantasy*.

A piece with only arpeggiated chords is not only effective, but it can be aesthetically pleasing. Indeed, many classical pieces or even pop/rock pieces only have arpeggiated chords, such as Bach's Prelude in C Major, BWV 846.[27]

Arpeggios can be played so fast that they are almost perceived as block chords.[28] Mark Cooksey used such arpeggios in "The Drawbridge"[29] from *Dragon's Lair* (1990) (*figure 6a* and *6b*). This type of arpeggios will be called "arpeggiator effects" in this thesis.

[27] Prelude and Fugue in C major, BWV 846, written by Johann Sebastian Bach, edited by Carl Czerny (New York: G. Schirmer, 1893), Sheet Music, in *IMSLP*, Website, accessed January 20, 2016, http://petrucci.mus.auth.gr/imglnks/usimg/6/68/IMSLP01005-Pre_fug1.pdf.
[28] "NES Audio: The Arpeggio Effect," demonstrated by Bucky, Video Clip, posted March 16, 2012, accessed January 22, 2016, *YouTube*, https://youtu.be/4HWHneafZ8w.
[29] "Level 1: The Drawbridge," written by Mark Cooksey, from *Dragon's Lair* (Los Angeles: CSG Imagesoft, 1990), NES Video Game, from WiiGuy's 8BitStereo, "Dragon's Lair (NES) - 8BitStereo," Video Clip, posted February 24, 2014, accessed January 16, 2016, *YouTube*, https://youtu.be/67_Yy8ipWec?t=1m57s.

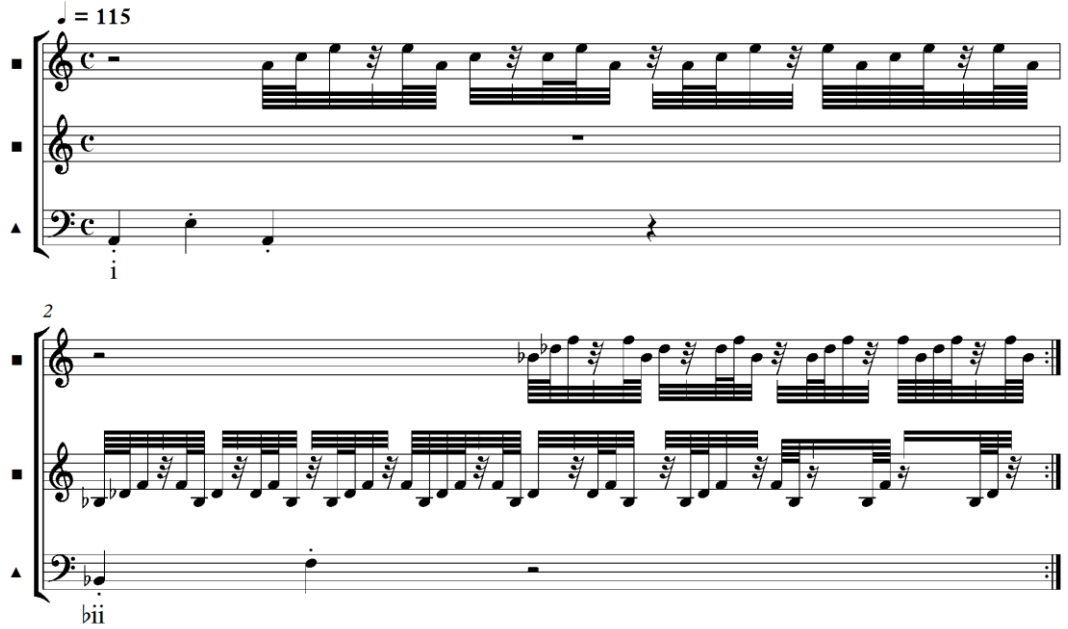

Figure 6a: Excerpt of "The Drawbridge" from *Dragon's Lair*.

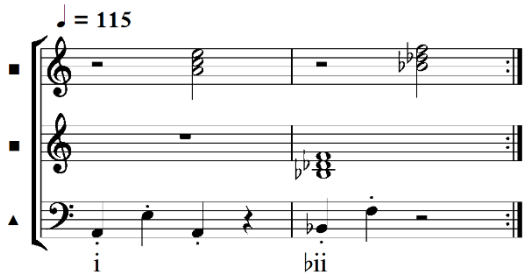

Figure 6b: Implied triads.

Compound Melodies

Though arpeggios are very practical for implying harmony in only one channel, there is a more complex way to apply both melody as well as harmony: compound melody. A compound melody is a melody that can imply more melody lines at the same time.[30] At the start of "Ending Theme"[31] by Koji Kondo from *The Legend of Zelda* (1986), only one voice

[30] Dmitri Tymoczko demonstrates how this works in his chapter "Five Components of Tonality," in *A Geometry of Music: Harmony and Counterpoint in the Extended Common Practice* (Oxford: Oxford Unity Press, 2011), 5.

[31] "Ending Theme," written by Koji Kondo, from *The Legend of Zelda* (Tokyo: Nintendo, 1986), NES Video Game, from WiiGuy's 8BitStereo, "The Legend of Zelda (NES) Soundtrack - 8BitStereo," Video Clip, posted September 23, 2012, accessed January 29, 2016, *YouTube*, https://youtu.be/XHIQTyBaGhw?t=4m44s.

is being used, but it manages to play both a melody and an accompaniment all by itself (*figure 7a*).

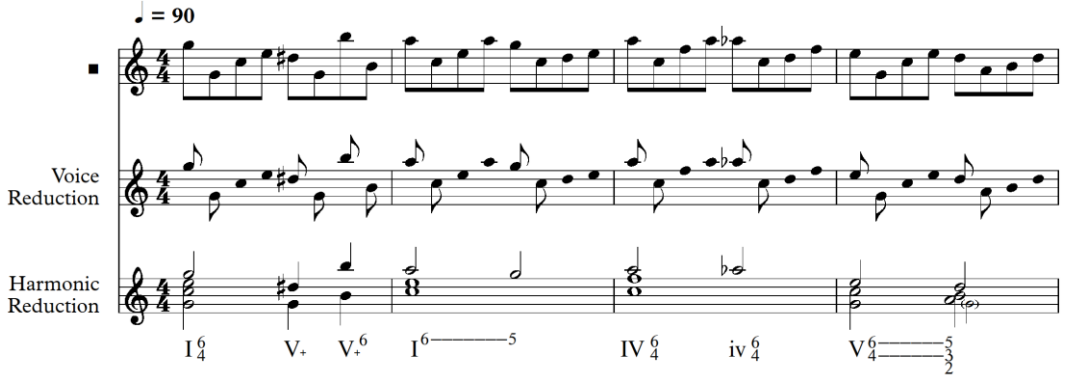

Figure 7a: Excerpt of mm. 1–4 of "Ending Theme" from *The Legend of Zelda.*

Since this compound melody implies three-part harmony, the added bassline (the second staff of *figure 7b*), which implies two voices, further adds texture to the harmony.

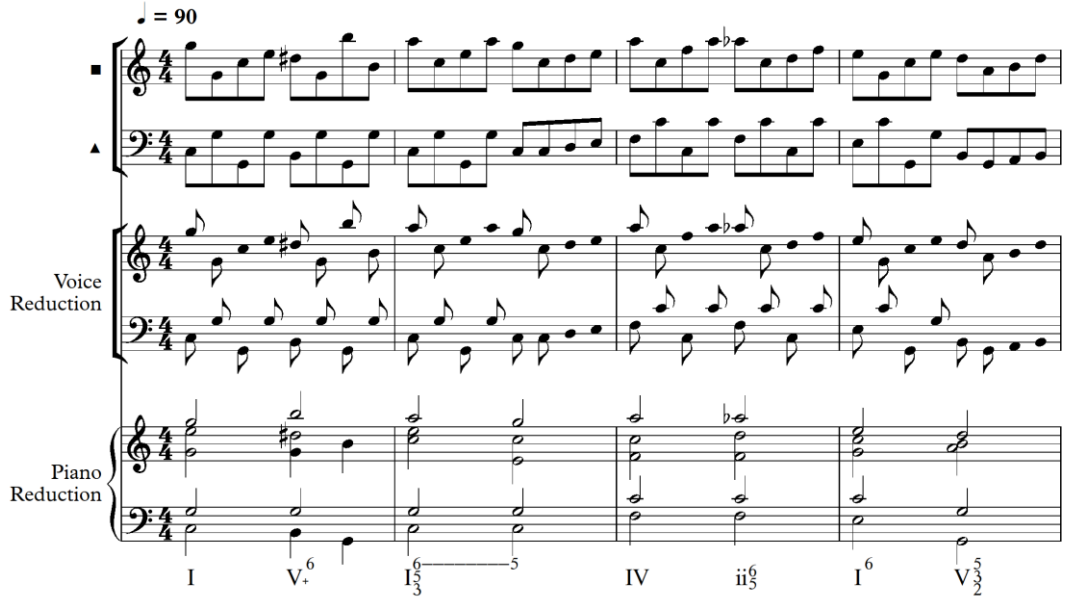

Figure 7b: Excerpt of mm. 5–8 of "Ending Theme" from *The Legend of Zelda.*

"Pushing Onward"[32] from *Ninja Gaiden* (1988) goes even further (*figure 8).* Although the previous example of *Zelda* is a compound melody not unlike flute pieces by

[32] "Pushing Onward," written by Keiji Yamagishi, Ryuichi Nitta, and Ichiro Nakagawa, from *Ninja Gaiden* (Tokyo: Tecmo, 1989), NES Video Game, from WiiGuy's 8BitStereo, "Ninja Gaiden (NES) Soundtrack - 8BitStereo," Video Clip, posted August 21, 2012, accessed January 16, 2016, *YouTube*, https://youtu.be/Zsm4S1EKGGc?t=1m11s.

Telemann (such as his Fantasia for Solo Flute No. 3 in A minor),[33] the compound melody of "Pushing Onward" is so wide, that it essentially sounds like two individual melodies cleverly compressed into one voice.

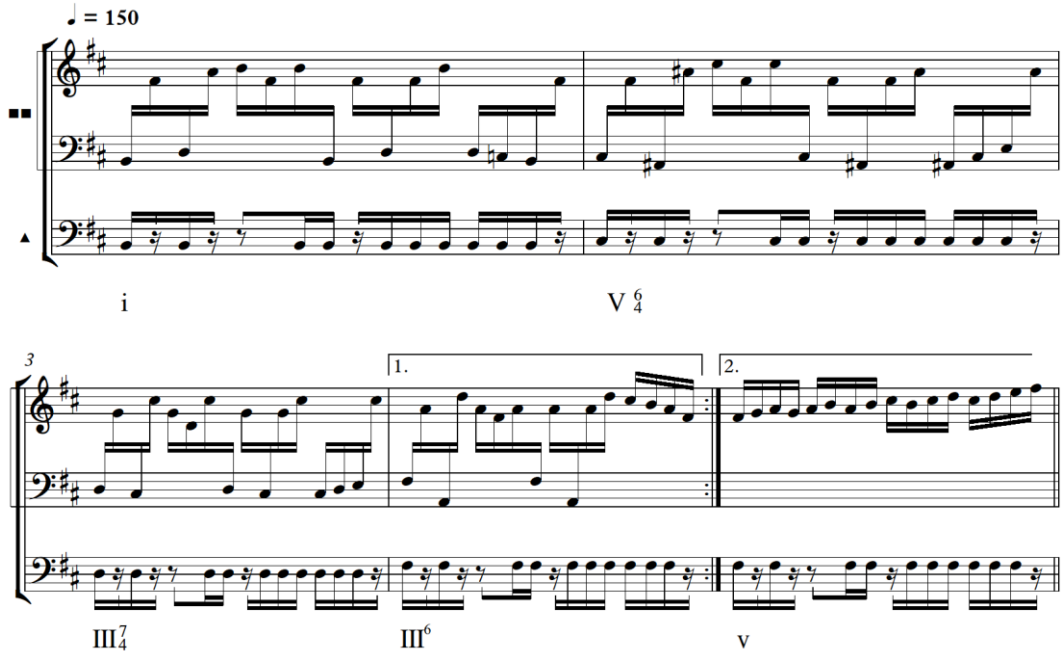

Figure 8: Excerpt of "Pushing Onward" from *Ninja Gaiden.*

Bach's Gigue[34] from the first half of his 6 Partitas, BWV 825, shows a similar extreme in emulating four voices (one top voice, one bottom voice, and two inner voices as accompaniment) with essentially only one voice (*figure 9*).

[33] "3. Fantasie für Querflöte ohne Baß, a-moll," in *Zwölf Fantasien für Querflöte ohne Baß* (Kassel: Bärenreiter Verlag, 1955), 6–7, Sheet Music, in *IMSLP*, Website, accessed February 3, 2016, http://javanese.imslp.info/files/imglnks/usimg/7/78/IMSLP96616-PMLP54405-214711-Telemann-12-Fantasias-Sheet-Music.pdf.

[34] "6. Gigue," written by Johann Sebastian Bach, in 6 Partitas, BWV 825–830, edited by Carl Ferdinand Becker (Leipzig: Breitkopf und Härtel, 1853), page 54, Sheet Music, in *IMSLP*, Website, accessed January 30, 2016, http://imslp.nl/imglnks/usimg/b/bf/IMSLP00789-BWV0825.pdf.

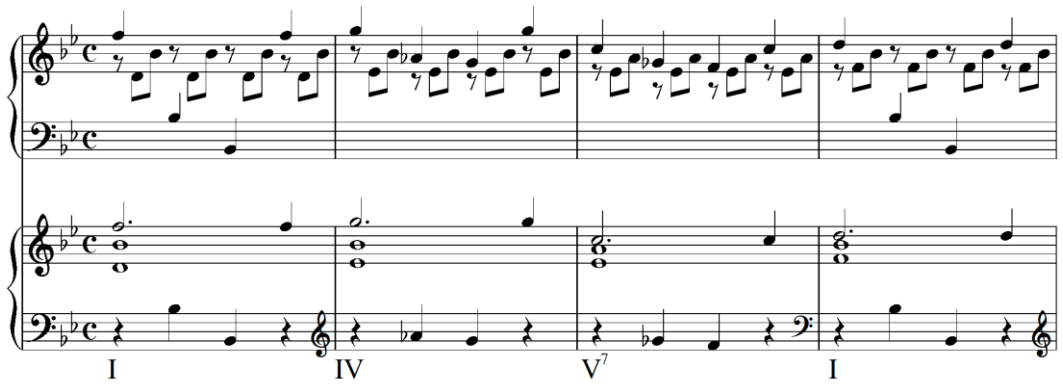

Figure 9: Excerpt of the Gigue (lower two staves show the melodic and harmonic reduction).

"Rainbow Resort"[35] from *Kirby's Adventure* (1993) has a pulse wave channel functioning as both a bassline and a far higher pitched accompany line, creating essentially a four-part structure (*figure 10*).

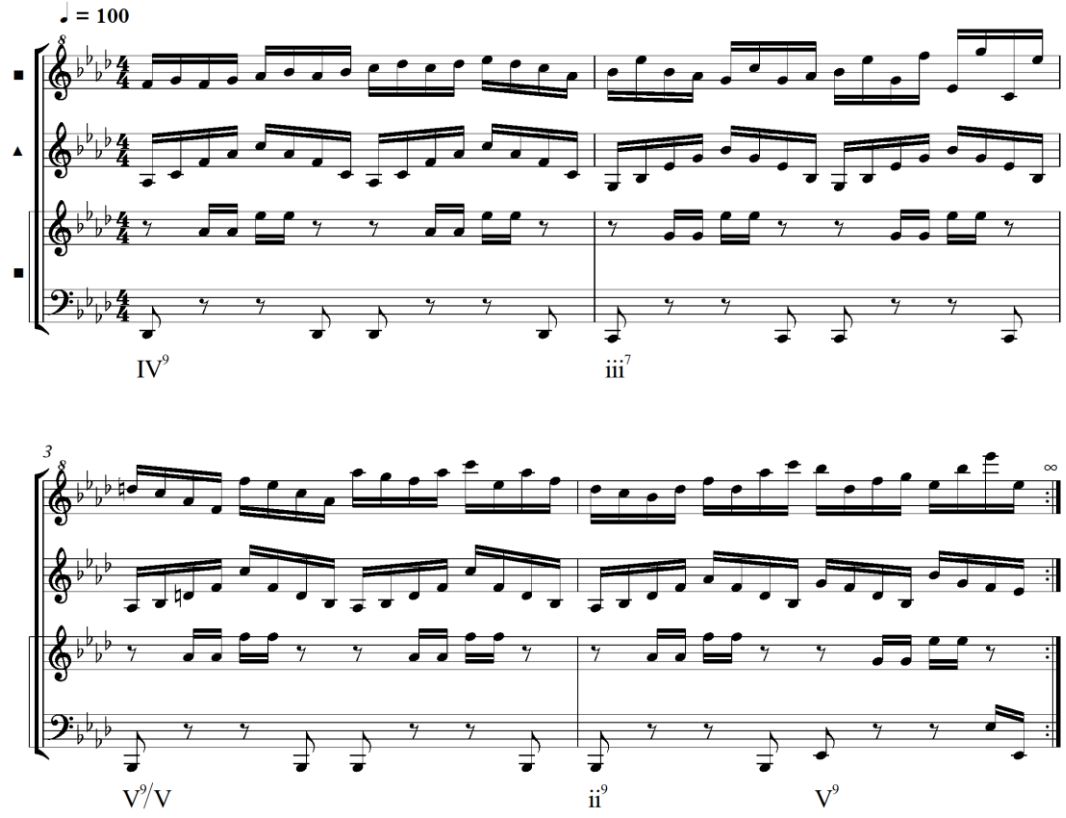

Figure 10: "Rainbow Resort" from *Kirby's Adventure*.

[35] "Rainbow Resort," written by Hirokazu Ando and Jun Ishikawa, from *Kirby's Adventure* (Tokyo: Hal Laboratory, 1993), NES Video Game, from WiiGuy's 8BitStereo, "Kirby's Adventure (NES) Soundtrack - 8BitStereo," Video Clip, posted December 26, 2012, accessed January 16, 2016, *YouTube*, https://youtu.be/O4nYMtErnKo?t=4m22s.

Pedal Points

Going back to "Château Ladutorm"[36] by Sugiyama, it is clear that he also uses compound melodies (*figure 11*). The main motif has pedal points similar to Bach's Toccata and Fugue, BWV 565.[37] These pedal points implies two lines in the motif; in mm. 1–2, there is a pedal point, *e*, and a falling stepwise motion from *e* to *a*. In mm. 3–4, both voices use the same method, implying four voices instead of two. The pedal points are technically types of compound melodies.

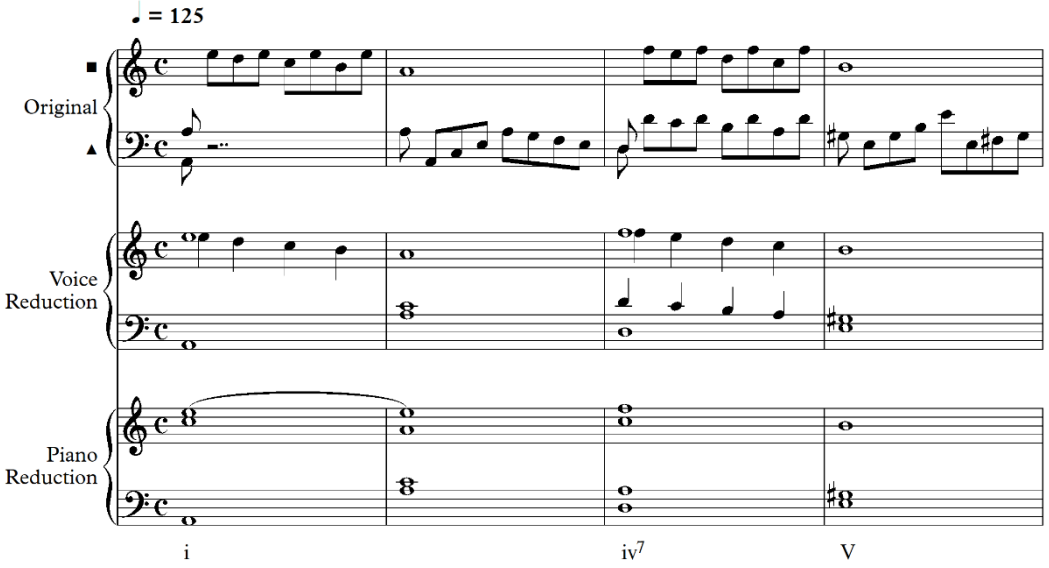

Figure 11: Excerpt of "Château Ladutorm" from *Dragon Quest*, part 1 of 2.

[36] "Château Ladutorm," https://youtu.be/WqdpKnx6TfY?t=2m22s.

[37] Johann Sebastian Bach, Tocatta and Fugue in D minor, BWV 565, edited by Wilhelm Rust (Leipzig: Breitkopf und Härtel, 1867) page 3, system 3, measure 2, Sheet Music, in *IMSLP*, Website, accessed January 20, 2016, http://petrucci.mus.auth.gr/imglnks/usimg/d/d3/IMSLP01135-Bach_Tocatta___Fugue_D_moll_565.pdf.

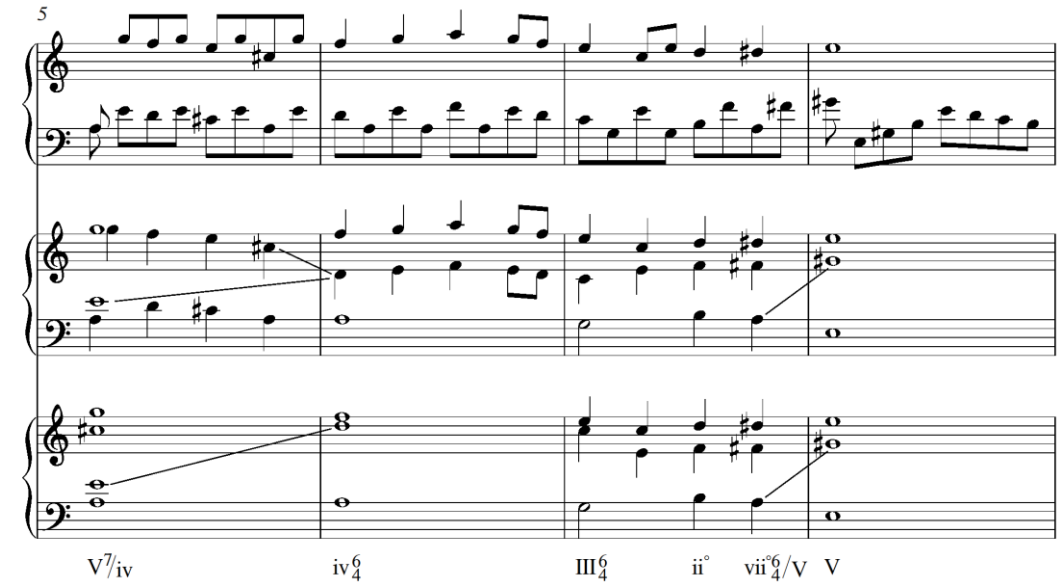

Figure 11: Excerpt of "Château Ladutorm" from *Dragon Quest*, part 2 of 2.

Memory Fill-In

The following technique is more an observation than a true technique. However, the idea of a memory fill-in, explains why some passages of music can still sound more full than they actually are. One example is replaying a song from memory inside one's head. Every detail can be recreated from memory alone. Pre-existing music on the NES can therefore stand out more as a musical piece, even though it may have been severely reduced in musical output, because of the connection with the original music that the player first could have heard. An article about memory and music by W. Jay Dowling, Barbara Tillman, and Dan F. Ayers, has a term that closely corresponds to my observed memory fill-in: memory recoding. It also mentions that "memory processing of previously presented information continues even while new information is entering the system."[38]

"Dr. Wily's Castle"[39] from *Mega Man 2* (1988), starts with a bassline and a melodic riff consisting mainly of thirds by the pulse-wave channels (*figure 12a*). Later in the piece, one pulse-wave channel performs a solo, leaving the melodic riff with only one available channel (*figure 12b*). However, the musical memory can reconstruct that which has been omitted.

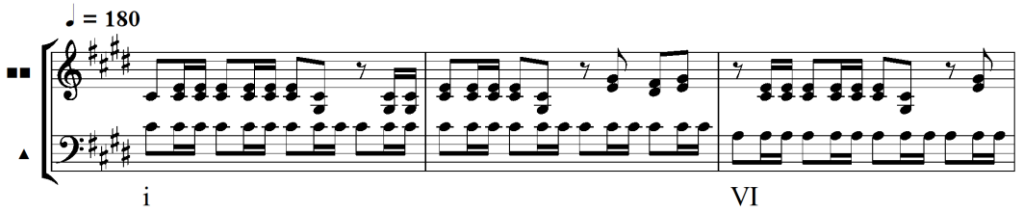

Figure 12a: Excerpt of "Dr. Wily's Castle" from *Mega Man 2*.

[38] W. Jay Dowling, Barbara Tillman, and Dan F. Ayers, "Memory and the Experience of Hearing Music," *Music Perception: An Interdisciplinary Journal* 19, No. 2 (Winter 2001): 273.
[39] "Dr. Wily's Castle," written by Takashi Tateishi, from *Mega Man 2* (Osaka: Capcom, 1988), NES Video Game, from WiiGuy's 8BitStereo, "Mega Man 2 (NES) Soundtrack - 8BitStereo," Video Clip, posted April 27 2012, accessed January 16, 2016, *YouTube*, https://youtu.be/BnFs2J8c-kU?t=14m27s.

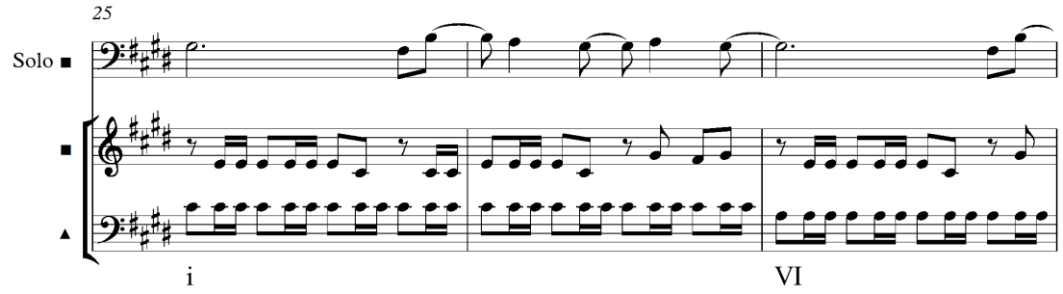

Figure 12b: Excerpt of "Dr. Wily's Castle" from *Mega Man 2*.

Delay and Reverb Effects

"Mission Briefing"[40] from the game *Top Gun* (1987) uses a very effective way of simulating a reverb. The song has a second voice (first staff in *figure 13a*) which is a delayed version of the main voice. This delay effect further enhances the texture. Because the delay starts a dotted eighth away from the main line, they interlock with each other (*figure 13b*). The way this delay is constructed, is a typical setup for a guitarist with a delay pedal. With the dotted-eighth delay setting of such a pedal, the result will be the same to that of "Mission Briefing." Some good example of songs that use the dotted-eight delay are Pink Floyd's "Run Like Hell"[41] and "With or Without You"[42] by U2 (the effect is the signature sound of The Edge, the guitarist of the band).

[40] "Mission Briefing," written by Kyouhei Sada, Kazuki Muraoka, and Kouji Murata, from *Top Gun* (Tokyo: Konami, 1987), NES Video Game, from WiiGuy's 8BitStereo, "Top Gun (NES) Soundtrack - 8BitStereo," Video Clip, posted September 9, 2013, accessed January 16, 2016, *YouTube*, https://youtu.be/cb96aw4qfpo?t=1m59s.
[41] "Run Like Hell," written by David Gilmour and Roger Waters, performed by Pink Floyd (New York: Columbia Records, 1979), Single.
[42] "With or Without You," written by Bono, performed by U2 (London: Island Records, 1986), Single.

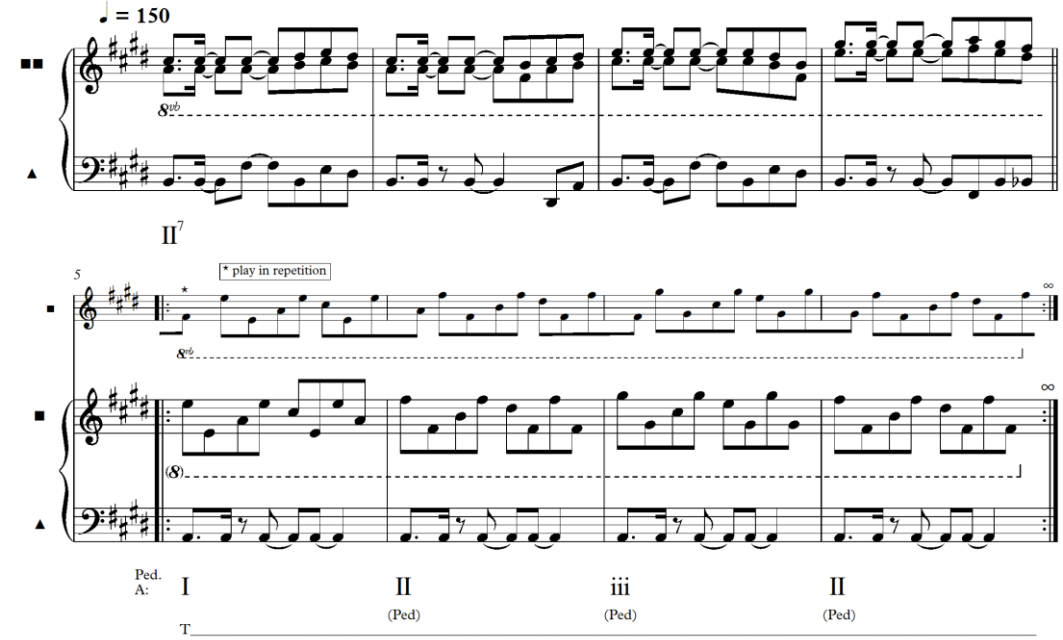

Figure 13a: "Mission Briefing" from *Top Gun.*

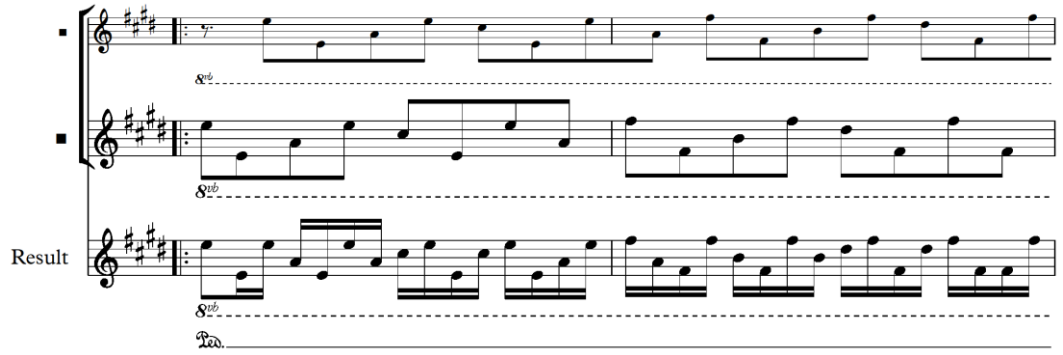

Figure 13b: Example of how the dotted eighth delay interlocks with the main melody line.

Jazz Harmony

Koji Kondo's "Water Land"[43] from *Super Mario Bros. 3* (1988) demonstrates how a simple three-voice piece can imply far more complex harmony (*figure 14*). The bassline is mostly constructing the roots and fifths of chords, while the upper voice is mostly adding the thirds. The inner voice is the main melody of the piece and it is both part of the harmony

[43] "Water Land," written by Koji Kondo, from *Super Mario Bros. 3* (Tokyo: Nintendo, 1985), NES Video Game, from WiiGuy's 8BitStereo, "Super Mario Bros. 3 (NES) Soundtrack - 8BitStereo," Video Clip, posted September 23, 2012, accessed January 16, 2016, *YouTube*, https://youtu.be/Z0kPBtHp6FM?t=59s.

and not. Every phrase has four half notes, to which the first and the fourth can be regarded as chord tones, and the second and third as chromatic passing tones (see first reduction of *figure 14*), except for the diminished chord in mm. 6. Another interpretation (see second reduction of *figure 14*) is even more selective with adding inner notes to the harmony.

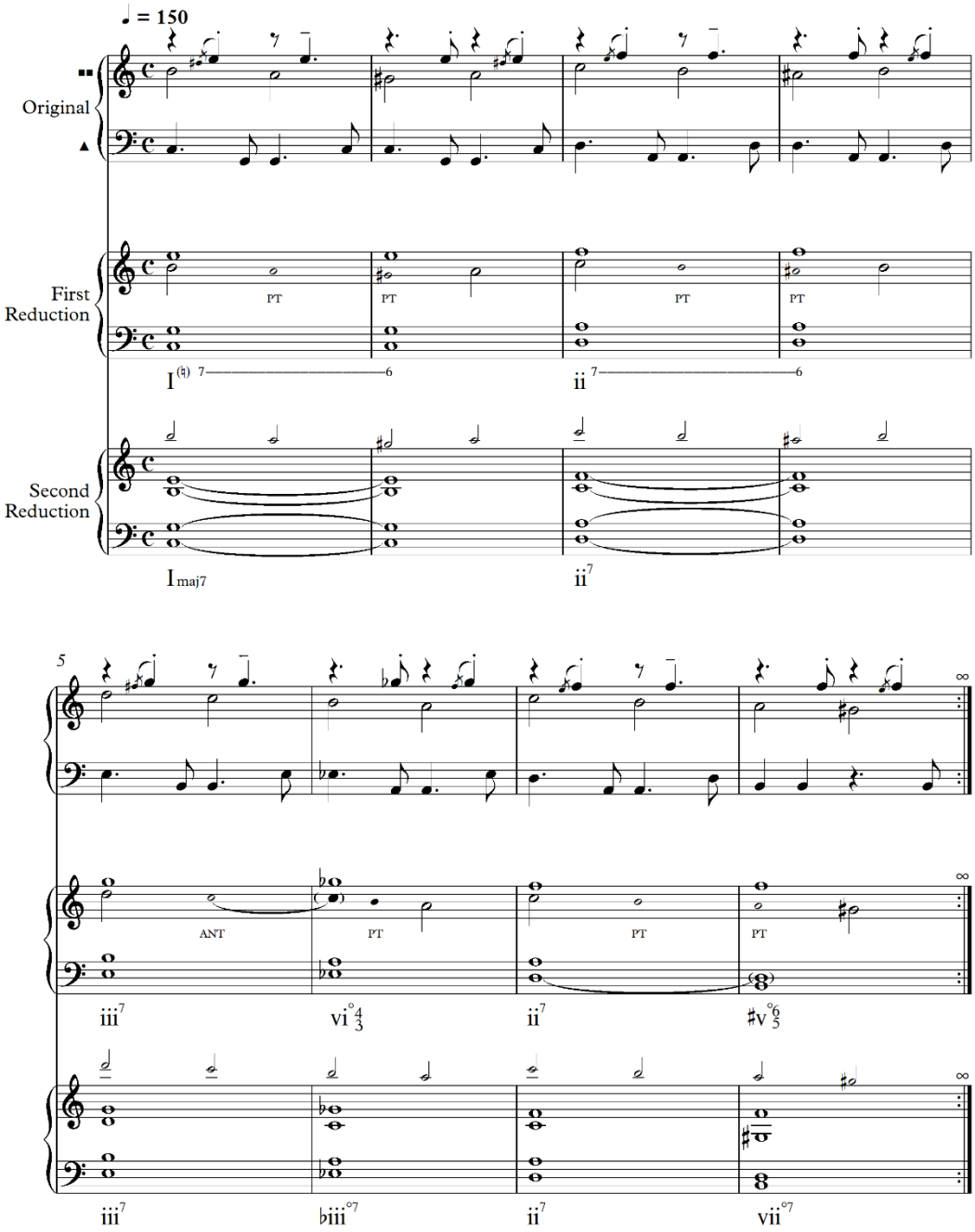

Figure 14: Excerpt of "Water Land" from *Super Mario Bros. 3.*

As atonal as the monophonic "Underworld"[44] from *Super Mario Bros.* (1985) initially might sound, it has a tonal basis (which can be interpreted in different ways, see *figure 15*) and it could as well have been a bass accompaniment for a jazz fusion band. Indeed, it sounds exactly like the main accompaniment of "Let's Not Talk About It"[45] by the jazz-fusion band Friendship from their eponymous album, *Friendship* (1979). Similarly to "Underworld," Friendship's song regularly changes to a new time signature.

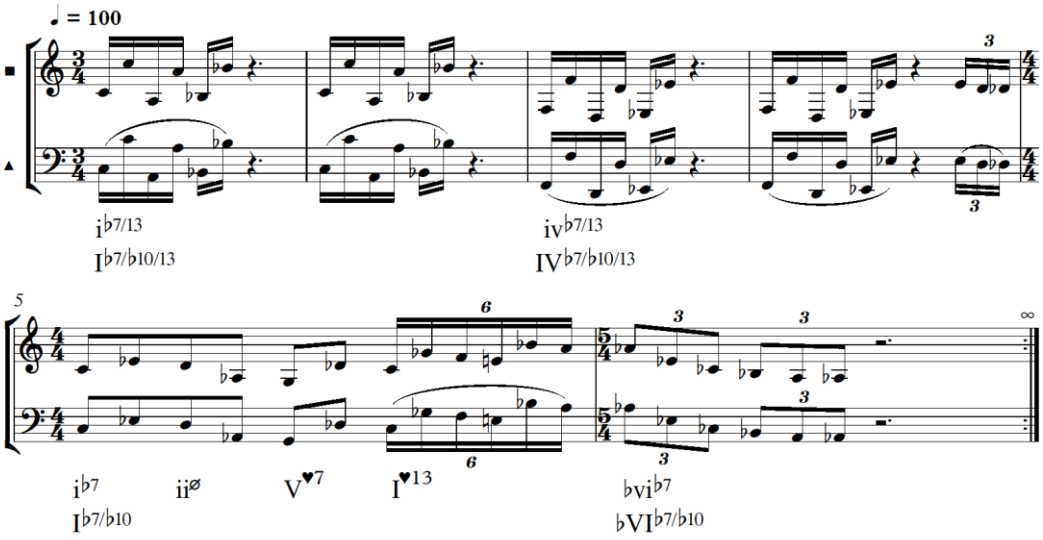

Figure 15: "Underworld" from *Super Mario Bros.*

The parallel sus2-chord harmony in Kondo's "Fortress"[46] from *Super Mario Bros. 3* (*figure 16a*), sounds close to a jazz piece with a pianist using parallel harmony, such as Erroll Garner's live performance of the jazz standard, "Laura"[47] (check especially at 2:30 for

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[44] "Underworld," written by Koji Kondo, from *Super Mario Bros.* (Tokyo: Nintendo, 1985), NES Video Game, from WiiGuy's 8BitStereo, "Super Mario Bros. (NES) Soundtrack - 8BitStereo," Video Clip, posted September 23, 2012, accessed January 16, 2016, *YouTube*, https://youtu.be/uZz8mNzgEEE?t=1m40s.

[45] "Let's Not Talk About It," written by Don Grusin, performed by Friendship, from *Friendship* (New York: Elektra Records, 1979), LP.

[46] "Fortress," written by Koji Kondo, from *Super Mario Bros. 3* (Tokyo: Nintendo, 1988), NES Video Game, from WiiGuy's 8BitStereo, "Super Mario Bros. 3 (NES) Soundtrack - 8BitStereo," Video Clip, posted September 23, 2012, accessed January 16, 2016, *YouTube*, https://youtu.be/Z0kPBtHp6FM?t=13m44s.

[47] "Laura," written by David Raksin and Johnny Merer, from *Laura*, directed by Otto Preminger (Los Angeles: 20th Century Fox, 1944), Motion Picture, live performance by Erroll Garner, from *Jazz 625* (London: BBC, 1964), from Apolineo Dionisiaco, "Erroll Garner - Laura [Jazz 625]," Video Clip, posted August 25, 2012, accessed February 2, 2016, *Youtube*, https://youtu.be/sRA-WV01Ogk.

a descending chromatic movement similar to that of "Fortress"). The oblique motion in mm. 5–8 creates a great sense of space, because it sounds like one line with tons of reverb (such as that of a big hall, see *figure 16b*).

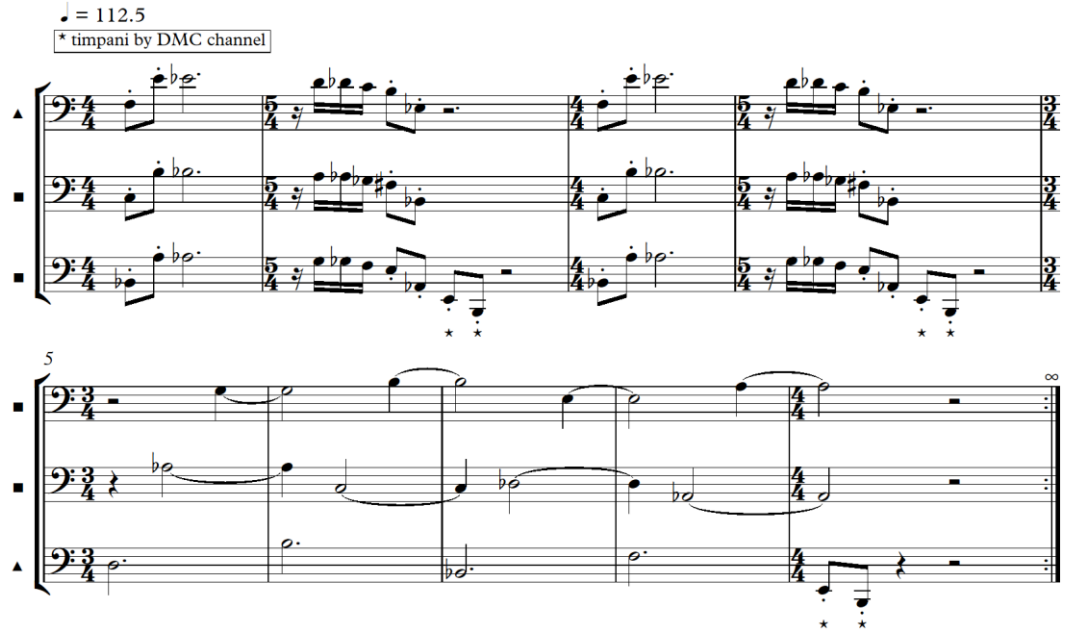

Figure 16a: "Fortress" from Super Mario Bros. 3.

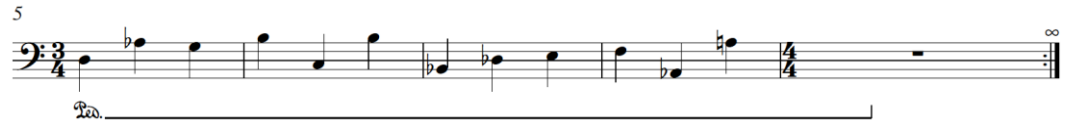

Figure 16b: Intended effect of mm. 5–8. The pedal mimics the endless reverb.

CHAPTER THREE

Instrumentation and Remediation

The Transfer of Idioms

As Manfred Bukofzer points out:

> With the discovery of idioms in the baroque, new possibilities arose from the deliberate exchange of idioms between different instruments, or between instrument and voice. This transfer of idioms forms one of the most fascinating aspects of baroque music.[48]

Bukofzer further explains that "entire forms, with all their stylistic peculiarities [can be exchanged] from one medium to another."[49] This idea can be connected with Jay Bolter's and Richard Grusin's theory of "remediation." They discuss the consequences of exchanging old media to new media, for instance an encyclopedia from a book to an electronic book (e-book): "the electronic version is offered as an improvement, although the new is still justified in terms of the old and seeks to remain faithful to the older medium's character."[50] NES music is remediating all different kinds of music for which the faithful representation depends on the game composer's mastery of transcribing and rearranging the music—new or pre-existing—to the NES.

Movie and TV-Show Adaptations

The NES games catalogue featured many movie and TV-show adaptations. Most of those

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[48] Manfred F. Bukofzer, "Renaissance Versus Baroque Music," in *Music in the Baroque Era: From Monteverdi to Bach* (London: J.M. Dent & Sons Ltd., 1977), 15.
[49] Ibid.
[50] David Jay Bolter and Richard Grusin, "Immediacy, Hypermediacy, and Remediation," in *Remediation: Understanding New Media* (Cambridge: MIT Press, 2000), 44.

games had newly written music rather than the movies' scores (probably due to copyright issues[51]). Some movie adaptations, however, did feature the music of the film. To observe the remediative aspect of NES video game music, I will examine three movie-based video games' main themes with their films' respective music themes: "Intro (Last Crusade Theme)"[52] from *Indiana Jones and the Last Crusade* (1991), "Title Screen Crawl"[53] from *Star Wars: The Empire Strikes Back* (1992), and "Title Screen (Top Gun Anthem)"[54] from *Top Gun*.

"Intro (Last Crusade Theme)" from *Indiana Jones and the Last Crusade*

Notable composition techniques used: arpeggiator effects, block chords, compound melodies, delay/reverb effects, memory fill-in (remediation), pedal points.

Tonality: major and Mixolydian ♭6.

Last Crusade's "Intro (Last Crusade Theme)"[55] is remediating John Williams's "Raiders March"[56] (1981) very well. The Follin brothers (Tim and Geoff Follin) are well known for both their musical artistry as well as their technological proficiency in programming music

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[51] This did not stop some composers from sneaking in some short recognizable motifs: the last two measures of "Area Clear" (see Appendix) from Konami's *Teenage Mutant Ninja Turtles* (1989) is clearly based on the theme song of the TV show.

[52] "Intro (Last Crusade Theme)," written by John Williams as derived from his "Raiders March," arranged by Tim Follin and Geoff Follin, from *Indiana Jones and the Last Crusade* (Tokyo: Taito Corporation, 1991), NES Video Game, from WiiGuy's 8BitStereo, "Indiana Jones and the Last Crusade (NES) Soundtrack - 8BitStereo," Video Clip, posted March 3, 2014, accessed January 16, 2016, *YouTube*, https://youtu.be/f9gfsKv0WT4?t=32s.

[53] "Title Screen Crawl," written by John Williams as derived from his "Star Wars (Main Title)," arranged by Paul Web, from *Star Wars: The Empire Strikes Back* (Yokohama: JVC Digital Studios, 1992), NES Video Game, from WiiGuy's 8BitStereo, "Star Wars: The Empire Strikes Back (NES) Soundtrack - 8BitStereo," Video Clip, posted August 12, 2013, accessed January 16, 2016, *YouTube*, https://youtu.be/AuzJ19PHYDg.

[54] "Title Screen (Top Gun Anthem)," written by Harold Faltermeyer and Steve Stevens as derived from their "Top Gun Anthem," arranged for the NES by Kyouhei Sada, Kazuki Muraoka, and Kouji Murata, from *Top Gun* (Tokyo: Konami, 1987), NES Video Game, from WiiGuy's 8BitStereo, "Top Gun (NES) Soundtrack - 8BitStereo," Video Clip, posted September 9, 2013, accessed January 16, 2016, *YouTube*, https://youtu.be/cb96aw4qfpo.

[55] "Intro (Last Crusade Theme)," https://youtu.be/f9gfsKv0WT4?t=32s.

[56] "The Raiders March," written and conducted by John Williams, performed by the London Symphony Orchestra, from *Raiders of the Lost Ark*, directed by Steven Spielberg, produced by Frank Marshall (Los Angeles: 20th Century Fox, 1981), Motion Picture.

into games. For "Intro," they have used an arpeggiator effect, similar to that of *Dragon's Lair's* "Level 1: The Drawbridge" (p. 16), to simulate more simultaneous notes on a monophonic channel (*figure 19*). With it, the two pulse wave channels can create triads, while there is still room for a bassline. Tim and Geoff Follin successfully kept the basis of the piece intact.

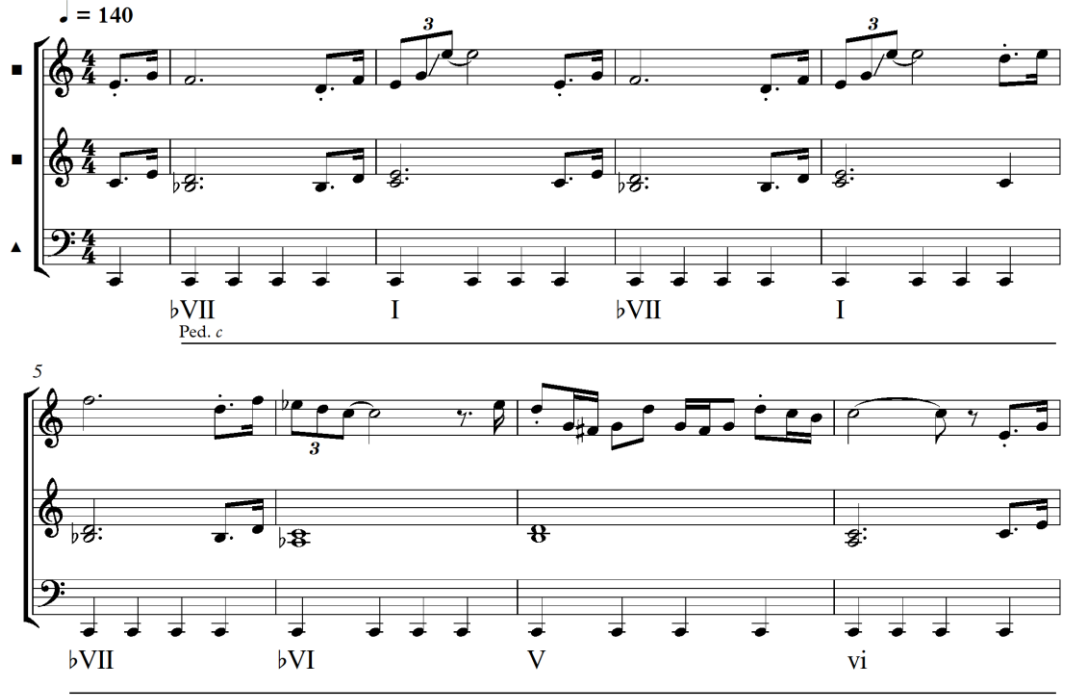

Figure 19: Excerpt of "Intro (Last Crusade Theme)" from *Indiana Jones and the Last Crusade.*

"Title Screen Crawl" from *Star Wars: The Empire Strikes Back*

Notable composition techniques used: arpeggios, block chords, compound melodies, delay/reverb effects, memory fill-in (remediation), pedal points.

Tonality: major with mixture of minor tonal degrees.

The Empire Strikes Back's "Title Screen Crawl"[57] (*figure 20a*) is a very ambitious transcription of John Williams's beloved "Star Wars (Main Theme)."[58] Video game composer Paul Webb constantly alternates between the higher and lower registers of every

[57] "Title Screen Crawl," https://youtu.be/AuzJ19PHYDg.

[58] "I. Main Title (5:20)," written by John Williams, in *Star Wars: Suite for Orchestra* (Milwaukee: Hal Leonard, 2009), Sheet Music.

channel. It seems he wanted to preserve the orchestral nature of the piece.

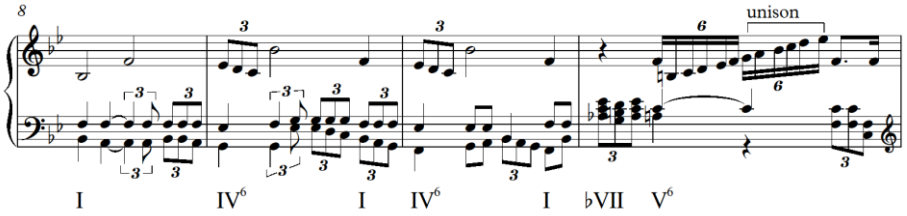

Figure 20a: Excerpt of "Title Screen Crawl" from *Star Wars: The Empire Strikes Back* [♩ = 120]. Due to the constant alternation of ranges between all three voices, a score with all the individual parts is included in the Appendix.

There are also many parts in "Title Screen Crawl" that uses unison movement. In mm. 16–17 (*figure 20b*), all three voices are in unison. And in m. 18, the bassline is copying the top melody line, while Webb could have effectively kept the contrapuntal rising Locrian-2 scale of the original (which combined with the upper thirds imply ii$^{\emptyset}$ to V). Indeed, in the original score, the whole orchestra is reduced to three-part harmony (*figure 20c*).

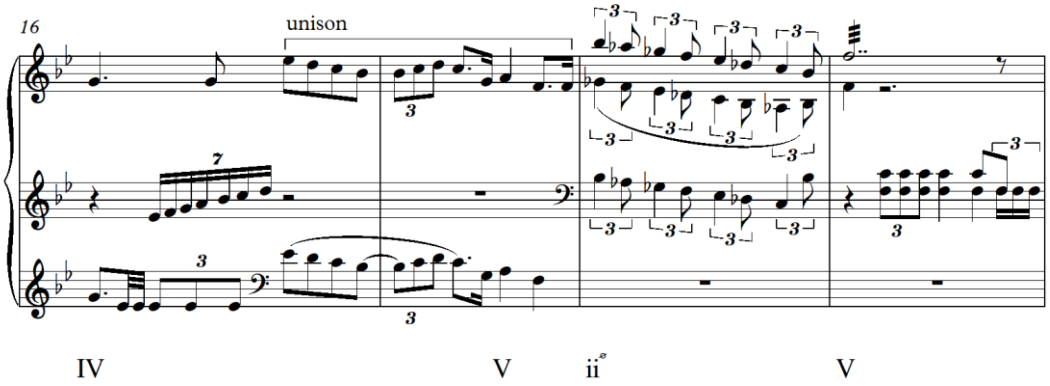

Figure 20b: Excerpt of "Title Screen Crawl" from *Star Wars: The Empire Strikes Back*.

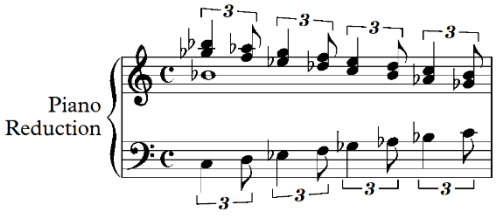

Figure 20c: The three-part harmony of John Williams's original "Star Wars (Main Theme)." While technically, the part can be regarded as four-part harmony, because of the pedal *b*♭, ignoring this note would not decrease the implied ii$^{\emptyset}$-function.

Webb managed to transfer the bitonality of the ending of the piece by including

both stacks of different chords in the accompanying arpeggios, which mimic the string section. In Williams's original,[59] the violins and the harp arpeggiate an Am7 chord, while the violas and cellos arpeggiate the D♭, A, and A♭+ chords with a steady contrabass (enharmonised in *figure 20d* for a more logical understanding of the progression). The rest of the orchestra supports the string section with block chords.

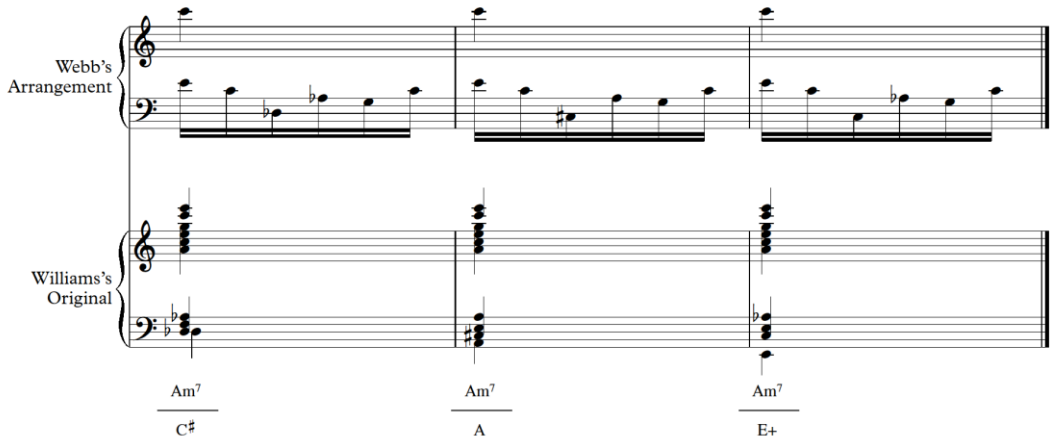

Figure 20d: Reduction of the last three bars of "Title Screen Crawl" from *Star Wars: The Empire Strikes Back*, compared to Williams's original.

Webb could have used the unused triangle wave channel for the bass line, but did not probably because, unlike the pulse wave channels, it has no volume control (as discussed in Chapter 1). Because Webb tried to replicate the fade-out, he had to get rid of the triangle wave channel.

"Title Screen (Top Gun Anthem)" from *Top Gun*

Composition techniques used: compound melodies, delay/reverb effects, memory fill-in (remediation), pedal points.

Tonality: major with non-tonal chords for modulation.

Top Gun's "Title Screen (Top Gun Anthem)"[60] is most strongly derived from its original, Harold Falterymeyer's and Steve Stevens's "Top Gun Anthem."[61] When the main melody

[59] "I. Main Title (5:20)," written by John Williams, in *Star Wars: Suite for Orchestra* (Milwaukee: Hal Leonard, 2009), 15–16.

[60] "Title Screen (Top Gun Anthem)," https://youtu.be/cb96aw4qfpo.

[61] "Top Gun Anthem," written and performed by Harold Faltermeyer and Steve Stevens (New

starts (*figure 21a*), there are essentially just two voices, because one channel is creating a reverb effect. Fortunately, the melody is strong enough to imply more harmony.

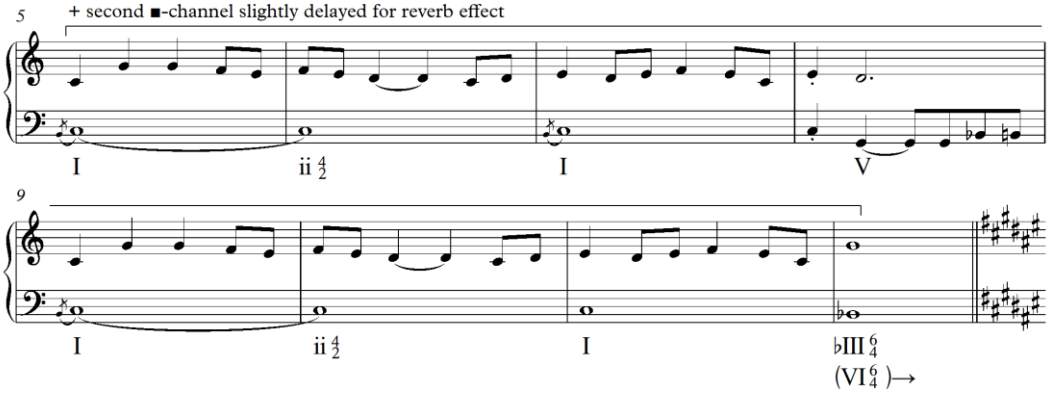

Figure 21a: Excerpt of "Title Screen (Top Gun Anthem)" from *Top Gun* [♩ = 12.5].

After the modulation to F♯ (*figure 21b*), the reverb effect disappears so that the channel becomes available to support the melody and the bassline. Similarly to "Title Screen Crawl,"[62] there is some unison movement.

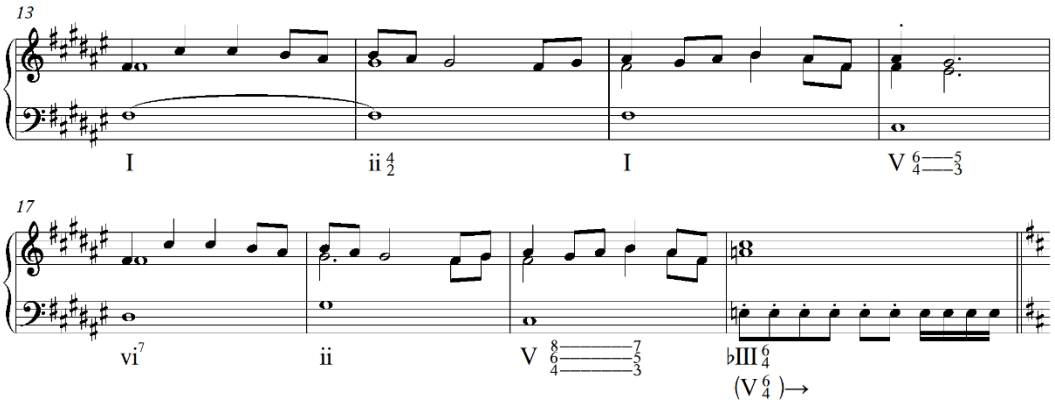

Figure 21b: Excerpt of "Title Screen (Top Gun Anthem)" from *Top Gun.*

The song then modulates to D (*figure 21c*), unlike the original anthem (which returns to C). The bassline plays a galloping rhythm and these 8 bars replay forever.

York: Columbia Reords, 1986), Single.

[62] "Title Screen Crawl," https://youtu.be/AuzJ19PHYDg.

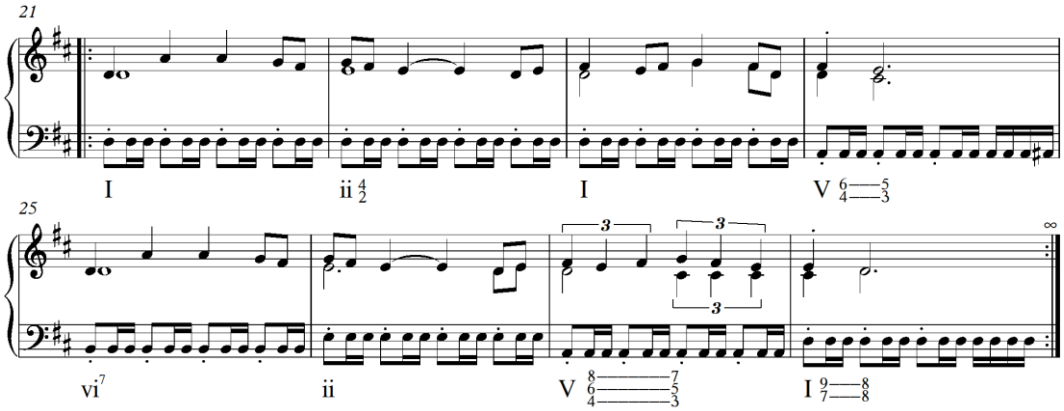

Figure 21c: Excerpt of "Title Screen (Top Gun Anthem)" from *Top Gun.*

CONCLUSION

Many different composition techniques were used to benefit from the NES sound chip's capabilities. Some video game composers, such as the Follin brothers for *Indiana Jones and the Last Crusade*, used an out-of-the-box thinking approach to composition techniques, for they mimic effects (the arpeggiator effects and delay/reverb effects). This is a voluntaristic usage to the given technology, because their music sounds as if it truly has more voices than what the NES sound chip is capable of. Other video game composers were more deterministic: they did not need to go beyond the capabilities, but embraced it. Sugiyama for *Dragon Quest* and Kondo for his *Super Mario Bros.* series mainly used compound melodies and counterpoint, which can also be performed by a human being, rather than only a computer program. NES video game composer Neil Baldwin gives an ironic observation: The music of video game composers who tried to go beyond the hardware limitations, stayed within the video game medium, while the music of video game composers who stayed within the hardware limitations, could go beyond the video game medium—becoming music for other media.[63]

The question whether the NES sound hardware can be regarded as a musical instrument in itself, or one that acts as a medium to musical ideas which are actually bigger than what the NES can handle, is harder to answer. The remediation of pre-existing music of film music—such as the music discussed of *Indiana Jones*, *Star Wars*, and *Top Gun*—clearly makes the sound hardware appear as a medium, rather than as an instrument; said music on the NES is an abstraction of what it is supposed to be. The memory of the original pieces can recode the NES sound chip's timbres of the tone channels to their respective remediated instruments (memory recoding[64]) and fill in the reduced harmony of the NES arrangements (memory fill-in). Conversely, the voluntaristic video game composers did seem to approach the NES sound chip as a musical instrument, for their music can only be

[63] Andrew Schartmann, *Koji Kondo's Super Mario Bros. Soundtrack (33 1/3)* (London: Bloomsbury Academic, 2015), 45.
[64] Dowling, Tillman, and Ayers, "Memory and the Experience of Hearing Music," 273.

performed on the NES or on similar computer hardware.

The different styles discussed—such as Baroque for *Dragon's Quest* and jazz for the *Super Mario Bros.* series—show that the NES sound chip did not restrict the possible styles composers could use. Combined with the NES's remediative nature, the video game composers who wrote for the system seemed to have written music both existing in the real world as it is (how it is performed on the NES) as well as imaginative (how the listeners can perceive it and expand it by their memory of musical styles and instruments).

Just like all technology, computer hardware kept improving. Nintendo's second game console, the Super Nintendo Entertainment System (released in 1990), features a sound chip which support eight simultaneous voices and all these voices trigger samples of significantly higher quality than what the NES's DMC was capable of.[65] When file size became a non-issue due to the much larger capacity of disc-based technology, such as on the Nintendo GameCube (released in 2001), and improved digital audio compression, such as MP3 technology,[66] synthesized music made way for live music (i.e. CD recordings could fit into a video game). Further research could investigate if the musical styles remained similar to that of the NES, but only aesthetically improved due to the higher sound quality, or if video game music changed to something completely new.

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[65] "CMOS 8-bit Single Chip Microcomputer," in *DatasheetCatalog.com*, Website, accessed February 4, 2016, http://pdf.datasheetcatalog.com/datasheet/sony/a6802761.pdf.
[66] "MPEG-1 Audio," in *The Moving Picture Experts Group*, Website, accessed February 4, 2016, http://mpeg.chiariglione.org/standards/mpeg-1/audio.

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"Fortress." Written by Koji Kondo. From WiiGuy's 8BitStereo. "Super Mario Bros. 3 (NES) Soundtrack - 8BitStereo." Video Clip. Posted September 23, 2012. Accessed January 16, 2016. *YouTube*. https://youtu.be/Z0kPBtHp6FM?t=13m44s.

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"Area Clear." Written by Jun Funahashi. From WiiGuy's 8BitStereo. "Teenage Mutant Ninja Turtles (NES) Soundtrack - 8BitStereo." Video Clip. Posted April 22, 2013. Accessed January 16, 2016. *YouTube*. https://youtu.be/SEA8cievfUE?t=7m36s.

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APPENDIX

Editorial Note

Proper measures were taken to achieve very accurate transcriptions of the studied NES music. The program nsf2midi[67] is a very powerful tool for this job, because it translates the machine code containing the music of a game (capsuled into an NSF file) into MIDI,[68] a format which is useable for digital workstations such as Reaper.[69] Unfortunately, the MIDI files still need to be corrected, because they appear to be lacking a tempo map. This means that the notes do not align properly on a given beat for which several tweaks were needed to correct this error. Sometimes, the original music code is different so that nsf2midi cannot convert it properly. In those instances, I had to transcribe everything by ear for which I used NSF players: G-NSF[70] and NSFplay.[71] These software tools can read and play NES music, with additional options to slow down the music and/or mute some of the channels. Finally, I transcribed the music into Sibelius 7.5,[72] a scorewriter program.

Most of the scores only contain the tone channels. The noise and DMC channels are mostly omitted. However, some tracks do contain them, because the percussion on those tracks were deemed useful for some musical analyses examples in their respective chapters during the research (i.e. comparing "Title Screen [Top Gun Anthem]"[73] with Faltermeyer's and Stevens's original[74]).

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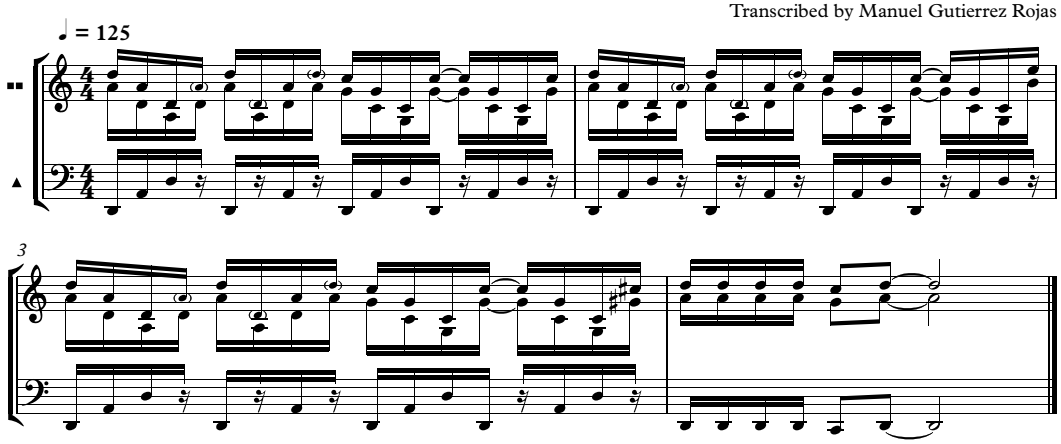
[67] http://gigo.retrogames.com/download.html.
[68] https://www.midi.org.
[69] http://www.reaper.fm.
[70] http://gigo.retrogames.com/download.html
[71] http://www.pokipoki.org/dsa/index.php?NSFplay.
[72] http://www.sibelius.com/home/index_flash.html.
[73] "Title Screen (Top Gun Anthem)," https://youtu.be/cb96aw4qfpo.
[74] "Top Gun Anthem," Single.

Area Clear

Teenage Mutant Ninja Turtles (1989)

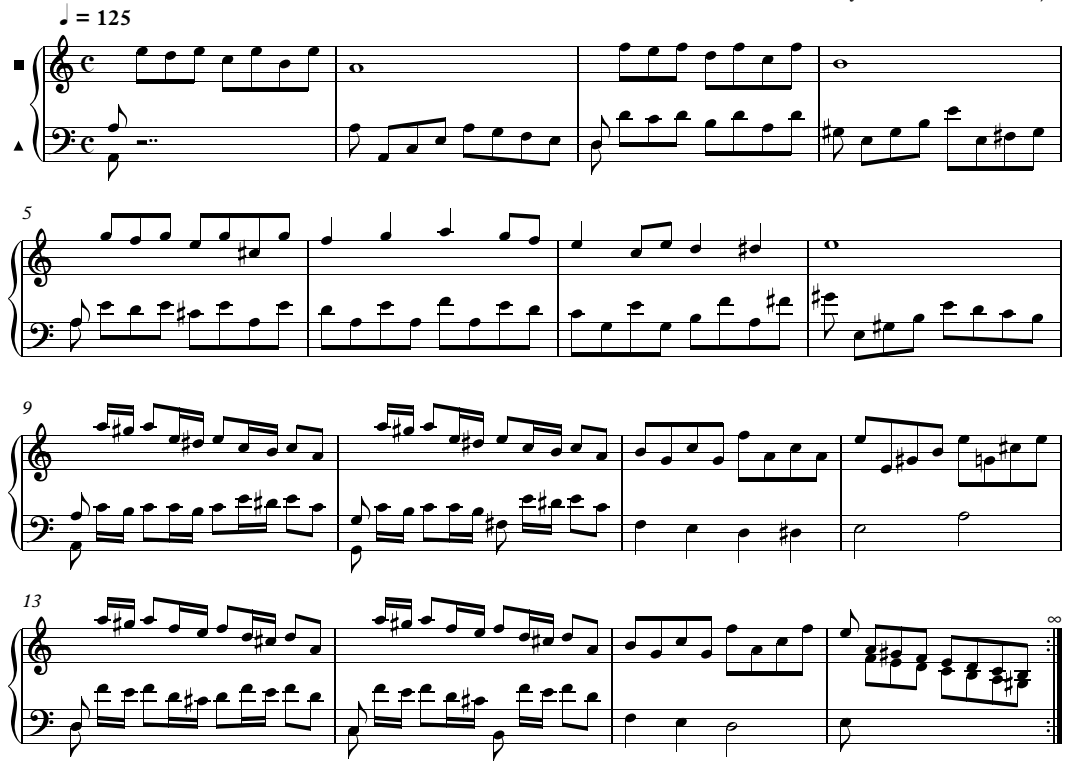
Music by Jun Funahashi
Transcribed by Manuel Gutierrez Rojas



Château Ladutorm

Dragon Quest (1986)

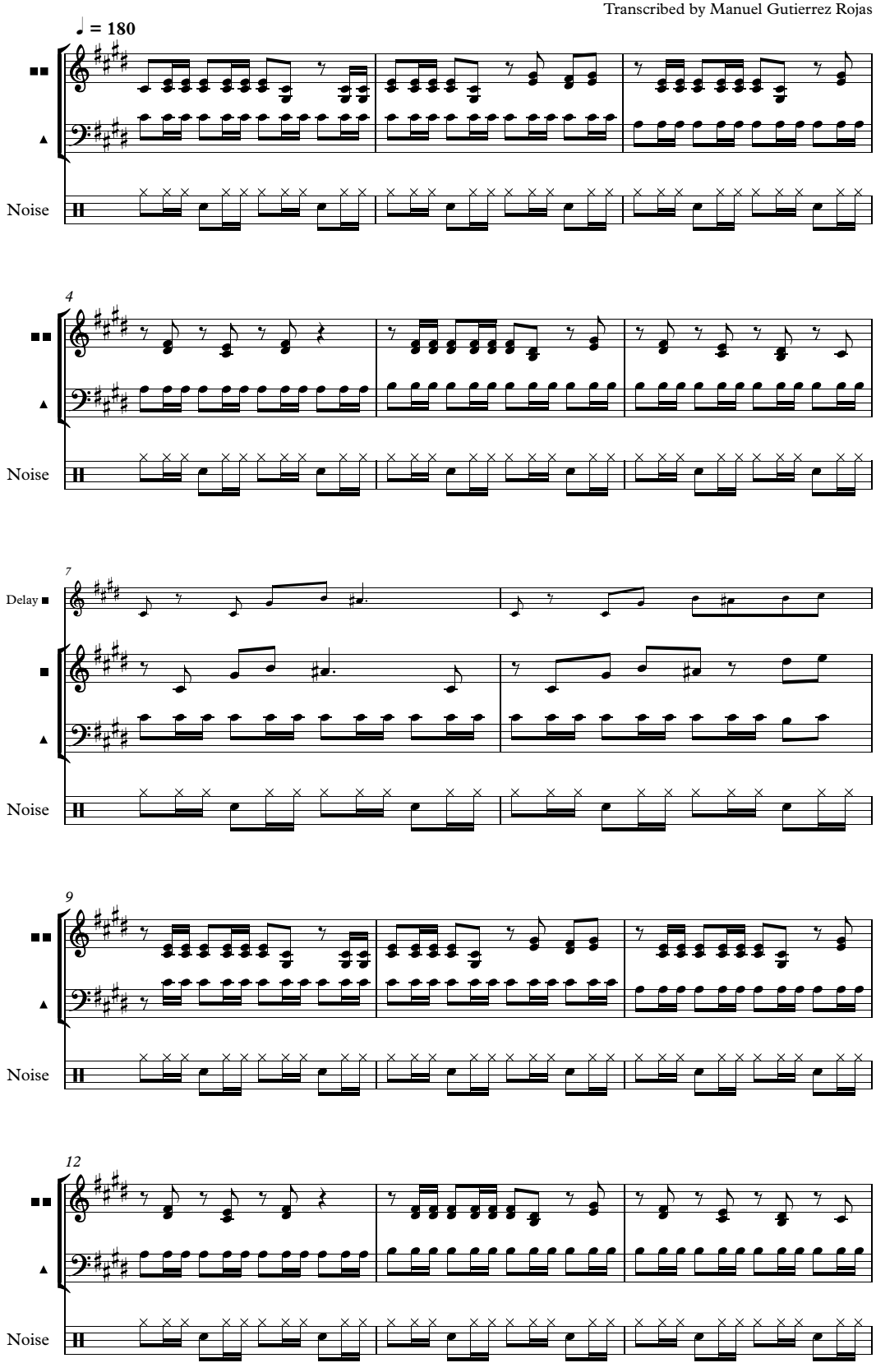
Music by Koichi Sugiyama
Transcribed by Manuel Gutierrez Rojas

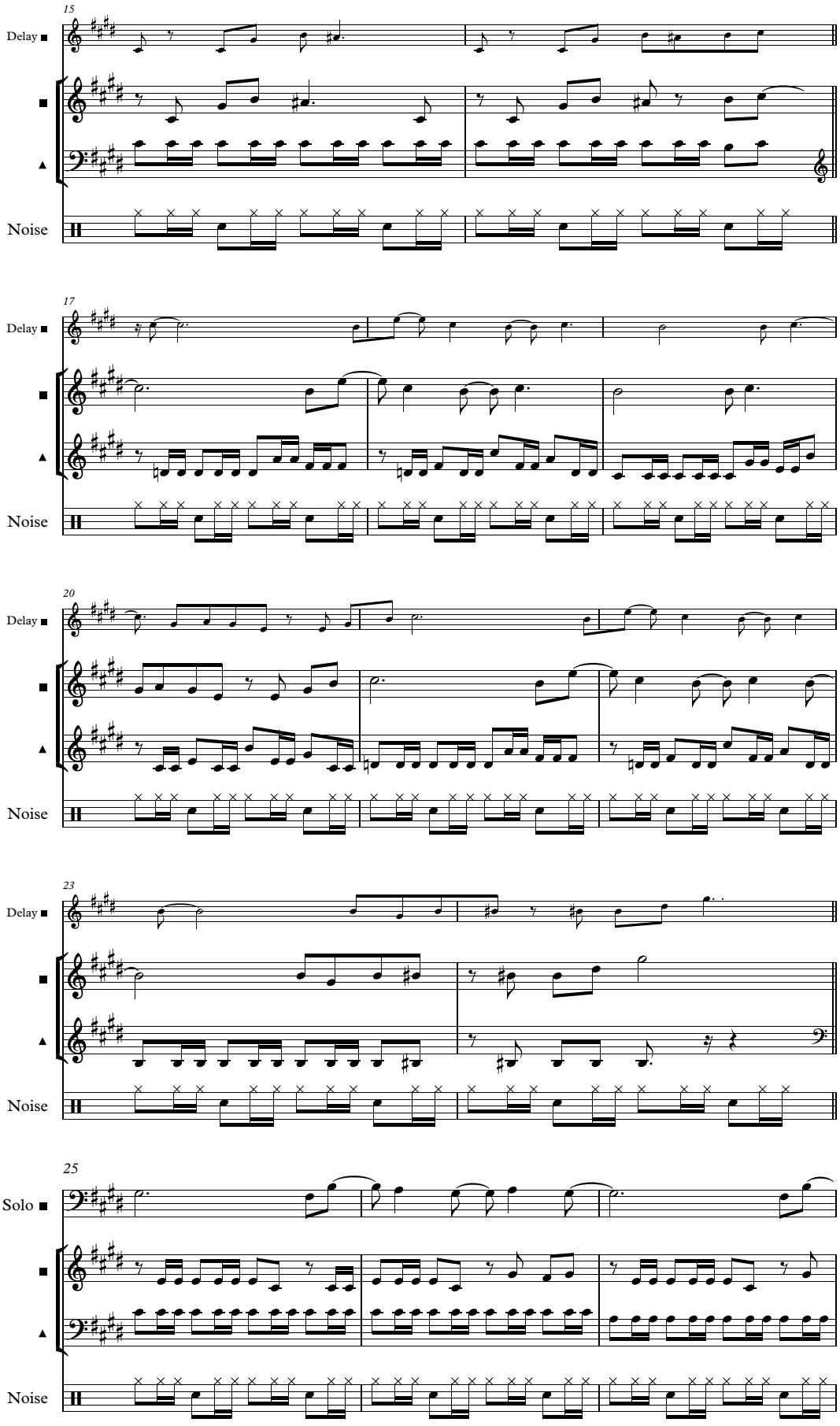


Dr. Wily's Castle

Mega Man 2 (1988)

Music by Takashi Tateishi
Transcribed by Manuel Gutierrez Rojas

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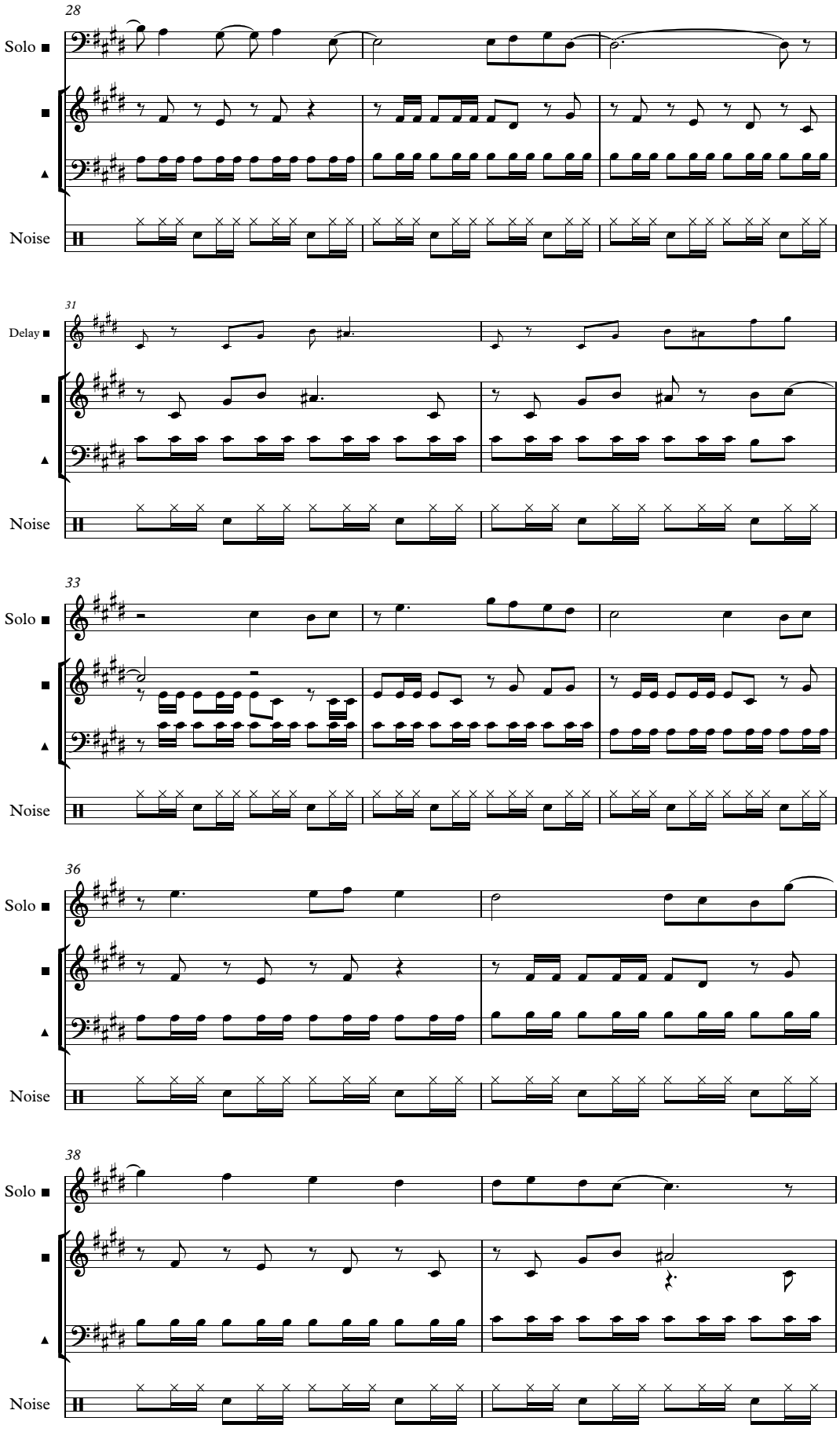
Delay
Noise
17
Delay
Noise
20
Delay
Noise
23
Delay
Noise
25
Solo
Noise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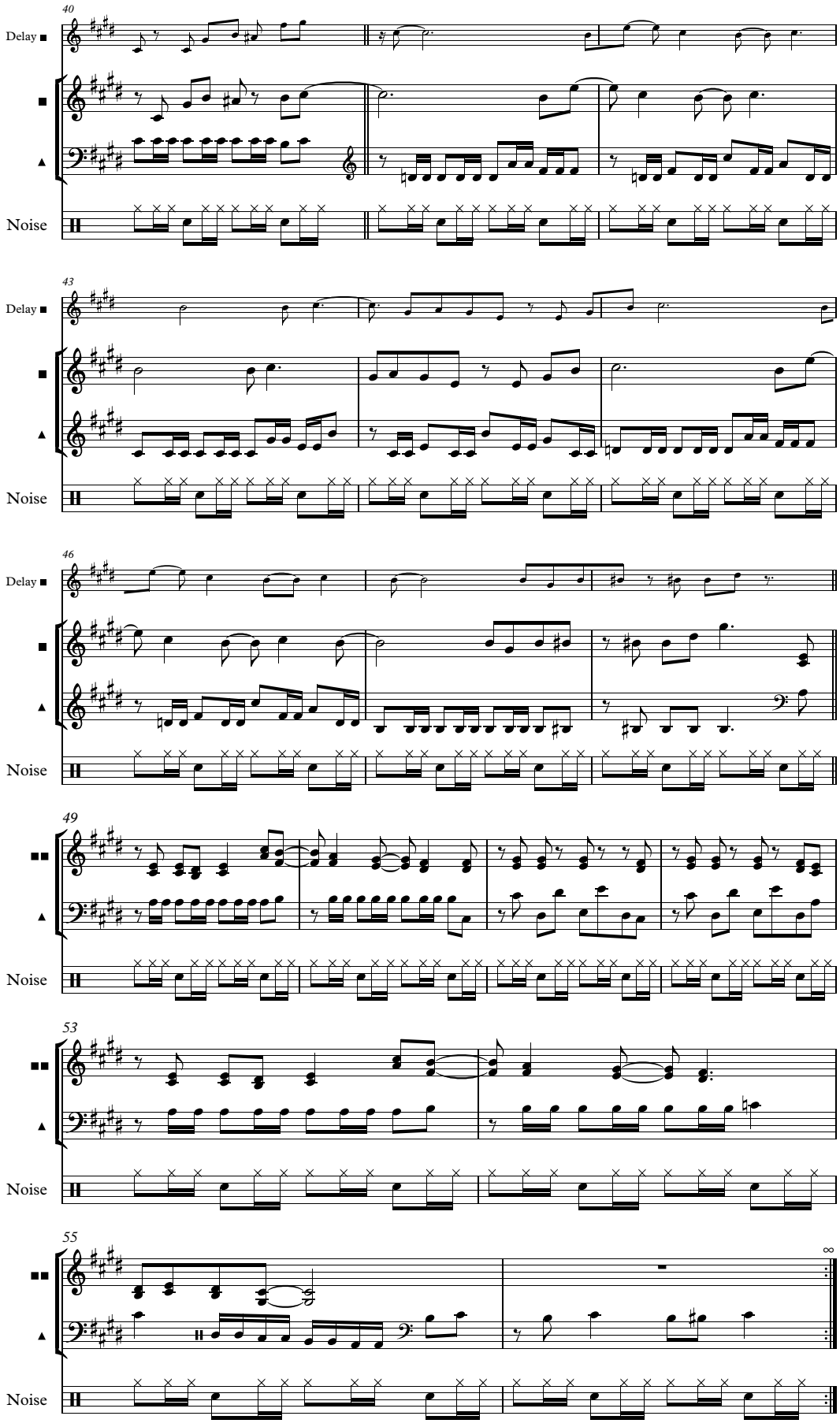
Solo
Noise
31
Delay
Noise
33
Solo
Noise
36
Solo
Noise
38
Solo
Noise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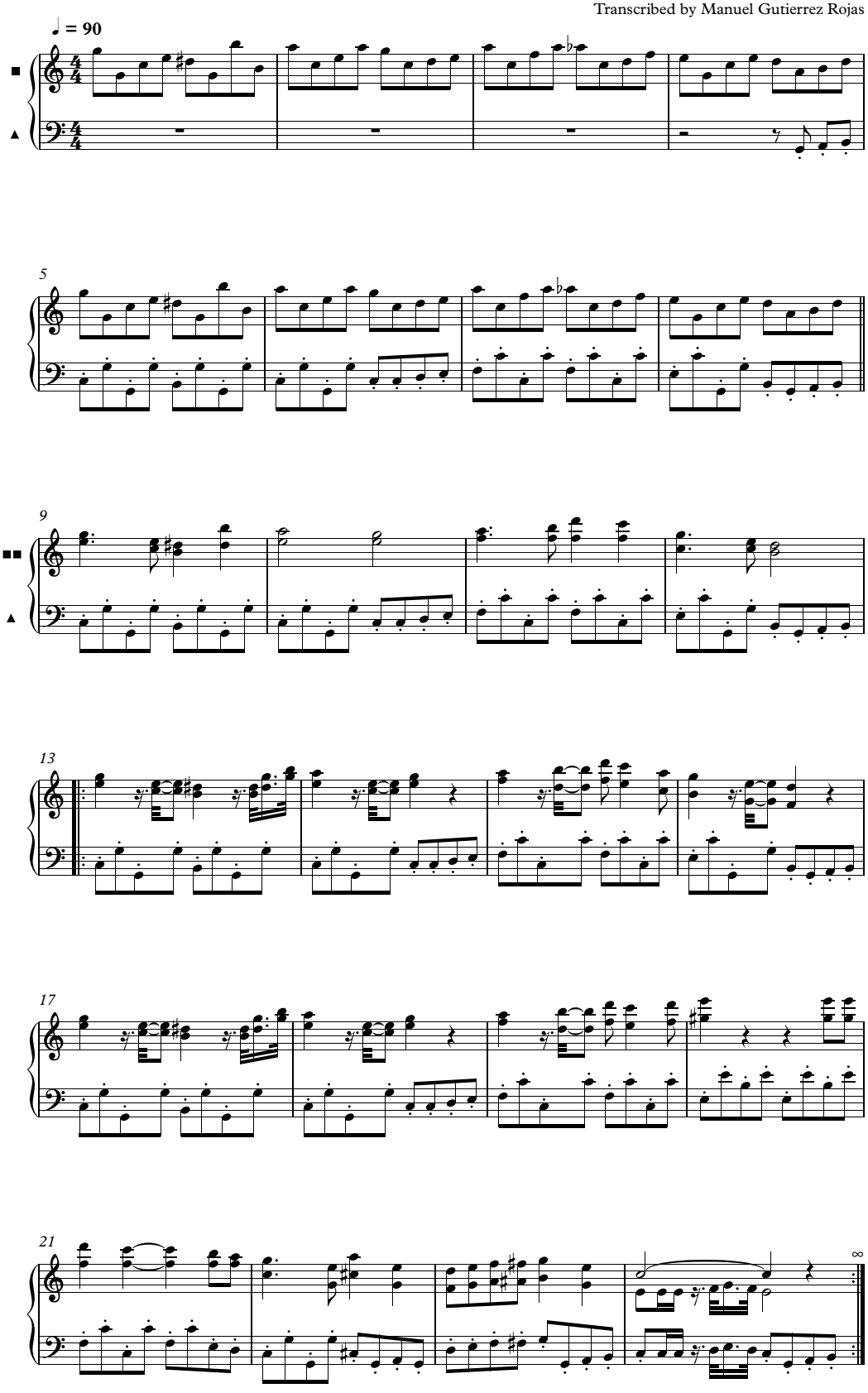
Delay
Noise
43
Delay
Noise
46
Delay
Noise
49
Noise
53
Noise
55
Noise

Ending Theme

The Legend of Zelda (1986)

Music by Koji Kondo
Transcribed by Manuel Gutierrez Rojas

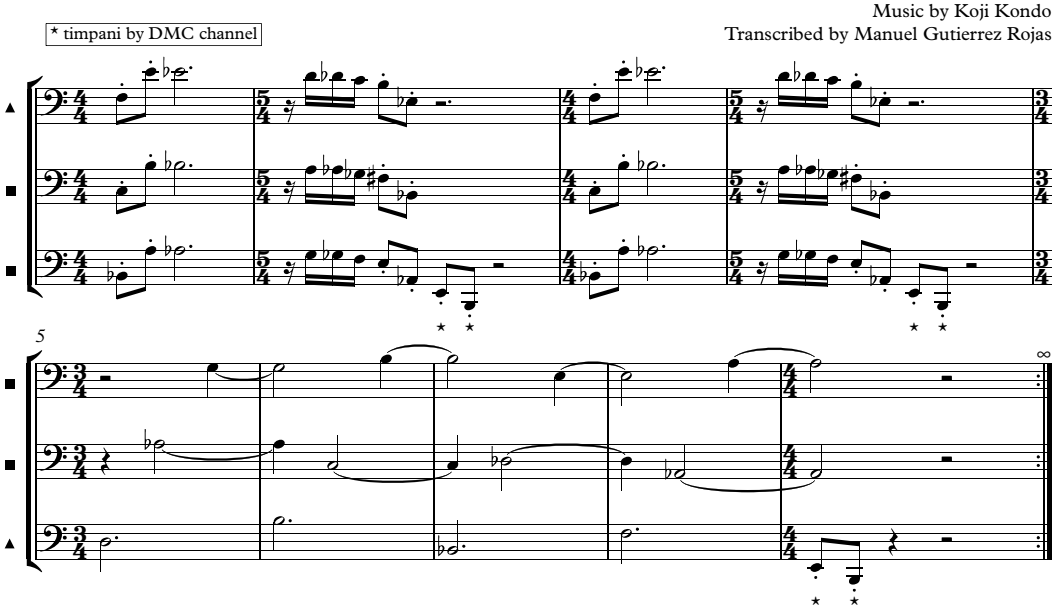


Fortress

Super Mario Bros. 3 (1988)

♩ = 112.5

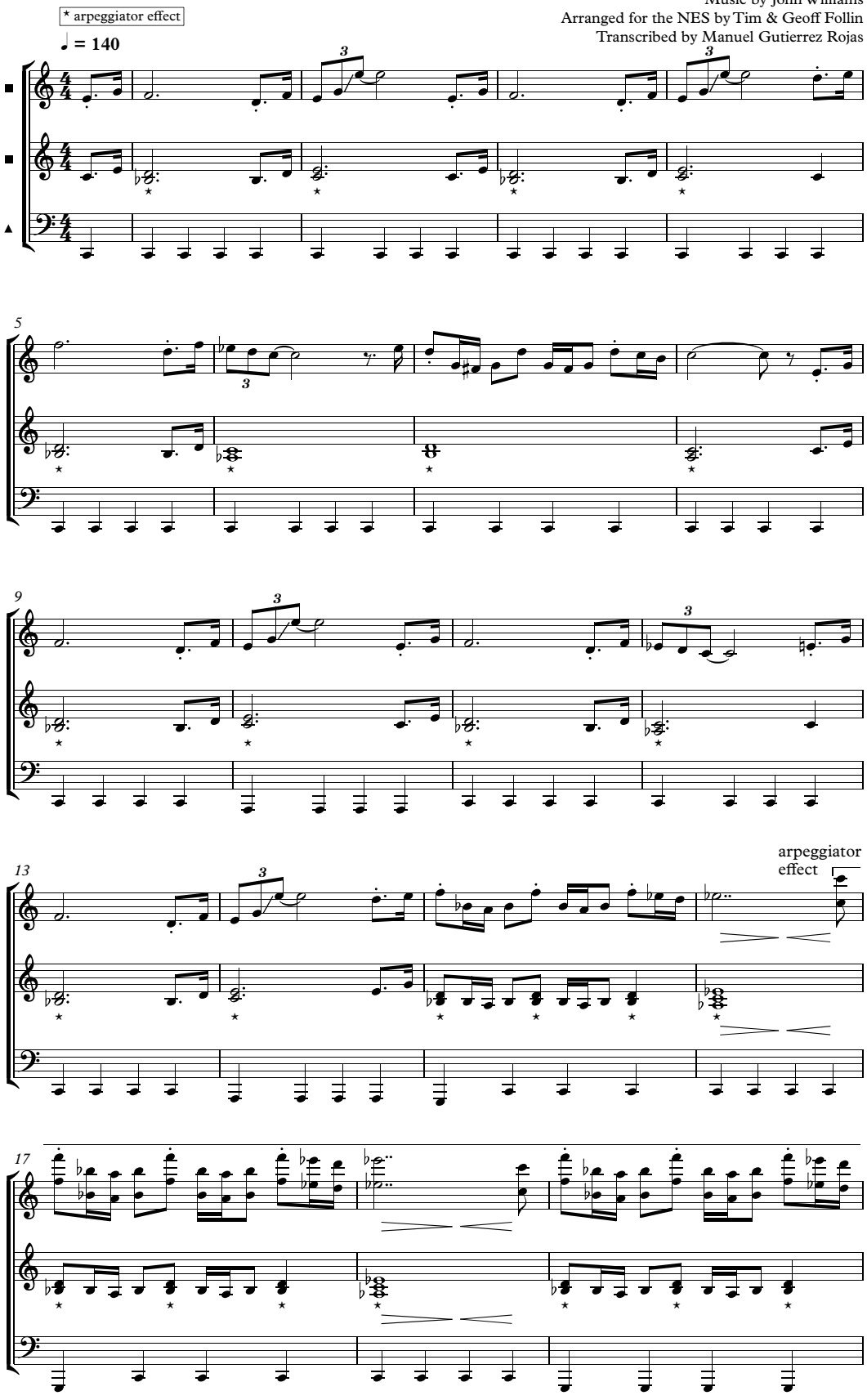
Music by Koji Kondo
Transcribed by Manuel Gutierrez Rojas

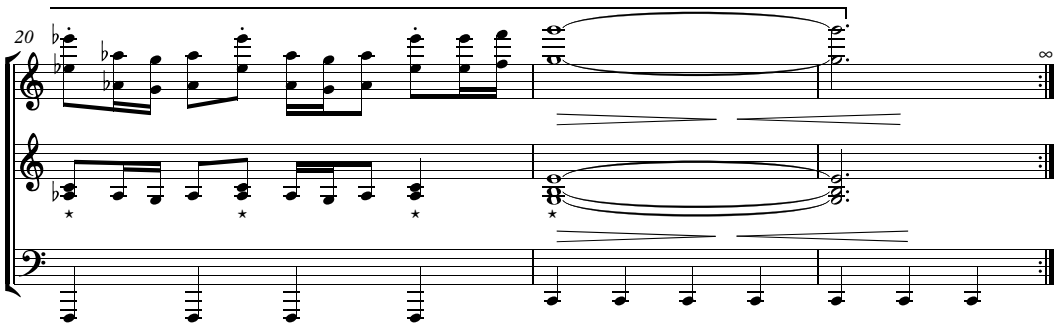


Intro (Last Crusade Theme)

Indiana Jones and the Last Crusade (1991)

Music by John Williams
Arranged for the NES by Tim & Geoff Follin
Transcribed by Manuel Gutierrez Rojas

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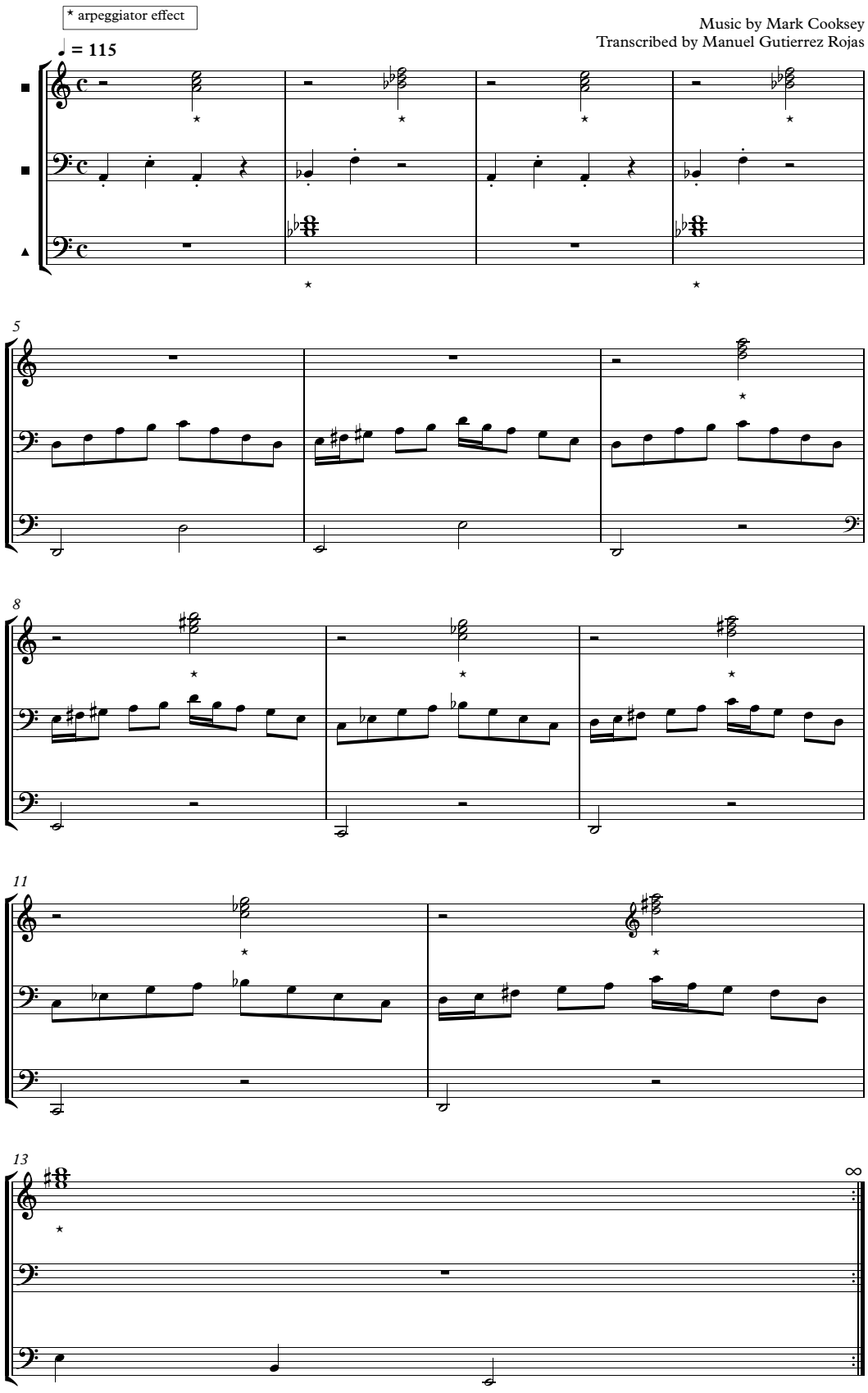
Level 1: The Drawbridge

Dragon's Lair

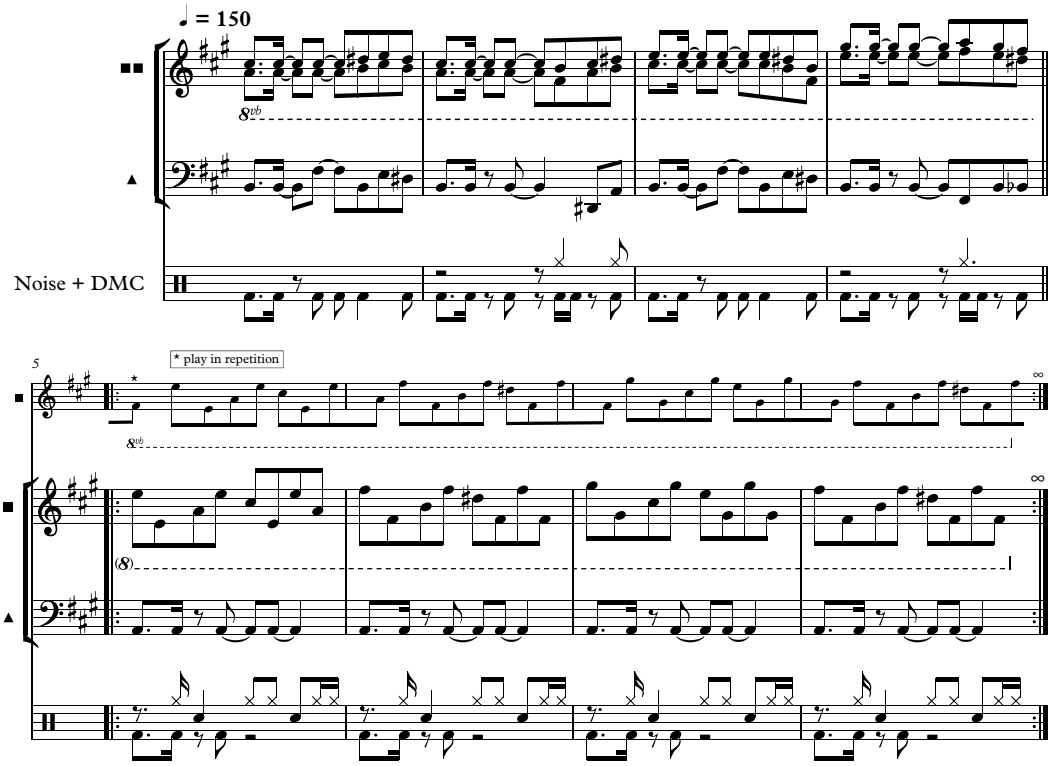


Mission Briefing

Top Gun (1987)

Music by Kyouhei Sada,
Kazuki Muraoka, and Kouji Murata

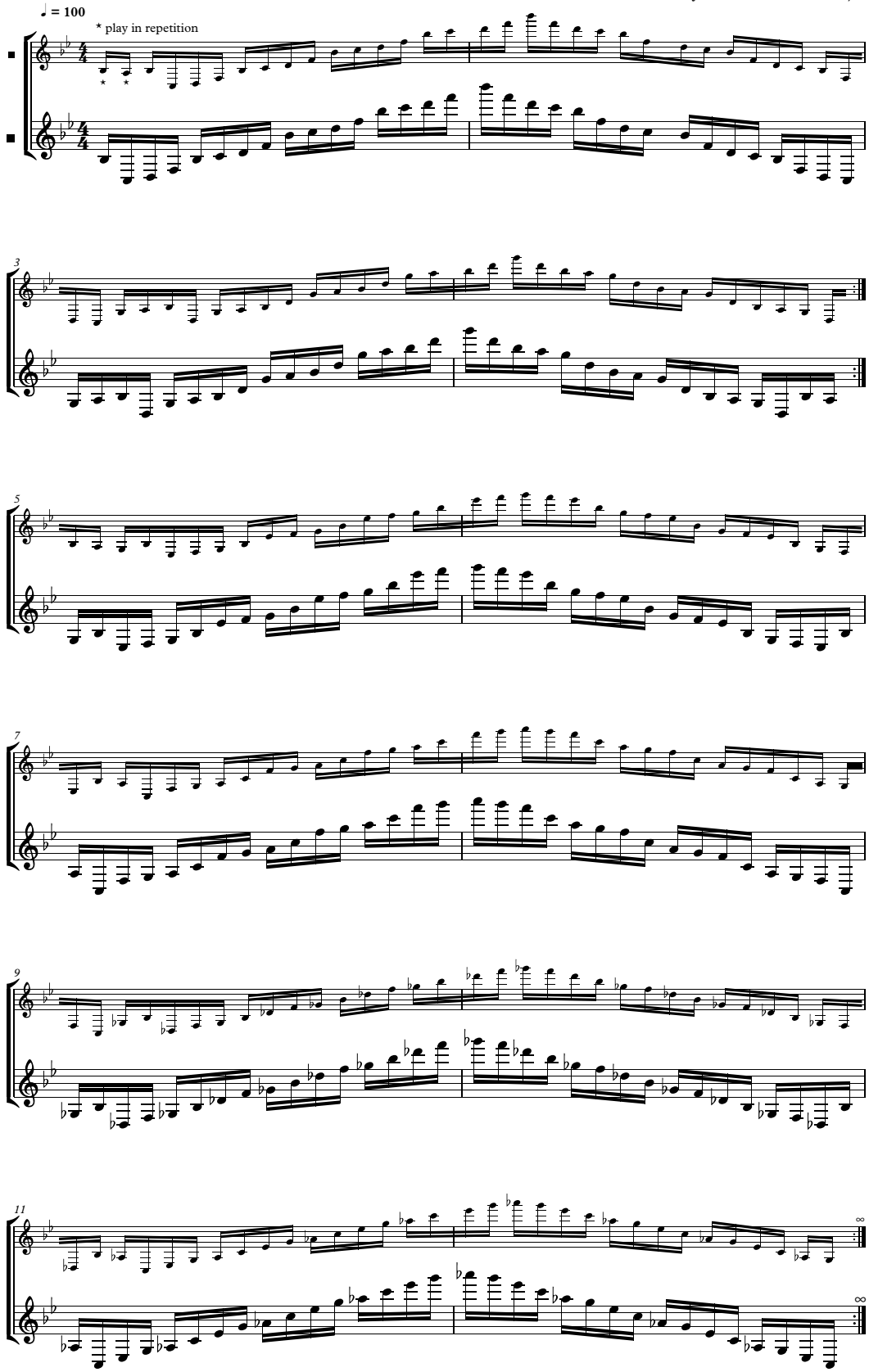
Transcribed by Manuel Gutierrez Rojas



Prelude

Final Fantasy (1987)

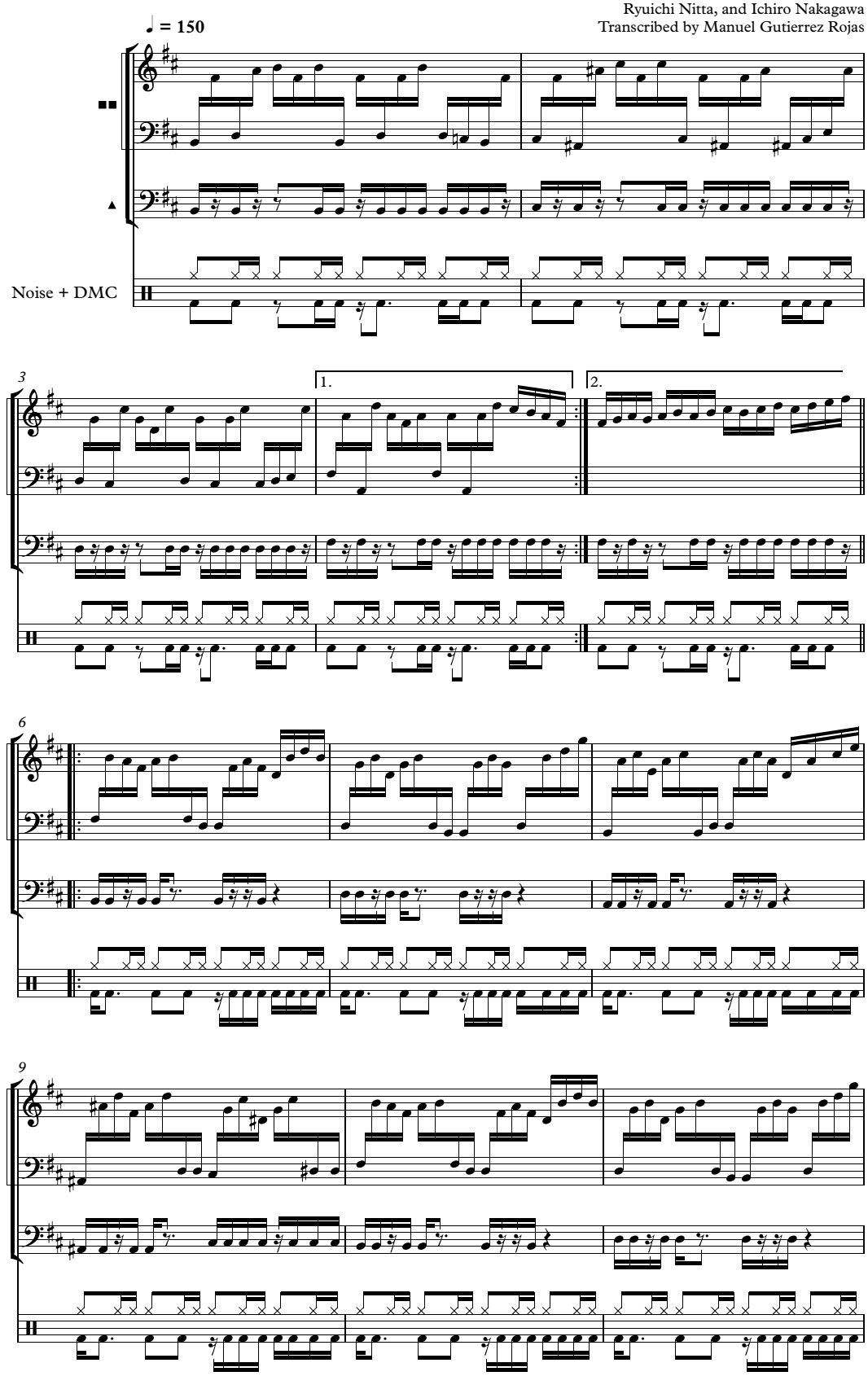
Music by Nobuo Uematsu
Transcribed by Manuel Gutierrez Rojas

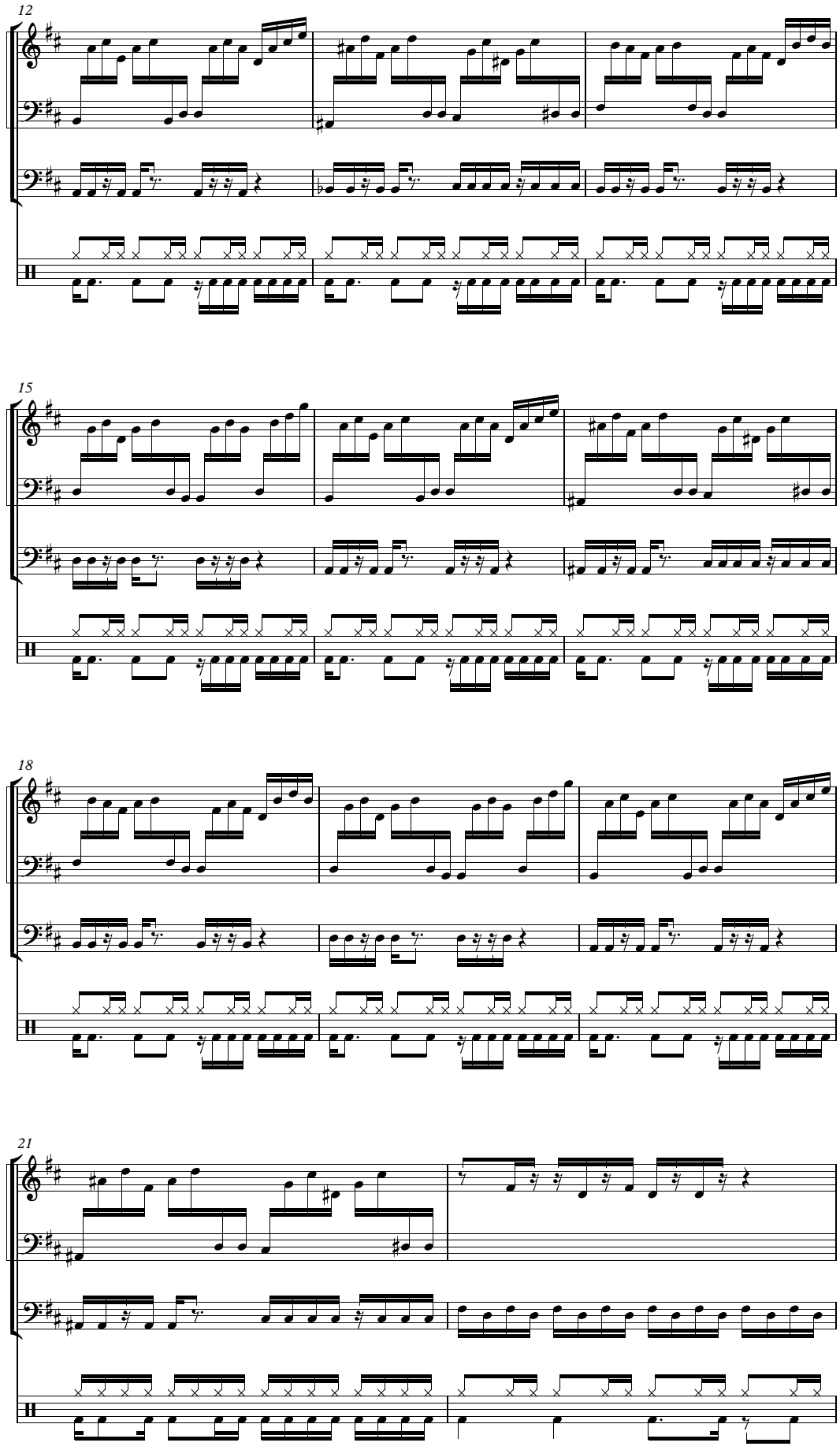


Pushing Onward

Ninja Gaiden (1989)

Music by Keiji Yamagishi,
Ryuichi Nitta, and Ichiro Nakagawa
Transcribed by Manuel Gutierrez Rojas

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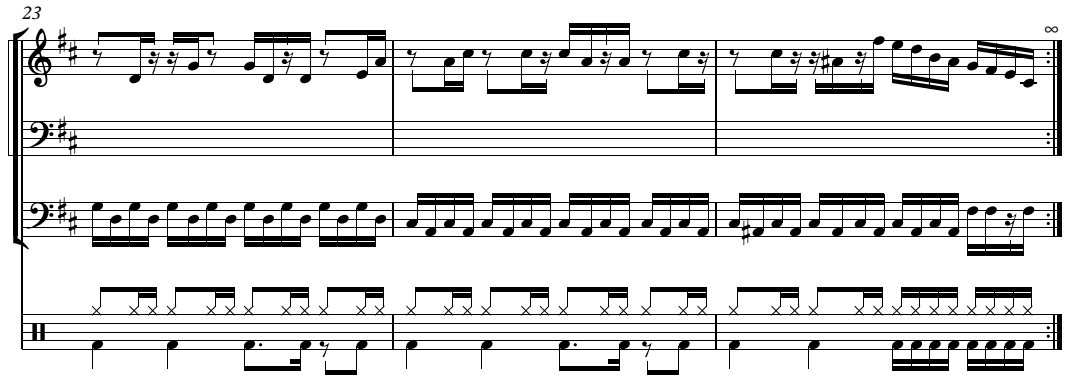
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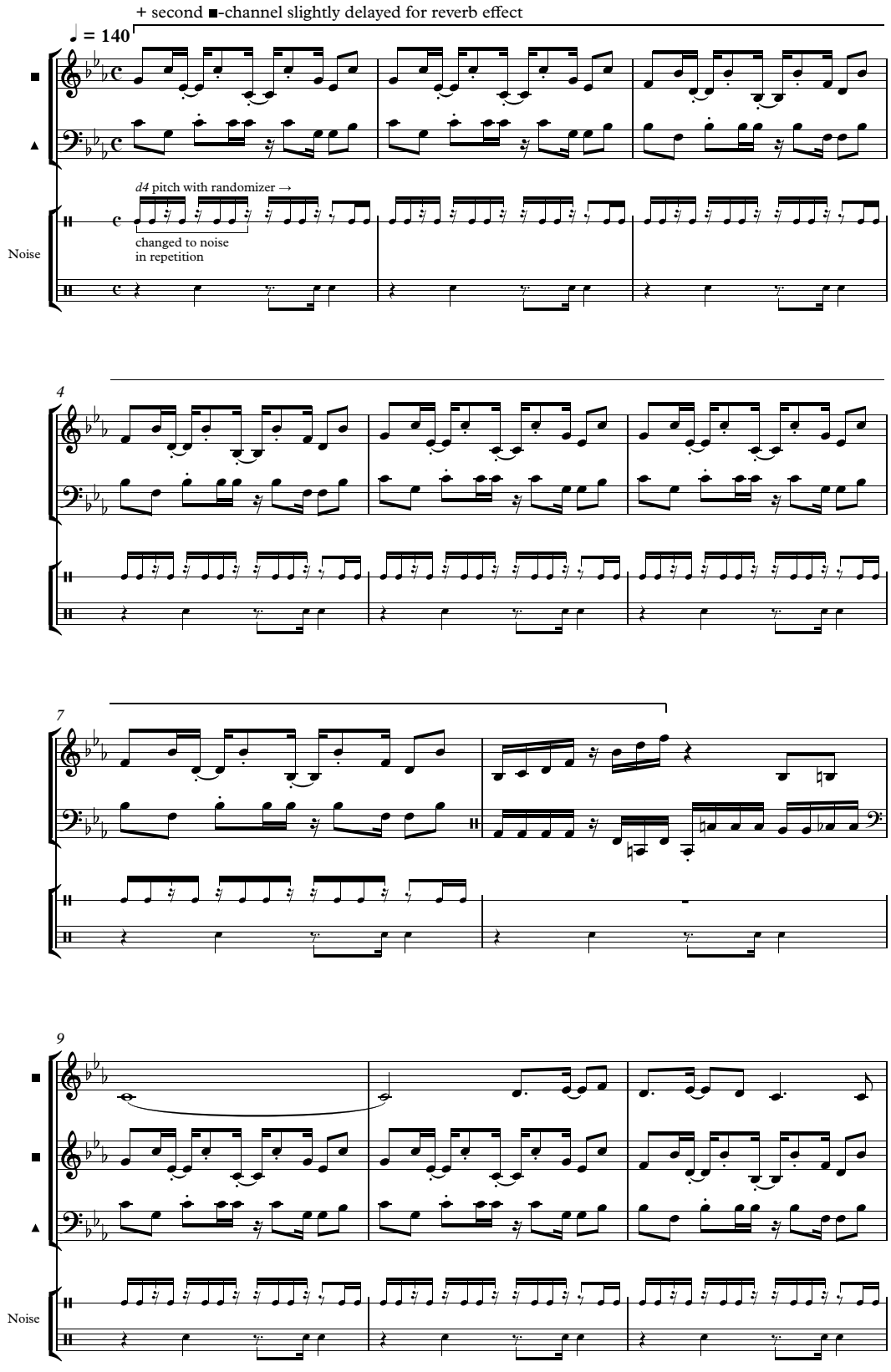
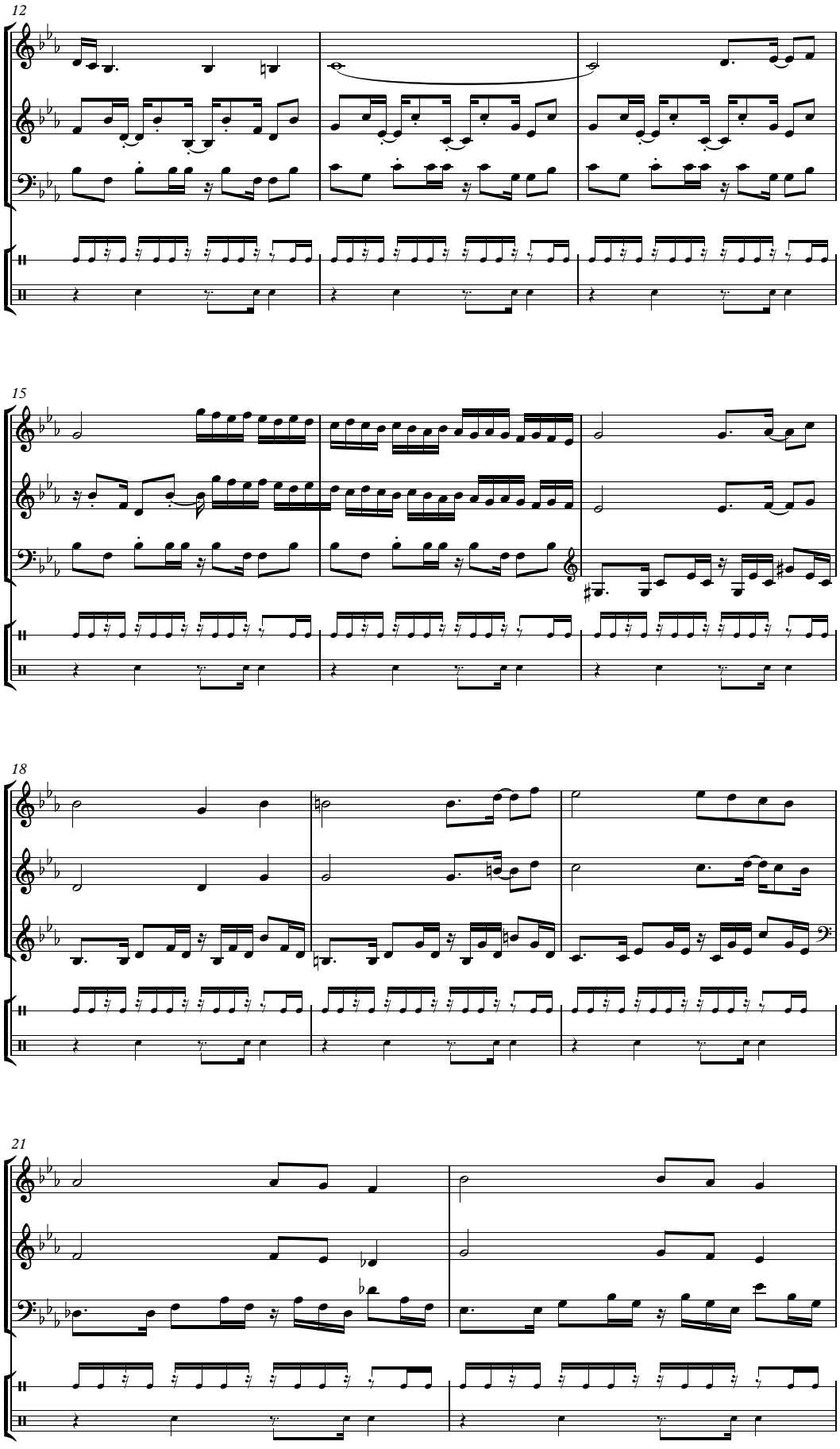
Quick Man

Mega Man 2 (1988)

Music by Takashi Tateishi
Transcribed by Manuel Gutierrez Rojas

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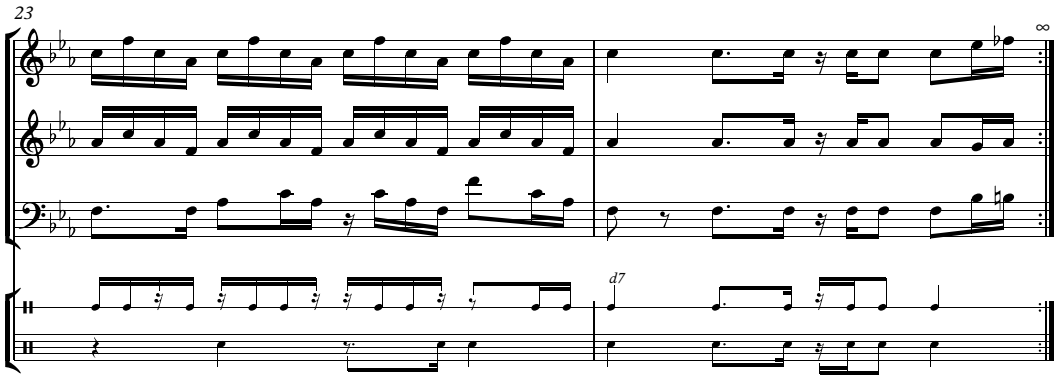
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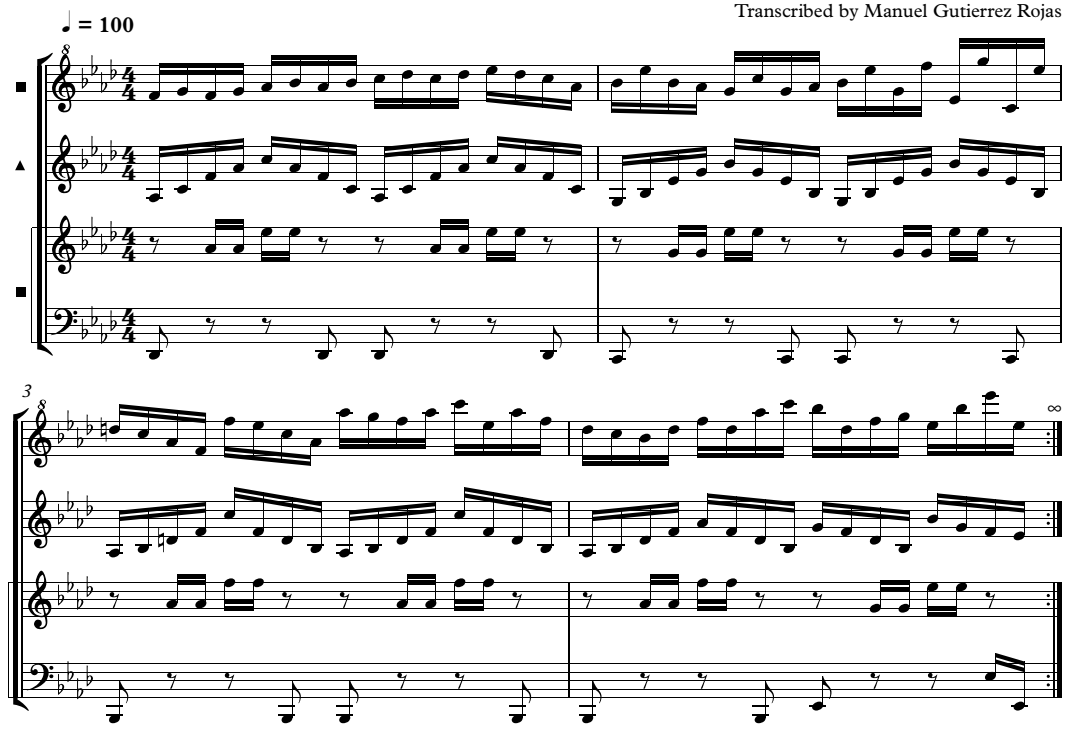
Rainbow Resort

Kirby's Adventure (1993)

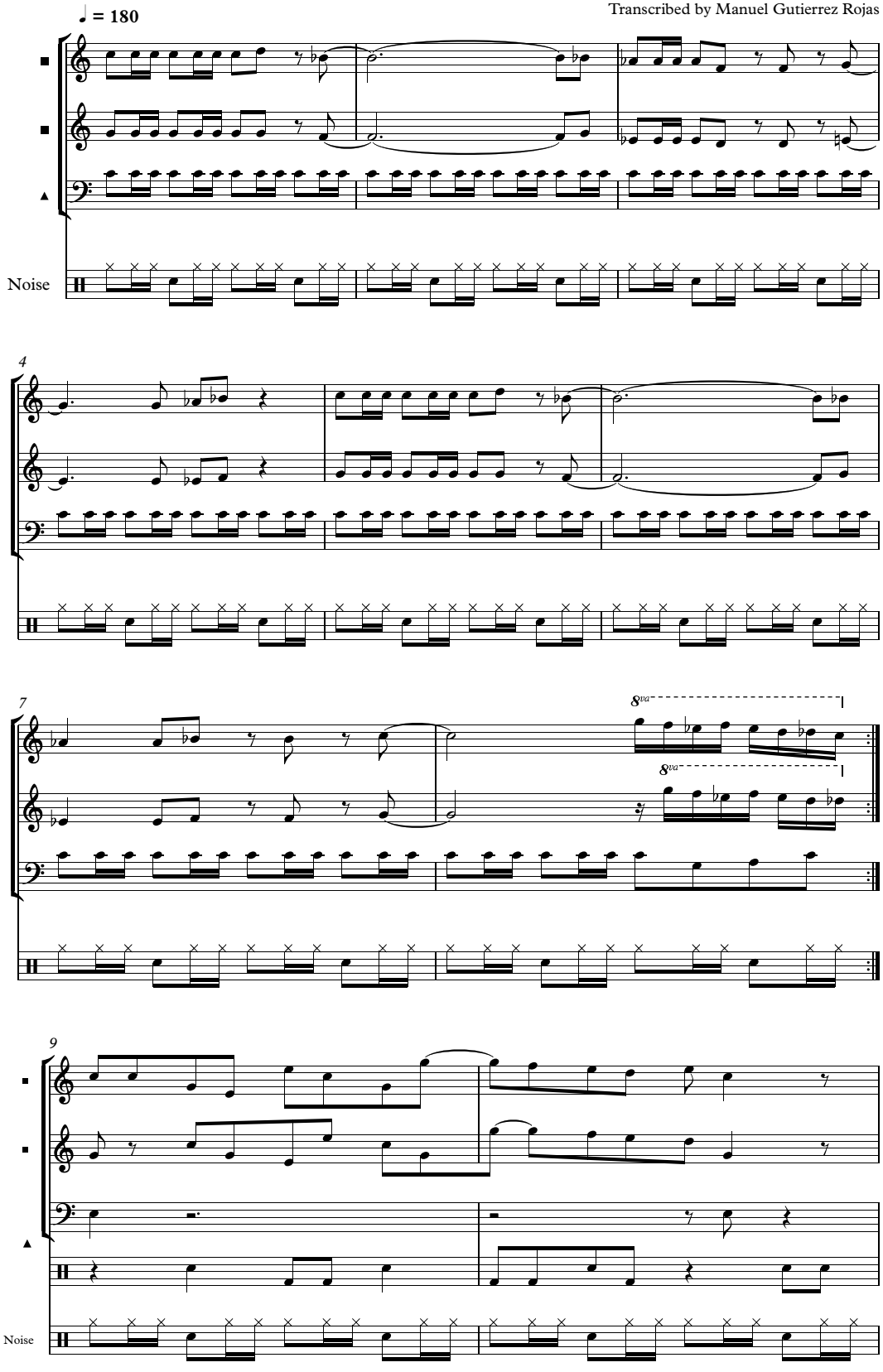
Written by Hirokazu Ando and Jun Ishikawa
Transcribed by Manuel Gutierrez Rojas

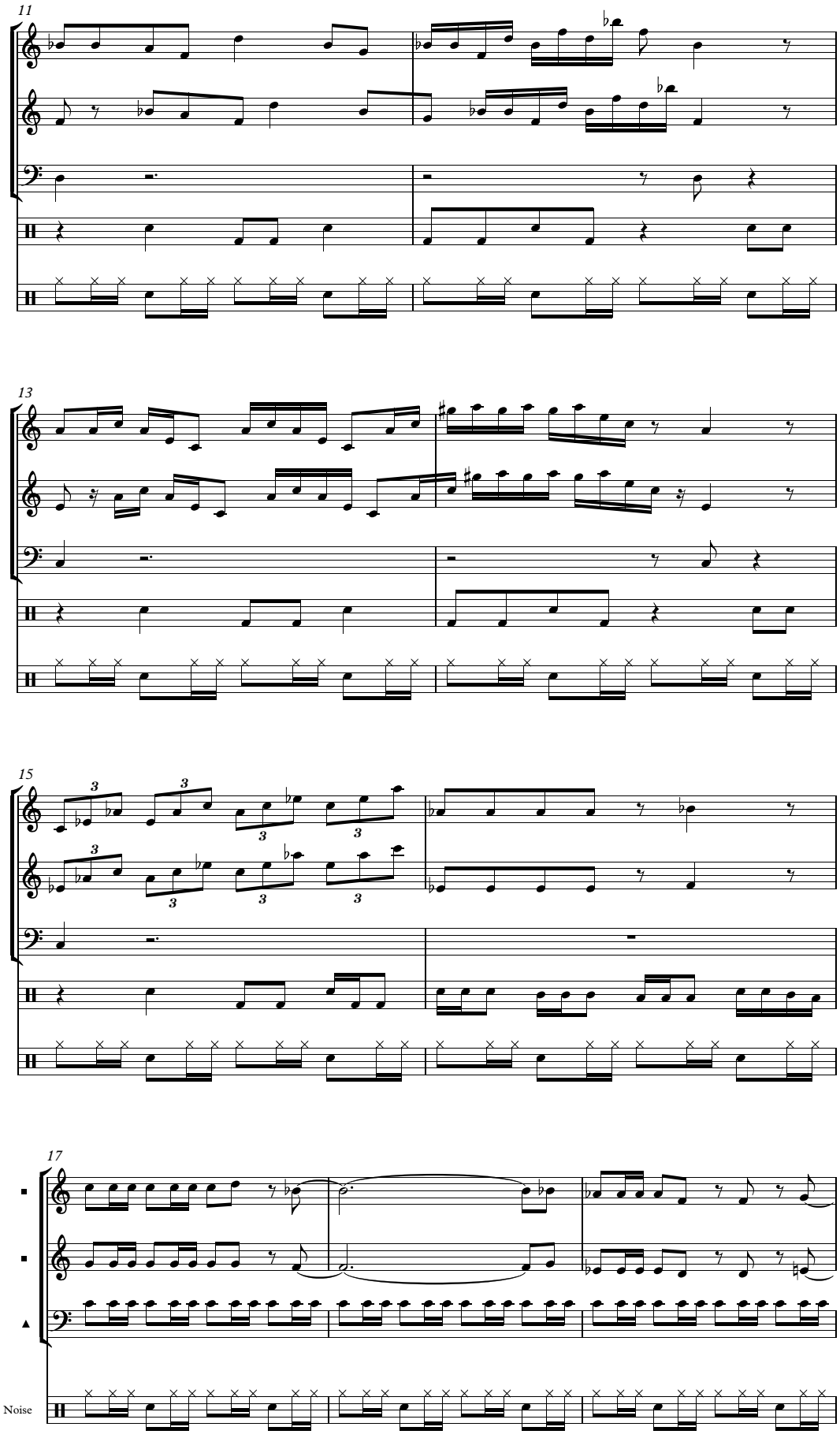


Title Screen

Mega Man 2 (1988)

Music by Takashi Tateishi and Manami Matsumae
Transcribed by Manuel Gutierrez Rojas

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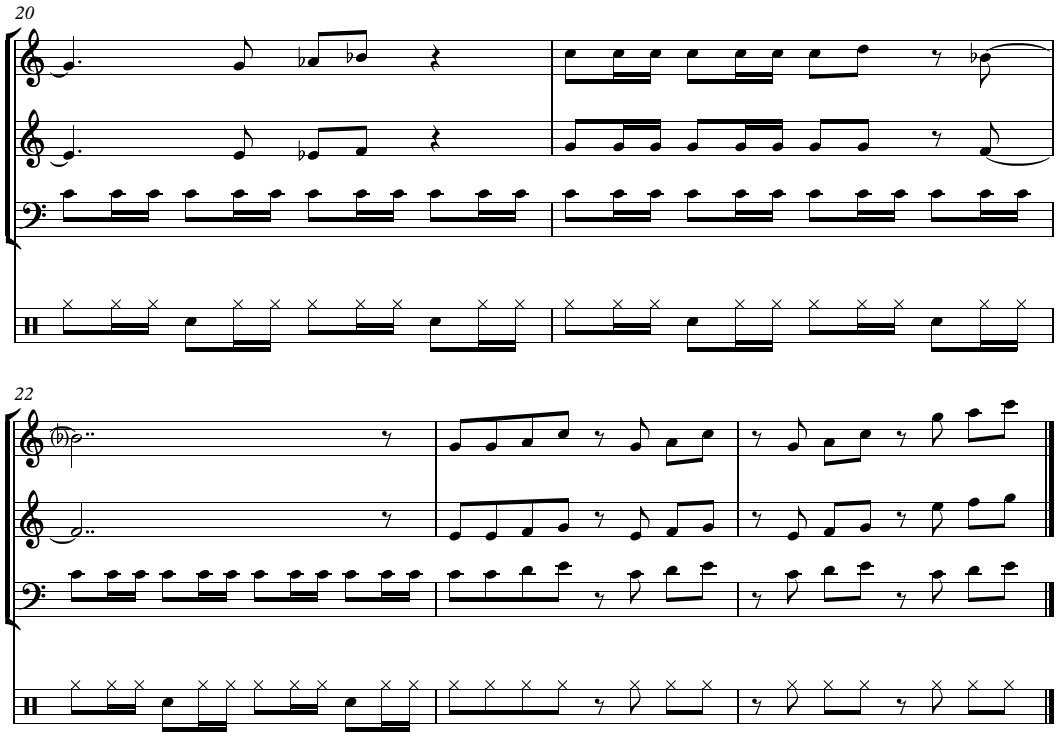
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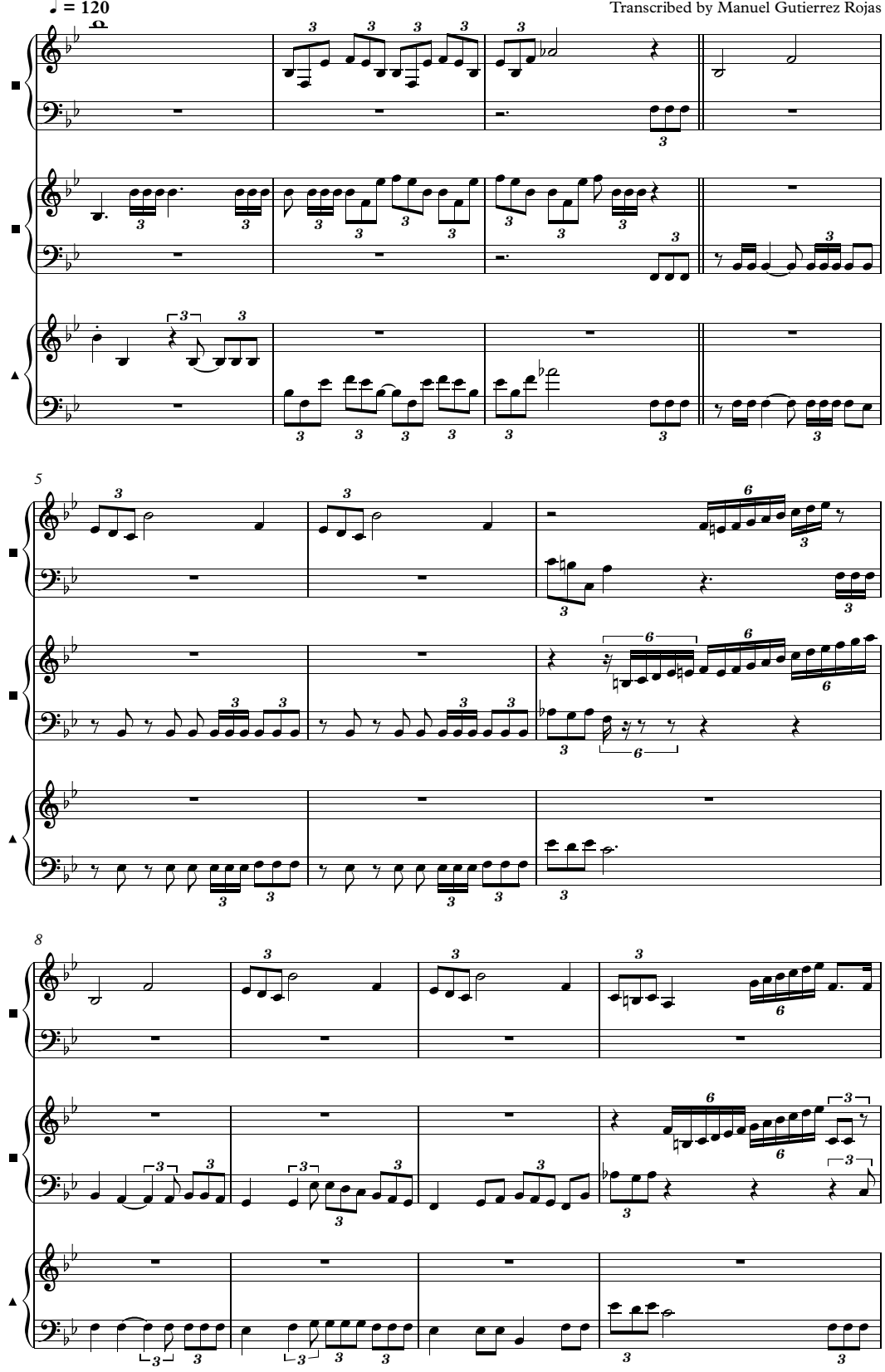
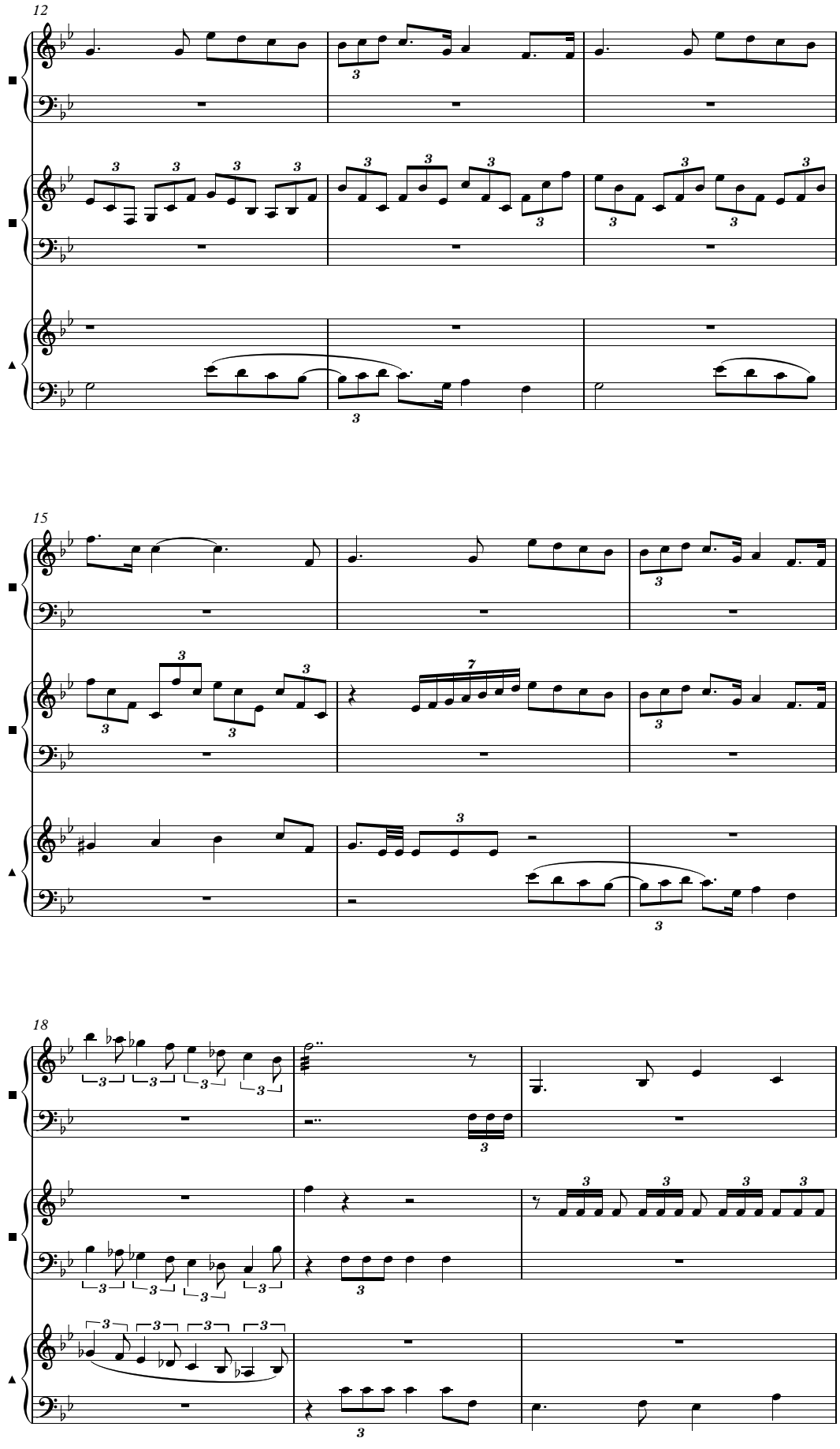
22

Title Screen Crawl [Parts]

Star Wars: The Empire Strikes Back (1992)

Music by John Williams
Arranged for the NES by Paul Webb
Transcribed by Manuel Gutierrez Rojas

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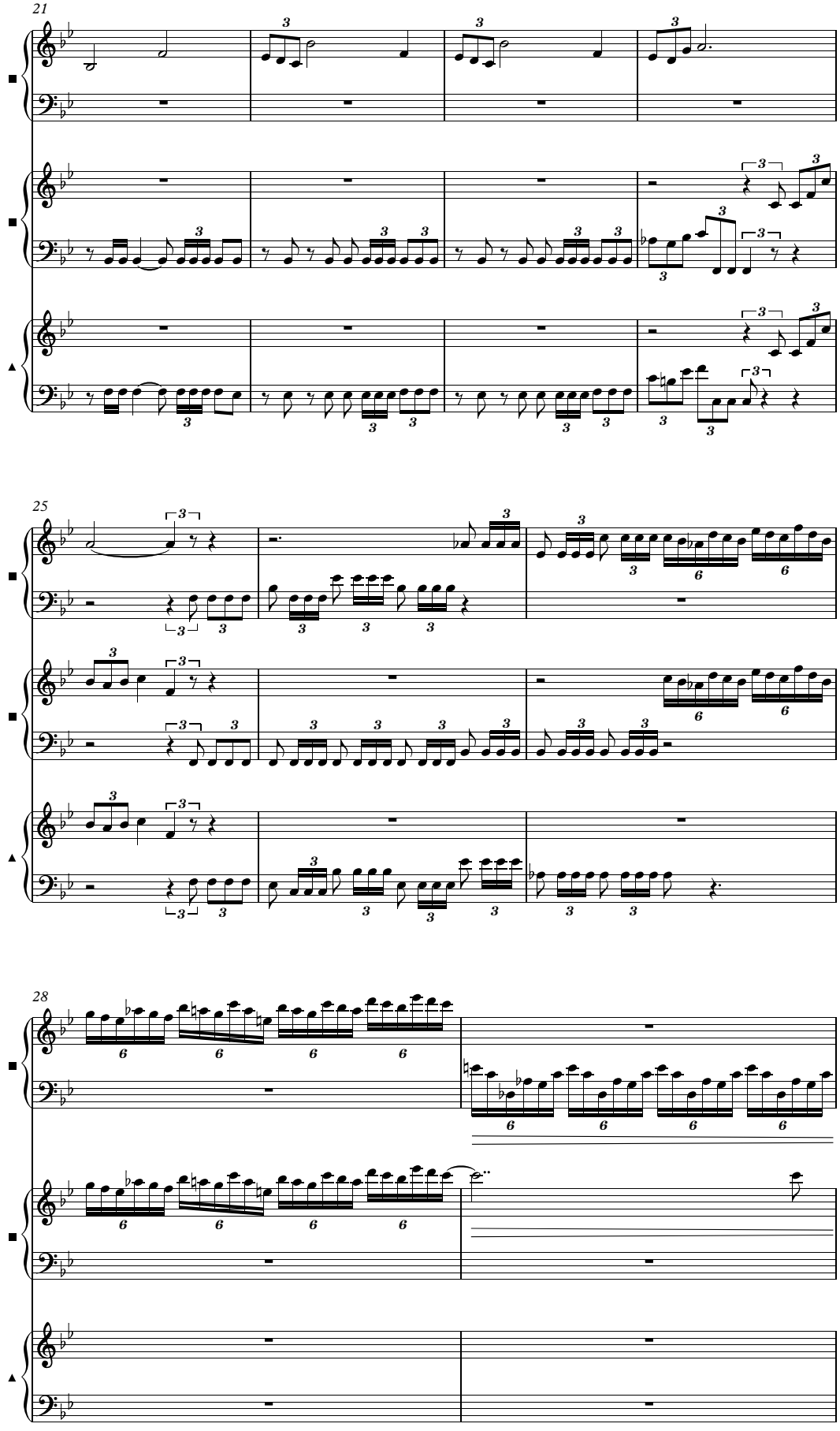
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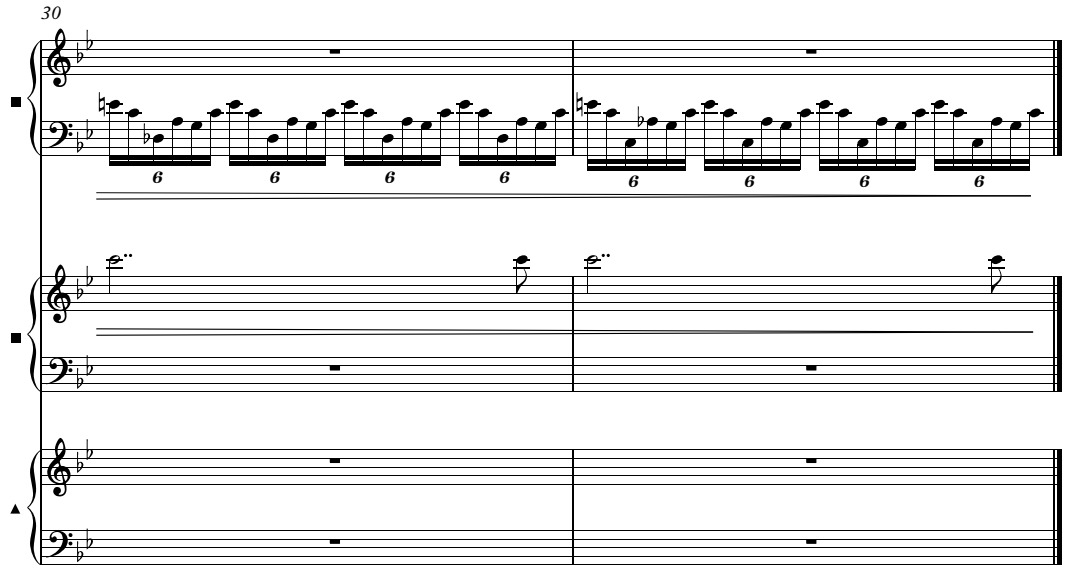
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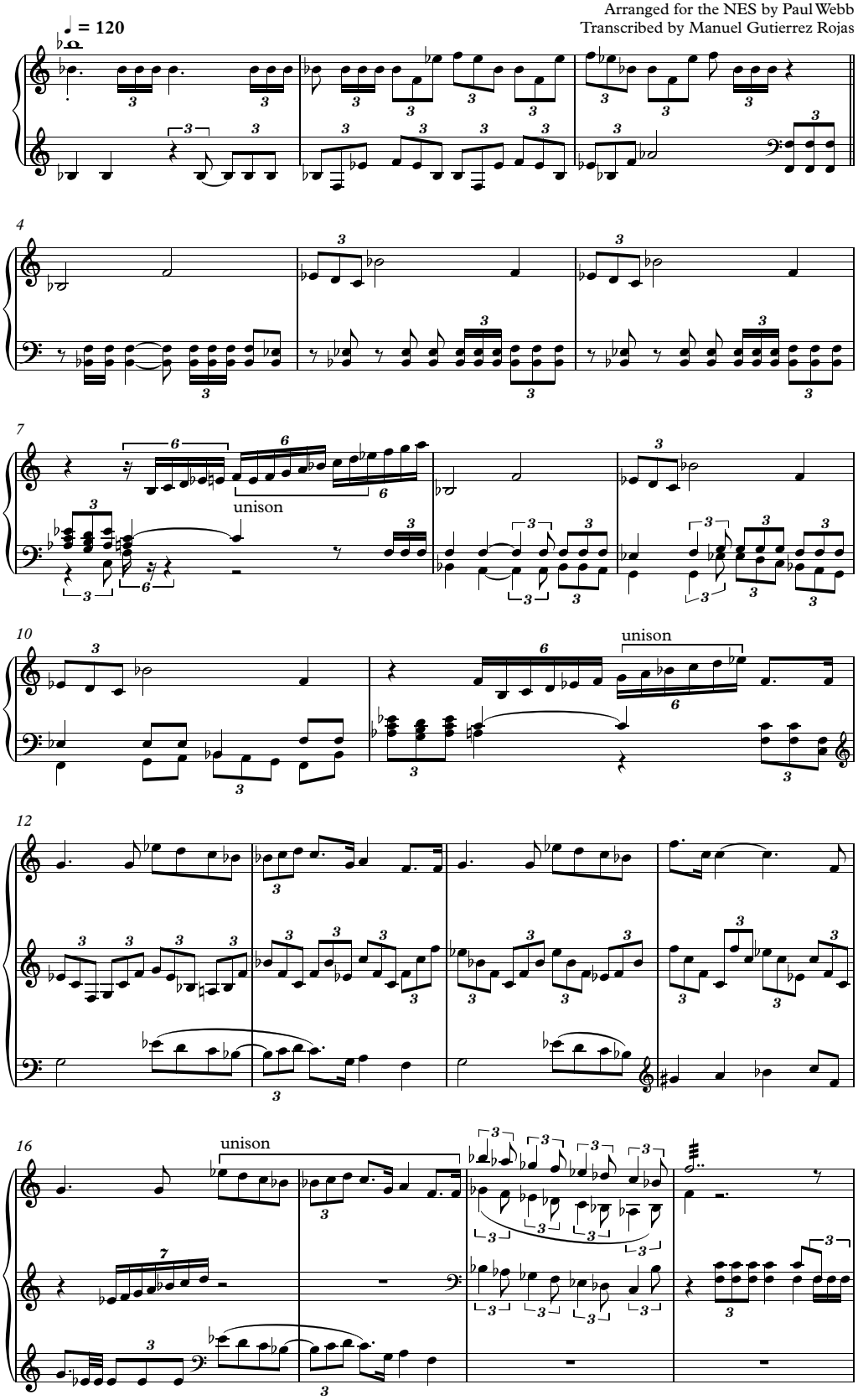
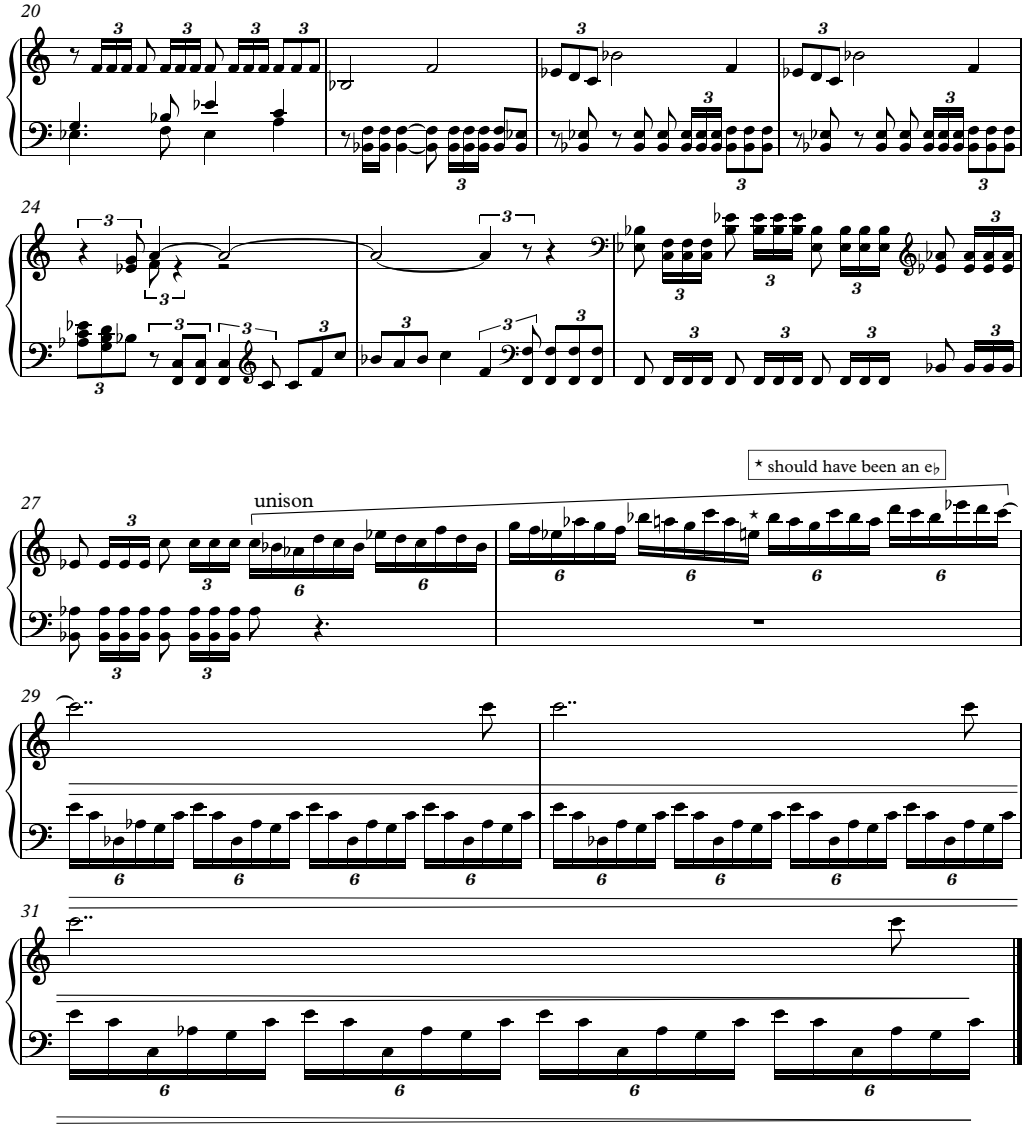
Title Screen Crawl [Piano Reduction]

Star Wars: The Empire Strikes Back (1992)

Music by John Williams
Arranged for the NES by Paul Webb
Transcribed by Manuel Gutierrez Rojas




20
24
27
unison
* should have been an e♭
29
31

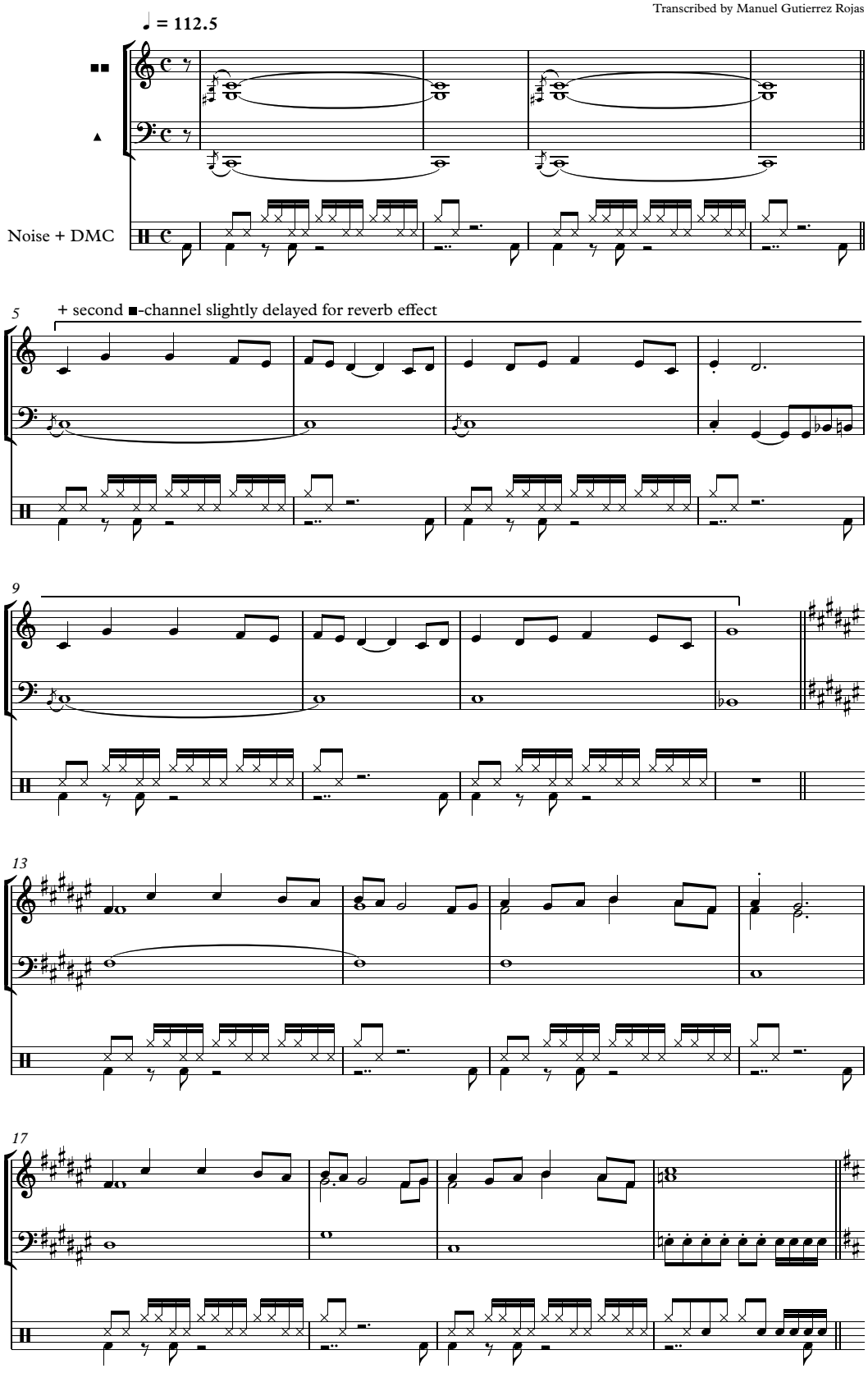
Title Screen (Top Gun Anthem)

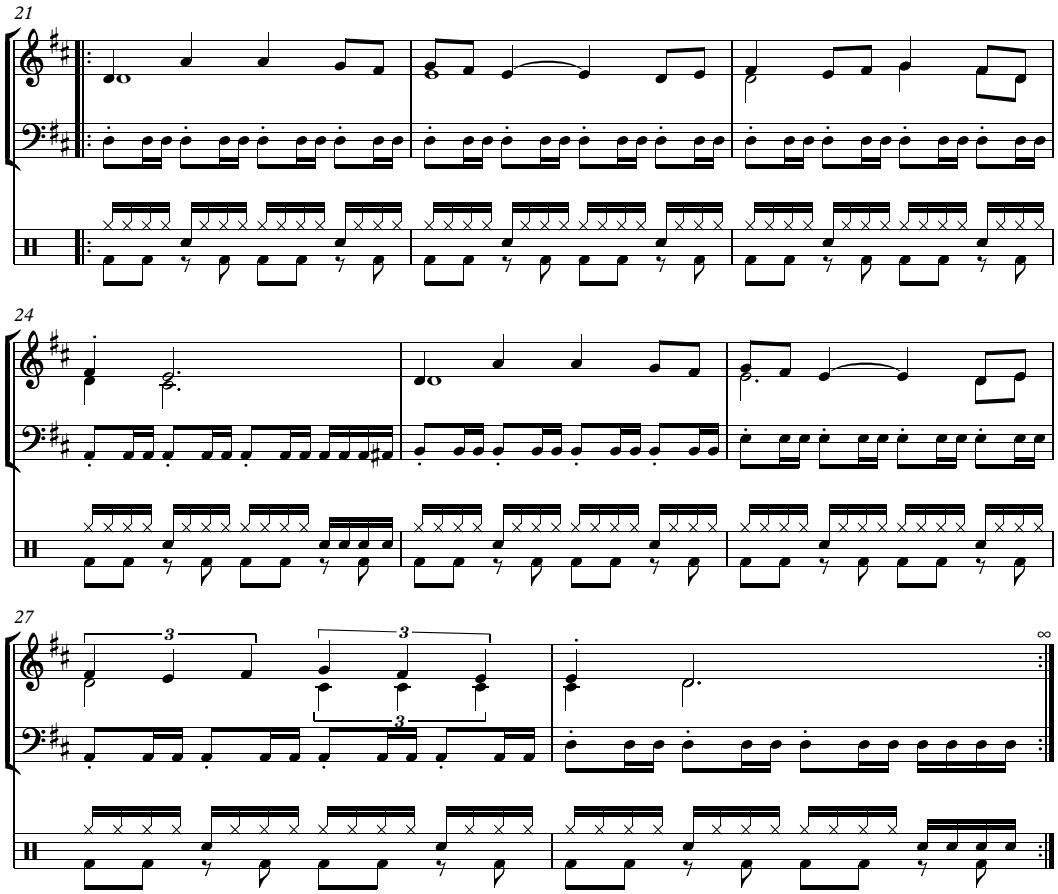
Top Gun (1987)

Music by Harold Faltermeyer

Arranged by Kyouhei Sada,
Kazuki Muraoka, and Kouji Murata

Transcribed by Manuel Gutierrez Rojas

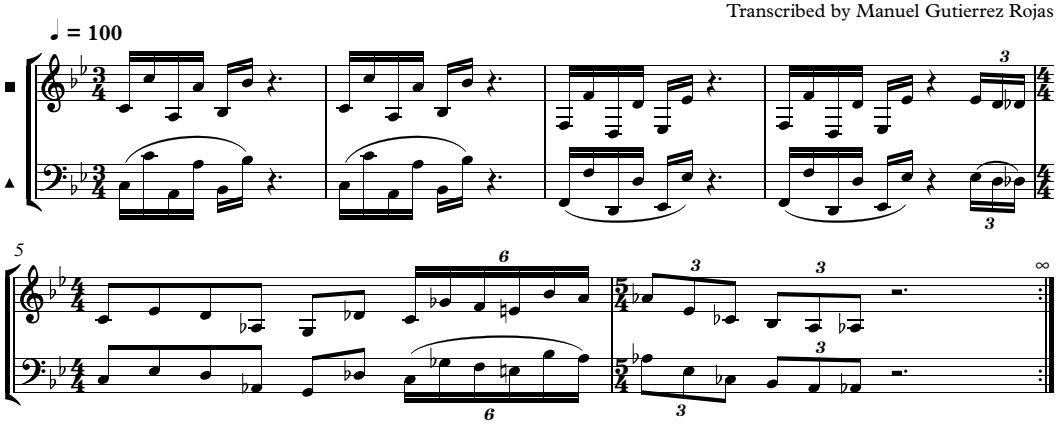



21
24
27
3
3
3

Underground

Super Mario Bros. (1985)

Music by Koji Kondo
Transcribed by Manuel Gutierrez Rojas



Water Land

Super Mario Bros. 3 (1988)

Music by Koji Kondo
Transcribed by Manuel Gutierrez Rojas