DOCTORAL THESIS

A portfolio of compositions and an investigation into electroacoustic compositional techniques and aesthetics in cinematic film

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A Portfolio of Compositions and an Investigation into Electroacoustic Compositional Techniques and Aesthetics in Cinematic Film

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A thesis submitted in partial fulfillment of the requirements
for the degree of
Doctor of Philosophy

Principal Supervisor: Dr. KEYES, Christopher

Hong Kong Baptist University

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DECLARATION

I hereby declare that this thesis represents my own work which has been done after registration for the degree of PhD at Hong Kong Baptist University, and has not been previously included in a thesis or dissertation submitted to this or any other institution for a degree, diploma or other qualification.

Signature: _____

Date: March 2014

ABSTRACT

The purpose of this study is to investigate the occurrences of electroacoustic content in and its relation to cinematic film. Key research questions include: What pioneering techniques and aesthetic positions used by creators of early electroacoustic music have found their way into mainstream cinema? Where and when have they been developed? In which films do they appear, and how are they distributed among film genres?

The findings of this study assert the idea that many techniques that are part of sound design of contemporary cinematic film (the process and result of mixing and manipulating sounds) come directly from pioneers of electroacoustic music. Electroacoustic techniques and aesthetics play an important role in the history of sound film in making fundamental contributions to production processes, the relation between directors and sound makers, and film sound theory. On an aesthetic level, electroacoustic music in film has reformed the role of sound in film: a film score can contain 'noise', while speech and sound effects can actually serve as music.

The findings also assert that electroacoustic techniques and aesthetics can be found in cinematic film from the beginning of sound film in the late 1920s. Once established, techniques have largely remained the same, regardless of the carrier media and their transformation from analog to digital: modern, digital techniques are refinements of their analog predecessors. Aesthetics have developed along with techniques, albeit much slower; their potential and exploration is far from being exhausted. The use of electroacoustic content for a particular element of film sound is not unusual and often genre-specific (for example in science fiction and thriller). However fully electroacoustic scores are rare.

A portfolio of selected original compositions by the author complements this study. Acoustic and electroacoustic pieces for film and multimedia highlight different aesthetics, techniques and practices of film sound and film music.

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Thanks go first and foremost to my supervisor Prof. Christopher Keyes whose support has been fundamental; his guidance and criticism have been inspiring me throughout the years of my doctorate. Co-supervisor Dr. Christopher Coleman has provided helpful comments and insight, and pointed me to relevant films; I am grateful for the time he spent listening to and commenting on my compositions.

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Sebastian Seidel
Hong Kong, March 2014

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Abbreviation

The arrow symbol (→) will be used in the main text (pp. 1 – 109) to refer the reader to the page number of a chapter, paragraph, figure or table in this dissertation that is relevant to the context in which the arrow symbol appears. In this dissertation, the symbol can be read as the word 'see'.

Author background

The motivation and inspiration for this dissertation stems from the author's continuous practice in music composition and multimedia design. Having studied Media Art and Design (*Mediengestaltung*) at the Bauhaus University Weimar with a focus on film production and theory, radio and electroacoustic music, the authors artistic practice includes audiovisual works in fixed media (film, video, installation) and performance (live performance, radio broadcast, internet webcast of electroacoustic music and experimental video). Founding member of the experimental webcast platform pingfm.org (Weimar/Germany 1999 - 2004), the author was part of an early generation of 'webcasters' - artists, musicians, programmers and media activists streaming experimental audio and video live over the internet in weekly broadcasts as well as and onsite collaborations with sound artists and multimedia artists.

Introduction to the dissertation

As the author's core interest lies in the creation, critical observation and discussion of the relation of sound and picture in audiovisual media, and specifically film sound (sound design, film music) in practice, theory and its history of technology and aesthetics, this dissertation therefore consists of two parts: a portfolio of practical works and an investigation into electroacoustic content in cinematic film.

The portfolio includes examples of the author's ongoing practice of composing musical and audiovisual pieces, the core of which have been produced for film. Examples of film sound presented in this portfolio aim to search for a sound language that evolves from and with the characters and their actions yet remains ambiguous and - if need be - suggestive, rather than imposing a pre-defined set of emotions that is triggered through the use of classic patterns of film music. Judging from the experience gained in this practice and subsequent research it seems that electroacoustic aesthetics and techniques hold great potential for such objectives. They are, however, insufficiently explored, and often ignored in practice and research; as is the importance of sound and sound design techniques for cinematic film in general. Yet, in addition to the author's positive practical experiences with electroacoustic techniques and aesthetics for film sound, research shows that films with such content have been at the forefront (if not the cause) of the evolution of film sound; prominent (although few) examples can be found in different genres and eras.

The second part of this dissertation therefore presents an investigation into electroacoustic aesthetics and techniques in cinematic film from the late 1920s to the present. This is a new research field, lacking in literature with the exception of Langlois' “Les cloches d'Atlantis” (2012). It does, however, tie in with a fairly recent 'new generation' of film sound research by people such as Flückiger (2001) and Martin (2010) where film sound is, on one hand, seen as an inclusive matter, abolishing traditional borders of music, dialog, effects, and their production, aesthetics and technologies; and where it is, on the other hand, being discussed in strict separation from the image, thus giving proof of the emancipation of film sound also in film theory. By researching occurrences of electroacoustic content in film, the author will argue that such content holds aesthetic potential for film sound in creating a unique language in film sound that strongly contrasts film sound's classical aesthetics of orchestral film scores with stylized predictable sound effects. Film examples from different eras, countries and genres will be discussed to emphasize this. This investigation is survey-oriented and analytical only to underscore certain points.

1. Portfolio of Compositions

Previous studies and artistic practice place the author's practical work in an audiovisual context; in the portfolio, this practice is reflected in two multimedia pieces (*Portrait* and *Snowflakes*). More recently, more traditional music for film has been explored (*Scharmuetzel*, *The Armadillo*) serving as examples for what are common practice and expectations of film score composers. Experimental in the context of a film, yet more common in contemporary music are electroacoustic pieces such as *Kanpaiak*. The examples chosen for the portfolio are therefore not only representative for the author's own artistic practice, but also reflect current practices in film sound.

Portrait

Real time video engine, 2011

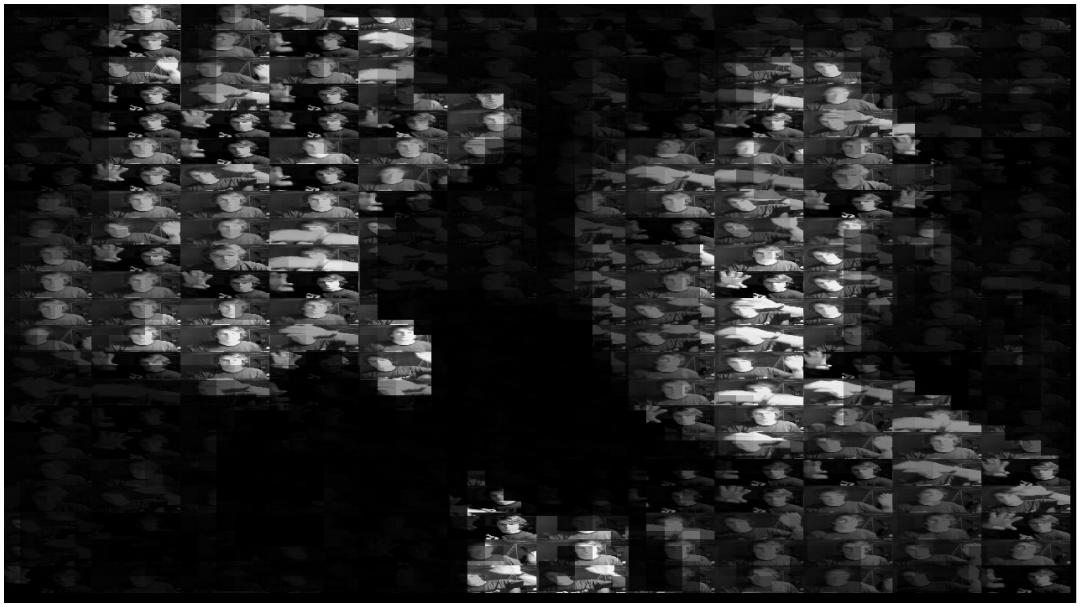

Figure 1: Portrait screenshot (Sebastian Seidel)

Portrait is conceived as a single channel real time video engine. A webcam feed is multiplied and copied onto a number of matrices - smaller windows that each show the webcam feed. These small matrices fill the output window. Layered onto this big window is a downsampled copy of the original webcam feed, the resolution of which equals the amount of matrices (smaller windows) in the big picture. The brightness values in the downsampled matrix control the brightness value of the matrix in that particular position. In addition to this, each sub-matrix is randomly delayed by up to 100 frames or about 4 seconds. The number of sub-matrices and the resolution of the output window can be adjusted.

Programming environment: MAX MSP/Jitter

→ Appendix *Portfolio DVD 1* for video example and commentary video

Figure 2: Portrait interface (Sebastian Seidel)

Snowflakes

Real time audiovisual synthesis, 2013

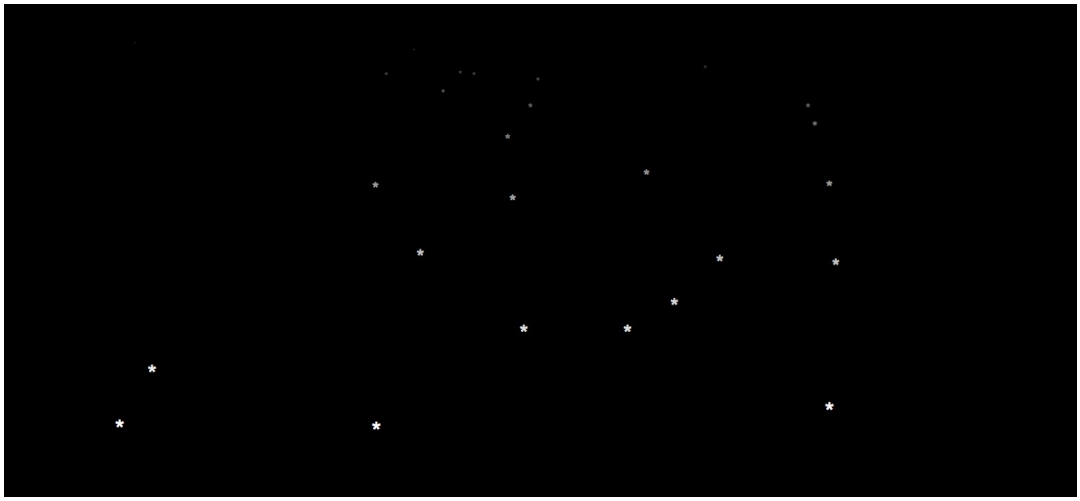

Figure 3: Snowflakes screenshot (Sebastian Seidel)

Snowflakes is a real time synthesis of image and sound. Along the x-axis of the screen, snowflakes are seen falling down. Each snowflake triggers a sound the centre frequency of which roughly corresponds to its position on the screen. Low frequencies appear left, high frequencies right. After it has reached the bottom of the screen, each snowflake will re-generate in a different position along the x-axis. Depth - an imaginary z-axis - is suggested by varying speeds, different sizes and different brightness values for each snowflake; these also map to different levels of amplitude: a snowflake that is further away falls slower; it is smaller and stands out less from the background; and it is not as loud as one that falls in the foreground. While the number of Snowflakes is pre-determined, their positions on the x-axis and on the imaginary z-axis are randomized each time they reach bottom. The result is a shimmering, oscillating soundscape that fades in and out of different degrees of harmony and disharmony. Snowflakes is loosely inspired by the *ANS* synthesizer and its use by Russian Composer Eduard Artemyev for sounds in the film *Solaris* directed by Andreij Tarkovsky.

Programming environment: MAX MSP/Jitter

→ *Appendix Portfolio DVD 1* for video example and commentary video

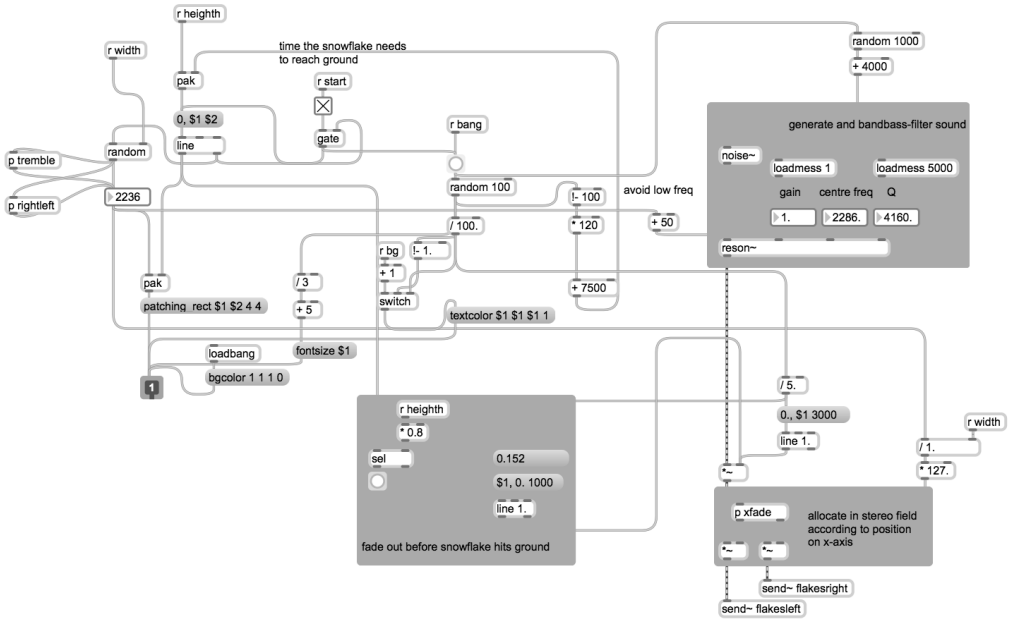

Figure 4: Snowflakes engine (Sebastian Seidel)

26 Happiness Road

Film (Drama), Hong Kong 2010, 88 min

Director: Bill Chiu

DoP: Simon Young

Producer: Patrick Ho

Sound Design, 5.1 Sound Mix, Music: Sebastian Seidel

http://26happinessrd.com

Production note:

26 Happiness Road was mixed in 5.1 surround at the Hong Kong Baptist University's Electro-Acoustic Music Centre (EMC). Shot in Hainan and Beijing, creating the ambient sounds for these two principal auditory settings was a crucial part of this project. Library and newly recorded sounds alike were used to shape two very different soundscapes – wind, trees, water and animals in almost chaotic randomness, often in high frequencies, for Hainan; low-frequency loops of traffic noise, domestic machine humming and distant city drones is the sonic backdrop for Beijing. A substantial part of this project consisted in mixing and adjusting the original dialog which was lacking recording quality - the problem bits had to be fixed by finding the right balance between *subtractive* (noise reduction) and *additive* noise management - the latter being the subtle art of covering noise by adding additional sounds in the same frequency range as the noise source.

Circulation/Festivals:

2011 Los Angeles Reel Film Festival, 2011 Los Angeles Movie Awards, 2011 Canada International Film Festival, 2011 Skip City International D-Cinema Festival (Saitama, Japan), 2010 Hong Kong Independent Film Festival

Awards:

2011 Los Angeles Reel Film Festival (Runner-up Foreign Film, Best Cinematography, Best Actress), 2011 Los Angeles Movie Awards Award of Excellence, Best Actress, Best Screenplay, Best Director), 2011 Canada International Film Festival (Award of Excellence)

→ *Appendix Portfolio DVD 1* for excerpts and *Appendix Portfolio DVD 2* for trailer and full movie

Speechless

Film (Drama), Hong Kong 2012, 92 min

Director: Simon Chung

With Qilun Gao, Jian Jiang, Yung Yung Yu, Pierre-Matthieu Vital

Music, Sound Design, Sound Mix: Sebastian Seidel

Production note:

The music employed in the feature film *Speechless* works as a counterpoint to the story that the images tell. The films starts with a simple scope: two policeman encounter a foreigner who does not speak and carries no documents. While trying to find out his story, different people uncover a network of persons and events that grows more complex with every minute of the film. This narrative development is reversed on the soundtrack, where complex, atonal and synthetic soundscapes gradually fade into simple diatonic pieces of music played on acoustic instruments. Music was produced at Hong Kong Baptist University's EMC as above, including recordings of Marimba, played by Karina Yau.

Circulation/Festivals:

2011-12 HK Independent Film Festival (Indie Nations), 2012 BFI LGFF/London, 2012 Cinemasia/The Netherlands, 2012 Torino GLFF, 2012 Miami GLFF, 2012 Inside Out/Toronto, 2012 Filmout/San Diego (and others). DVD available online at amazon.com and at HMV stores in Hong Kong

→ *Appendix Portfolio DVD 1* for excerpts and *Appendix Portfolio DVD 2* for trailer and full movie

Haexagon

Film (Short/Action), Hong Kong 2012, 19 min

Director: Marco Sparmberg

Sound Design, Sound Mix: Sebastian Seidel

http://www.00c6.org

Production note:

Haexagon is unique in its lack of dialog and music during most of the film. The soundtrack consists of ambient and body sounds and additional suggestive elements; most of these were recorded for the film as foley. Foley artists recorded the characters walking on different surfaces in different clothes, manipulating different objects. Suggestive elements complementing the naturalistic synchronization included the use of helicopter and wood recordings. Both are integral parts of the film - wood represents the forest, where the action takes place during the first part of the film. Wood also illustrates movement and impact - from cracking branches and snapping sticks to stocks of trees breaking, wood is organic, dynamic, forceful and potentially violent. The helicopter, in the film the primary means of transportation, embodies the connection to the 'safe' outside world; it represents control through technology, machines and civilization, the downfall of which is materialized in the setting of the second part of the film. Different helicopter recordings (rotor blade, engine) and wood sounds (impact, break and tear sounds of branches, logs and trunks) were manipulated (reversed, cut, stretched etc.) and processed (with reverberation, distortion, echo etc.). They were then synchronized to the image in a non-naturalistic way, serving – similar to a musical motif – as key sound in scenes of extreme tension.

Circulation/Festivals:

3rd Unofficial Google Plus Film Festival - Official Selection

Snobby Robot's 2013 Best of Webseries (http://snobbyrobot.com/)

→ *Appendix Portfolio DVD 1* for excerpts and *Appendix Portfolio DVD 2* for trailer and full movie

Kanpaiak

Electroacoustic composition for fixed media (audio, 5 channels)

Figure 5: Ting Sha and *Aslatua,* instruments used in Kanpaiak (Sebastian Seidel)

Kanpaiak is an electronic composition intended for a spatialization over 5 channels. Source materials for the composition are recordings of an Aslatua (West-African shaker: two pebble-filled gourds connected by a string) and Ting Sha (small Tibetan cymbals). The source material has been manipulated and processed with a variety of techniques including time-stretching, pitch-shift, delay and filter.

Kanpaiak focuses on elements of rhythm (horizontal musical development in time) and harmony (vertical alignment and synchronization of timbres: paused in time), thus alluding to the cultural context in which the two source instruments are used: dance and meditation.

Hong Kong 2013, 7:30 min

→ *Appendix Portfolio DVD 1* for audio

Scharmuetzel

Acoustic composition for piano and electric guitar or mallet instruments

Hong Kong 2012, 3:25 min

Scharmuetzel (German for 'skirmish') is a duet originally written for piano and electric guitar. The piece explores ideas of polyrhythms that follow a steady pulse while constantly shifting downbeats. Over three parts, two different motifs - one rhythmic, one melodic - are introduced and manipulated, changing pitch-centre and rhythmic structure.

→ *Appendix Portfolio DVD 1* for audio and p.120 for score

The Armadillo

Acoustic composition for piano

Hong Kong 2010, 4:58 min

The Armadillo is a composition written for solo piano. The largely atonal piece develops a motif, while moving through different focal points of pitch and rhythm. Transformation of the motif includes fragmentation, compression, retrograding and expansion.

→ *Appendix Portfolio DVD 1* for audio and p.130 for score

2. An Investigation into Electroacoustic Compositional Techniques and Aesthetics in Cinematic Film

Background and methodology

The technical development and sophistication of moving images precede sound in cinematic film by decades. A quarter of a century has passed between early silent films (e.g. *The Great Train Robbery*, USA 1903) and the first sound film (e.g. *The Jazz Singer*, USA 1927). We may, in fact, say the same about research on images in cinema, and on sound:

> If we want to understand the history of edited images we start by looking to the films of Eisenstein, Vertov and Pudovkin (roughly 1920s - 1940s). To understand the history of edited sound, we do well to listen to Murch's work with Lucas and Coppola (roughly 1970s). (Jarrett 2000)

Film research has always shown a tendency to focus on the image. Gianluca Sergi (2004: 61) gives evidence that research on 'film sound' (all sounds found in a film, including dialog, music and effects) is rare, often amounting to a very small percentage (1 - 3%) within introductory books on cinema. Where researched, film music is the preferred subject of attention, and not other elements or the entirety of all sounds in film.

The Shortcomings of Film Sound Research[1]

Looking at presently existing studies on film sound with regards to the topic of this thesis, three major shortcomings can be made out: research on film sound lacks its own vocabulary; topics of film sound research are largely selective and isolated; and until 2012, there had not been any detailed and comprehensive research on electroacoustic music in film.

[1]It seems appropriate to mention that the importance of film sound is said to be undervalued in the practice of filmmaking as well (Sergi 2004: 74), a phenomenon that will be discussed (→ 2.5 *Findings* p.96).

Research on film sound lacks vocabulary[2] and language, as Sergi argues (2004: 73-75); it neglects precision and attention to detail when describing sound, its technologies and applications. Works by film sound scholars such as Chion (1995, 2009), Altman (1992), Flückiger (2001) and Whittington (2005) make significant efforts to overcome this. Terms and descriptions they use can be sensibly applied to sound in film, and differ from a language otherwise used to discuss (film) music or (film) images. Unfortunately, the mentioned works are an exception to the rule, and while the lack of language and vocabulary in film sound is not the topic of this study, it is the opinion of its author that film sound research needs to be conscious about the necessity of finding and employing an 'own' language.

Research on film sound goes into depth and not breadth; few studies, such as those by Langlois (2012), Rudy (2007) and Underwood (2008) extend over history, genre and techniques. Many subjects have not been considered for research: Chion (1994: 145) mentions the lack of research on “noises”; Sergi indicates insufficient investigation on the “conditions of reception” (2004: 73), referring to the three-dimensionality of sound in cinematic film and it’s “space(s) of reception” throughout the history of its formats (musical accompaniments of silent film; monaural, stereophonic and multichannel versions of sound film on optical and magnetic tracks).

With regards to research that focusses on or touches electroacoustic music and/or techniques and/or aesthetics, existing studies often describe a single genre (Whittington 2007, on science fiction film), a historical period (James 1986, on the 1920s) or a singular instrument, technique or composer (Glinsky 2000, on the *Theremin*). To my knowledge, the first book-length scholarly research on the topic of electroacoustic content in film was published in May 2012 by Philippe Langlois, two years after the beginning of research for this thesis. Written in French, his is undeniably the most important study of electroacoustic music in film as of 2012 for a francophone audience. Langlois extends his – mostly historical – investigation from cinema to a selection of art-related sub-genres of film, while leaving out, in several cases, technical details of the electroacoustic content he discusses.

[2] “Even the terminology with which we describe film sound is often built around image vocabulary. At every turn, we sense that sound critics are gleaning from a field already harvested by image critics, making it exceedingly difficult to work on sound without being corrupted, as it were, by a prior image-based Gestalt.” (Altman 1992: 171)

Among these are the functional principles of instruments of electronic synthesis such as the *ANS* and the *Trautonium*, both of which represent significant occurrences of electroacoustic content in film, and can be considered crucial in the history of electronic music technology as well. In comparison with Langlois, this research attempt a more concise definition of cinema ('cinematic film'); it aims to provide details of techniques and aesthetics of electroacoustic content in both cinematic film and art music, accentuating their roots and reproductions; and it refers to prominent, mostly (but not exclusively) Anglophone research in film sound in order to make it widely applicable and usable.

Possible Reasons

To find explanations on why research on film sound is more scarce than research on images in cinematic film, one can go back to the very beginning of sound film in the late 1920s. When sound came into film, it was not universally welcomed (Sergi 2004: 59-62): while some argued it was difficult to combine two separate entities (sound and image), others feared that sound made cinema too real and deprived it of aesthetic and artistic qualities. Further criticism accused sound of destroying the evolution of 30 years of silent cinema and resetting cinematic film to zero. Speech in film ('The Talkies') was met with special hostility: Weis and Belton (1985: 82) describe early theorists' arguing that film itself is a language; an additional verbal expression would destroy it.

Deleuze says that “what sound cinema seemed to lose was the universal language and the almightiness of montage”[3] (1985: 292); the image was “denaturalised”[4] (1985: 294). From a socio-economic point of view, sound film meant unemployment for some (musicians who had been accompanying regular presentations of silent films; actors who would not be re-employed because they couldn't speak well) at a time of economic instability (*Black Tuesday* 1929). This also shows that, for a long time, music was the only widely accepted element of sound in film.

[3] “Ce que le parlant semblait perdre, c'était la langue universelle et la toute-puissance du montage . . . ” (Deleuze 1985: 292)

[4] “We could say that the visual image is denaturalized.” (“On dirait que l'image visuelle est dénaturalisée.”) (Deleuze 1985: 294)

It is therefore no surprise that among the different elements of film sound, the film score ('film music': music composed for a film) appears to be the most frequently covered item[5]. Indeed, research often equates film music (and its authorship) to film sound (and its authorship) in order to make it 'researchable': Sergi (2004) proposes that film music offers the possibility to analyse author and artwork; it can be related to an author (the composer), and the created material (the score) can be read and easily analysed. The profession 'composer' is one of centuries of history and a large number of representatives (well-known also to non-experts); the 'sound designer', in contrast, is a very new occupation with no comparable personnel. The film score composer holds authorship over parts of the film sound – the person in charge of supervising the entire soundtrack (often the sound designer), however, does not[6].

In contrast to the film score composition, the production processes of other sounds in film – dialog, foley and effects recording, dubbing, effects production, mixing – are difficult to trace to one author; they are usually done by a team of people (sound recordists and/or engineers, foley artists), and they are more difficult to analyze. These processes – in which electroacoustic techniques and aesthetics have gained prominence – are still widely considered technical, and as such receive less attention and recognition, despite their aesthetic entitlement. “Even today, Sound Design is not recognized as a profession by the Academy of Motion Picture Arts. They argue that sound work is not a creative, but a purely technical occupation” (Flückiger 2001: 18)[7].

Opportunities to listen to such elements of film sound out of context – not in conjunction with the image and the film music – in order to study and research, for example, are rare and have only recently been offered to a niche audience through isolated efforts[8] (in contrast, many film scores are commercially available on CD and even as sheet music).

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[5] “For years, music has been one of the very few sound-oriented domains to receive systematic attention from critics. While the quality of work on film music made this attention something of a mixed blessing, it certainly did help maintain awareness of certain aspects of film sound.” (Altman 1992: 173)

[6] Comparing – as Sergi (2004: 82) does – the involvements of the film score composer with that of the sound supervisor/designer distorts the idea of the music composer holding authorship over the sound of a film. While the composer usually works independently and without the necessity to actively be involved in the production process, the sound supervisor/designer's involvement starts, at the latest, with production (filming) and finishes at the end of post-production.

[7] “Bis heute jedoch wird Sound Design von der Academy of Motion Picture Arts and Sciences nicht als Berufsbezeichnung anerkannt mit der Begründung, es handle sich bei der Tonarbeit nicht um eine kreative, sondern um eine rein technische Tätigkeit.” (Flückiger 2001: 18)

[8] Web resources such as *SoundWorks Collection* offer in-depth information on film sound production.

Methodology

This research is the result of extensive literature review; communication with professionals on film and electroacoustic music; and the sampling of electroacoustic content in film, based on specific selection criteria, resulting in a 'body of research' of film examples. A thematic overview was created on what electroacoustic techniques and aesthetics appear, when and where they are used, and how they influence film sound. Qualities unique to electroacoustic content in film were identified and conclusions drawn principally from this database.

Considering the preconditions of: a) comparatively little previous research on film sound; b) even less research on electroacoustic techniques in cinematic film; and c) the notion that film sound is widely considered technical and not artistic, this research is qualitative and descriptive in order to introduce and explore a field of research that is still scarce. It aims to introduce and investigate electroacoustic compositional techniques and aesthetics found in cinematic film, based on and extending existing theories and research on film and electroacoustic music.

Literature was found through database search with appropriate search terms ('electroacoustic music', 'electronic music', 'film', 'film sound', 'film music', 'sound design'; less helpful but sometimes practical were film titles or genres as search terms); references found in standard reference works on 'film sound' and 'electroacoustic music' such as *Audio-Vision* (Chion 1994), *Film Sound* (Weis and Belton 1985), *Electronic and Experimental Music* (Holmes 2012); and through informed recommendations from composers, film sound designers and academics.

Criteria for film selection were their appearance in research; identifiable electroacoustic content; their significance to film history; the level of documentation of electroacoustic content found in them; and unique features, where traceable ('only film with electroacoustic content in a genre/a certain period of time'; 'only film using a specific electroacoustic technique'; 'first appearance of a specific electroacoustic technique'; etc.).

Additionally, websites, forums, blogs and mailing lists, and the possibility to contact professionals through email have yielded inspiration and useful information. I concur with Sergi (2004: 74) in saying that the internet has “proven to be the real propulsion behind the exponential growth of interest in and around film sound”.

Disclaimer

This investigation provides an overview over electroacoustic techniques and mentions films where these techniques have most likely been applied. Verifications for the use of a technique in the films (mentioned in the 'Examples' table at the end of each technique's chapter) include references to publications and, to a lesser extent, websites. All films mentioned in the 'Examples' sections have been listened to by the author and cross-checked with the mentioned reference (and detailed indications therein, such as film scene and/or sound in question). Films without documentation of a technique have been included only where the use of such a technique is unquestionable and obviously distinguishable through listening to the film. They have been mentioned as such.

Objectives and scope

This research investigates the occurrence and application of electroacoustic compositional techniques and aesthetics in cinematic film from (approx.) 1928 to the present (2013).

The objectives of this study are to identify the most common and significant electroacoustic techniques that have been used in cinema, specifically techniques whose origins are analog, and that are, unless mentioned, still in use today, in analog or digital form; and that, in the digital domain, have been refined and streamlined but not essentially altered (unless radical differences exist between analog and digital forms, no special mention will be made as to whether a technique is analog or digital). Of these, examples will be given – where possible, early examples that represent the appearance of the technique, and later examples that represent their continuation.

This thesis aims to investigate the relationship of these techniques to aesthetics of film sound (dialog, music and sound effects and their relation to the image); to identify commonalities in the use of electroacoustic compositional techniques and aesthetics in film examples of different eras, genres and techniques; to identify genre affinity of electroacoustic music in cinematic film, if such affinity can be found; and to contribute groundwork and perspectives to existing research on sound and music in film, counter the mentioned shortcomings of film sound research and encourage the multiplication and diversification of academic discussion on film sound.

The scope of this research, however, does not extend to investigating, in detail, electroacoustic content in all forms of film/video/multimedia art, experimental film/video/cinema, avant-garde film/video and/or audiovisual performances in real time (to be defined as *experimental non-cinematic time-based audiovisual media* and briefly discussed → p. 31); neither does it extend to investigating electroacoustic content on TV. TV is not cinema according to the definition that will be given; as primarily a real time broadcast medium, aesthetics and techniques used in TV differ not only from program to program, but also from cinematic film to cinematic film in general[9]. Where TV presents electroacoustic content that fits the definition of this research, it often is in form of reruns of films already shown in cinemas.

Excluded from the scope of this research are furthermore acoustic, notated (or notatable) film scores or their electronic emulations with synthesizers (*synth scores*).

This thesis does not provide complete details on all instances of electroacoustic compositional techniques in cinematic film. An exhaustive catalogue of how much electroacoustic content there is in cinematic film is an extensive undertaking, including the necessity to identify and quantify electroacoustic content of every film made.

At this stage, qualitative research is important to explain historical background, effects, and musical examples; a quantitative research may be useful later.

Terminology

Electroacoustic Music

This thesis defines e*lectroacoustic music* as a music that represents the continuation of classical art music into the electronic realm, and that shares a similar compositional aspect and performance culture. It uses sounds that are recorded, synthesized and/or modified, and played back electronically to create sonorities that cannot be produced by an acoustic instrument. It can either be performed by itself, as fixed media, or in conjunction with acoustic instruments.

[9] Michel Chion (Audio-Vision 157) describes sound in television as essentially different than in cinema: “Never offscreen, sound is always there, in its place, and does not need the image to be identified. ”

Electroacoustic Compositional Techniques

In this thesis, the term *electroacoustic compositional techniques* describes methods of sound creation, editing and manipulation, as well as technologies and creative decisions that inform these techniques. The term refers to practical work with sounds, usually in a production environment such as a sound studio, with audio hardware such as tape recorders, mixing desks, loudspeakers, synthesizers, signal processing devices, computers, and others.

A list of historically significant techniques that will be reviewed in this thesis includes

- Tape manipulation: manipulation of the carrier medium of a recorded sound by means of cutting, splicing, reversal, repetition/duplication, looping
- Sound synthesis: artificial sound creation through electrical and electronic devices or processes supported by these
- Use of found sounds (see definition below): recordings 'natural', unperformed sounds
- Signal processing: manipulation of a sound signal, recorded or real time, by means of electrical and electronic components
- Mixing: the intentional combination/superimposition of more than one sound

These techniques can be accomplished with analog and, to the virtually same effect, digital technologies. The term *electroacoustic compositional techniques* may be shortened to *techniques* where this can be done without ambiguity.

Aesthetics of Electroacoustic Music

Electroacoustic music originated as an avant-garde movement in Western Europe during the second quarter of the 20th century. This research uses the term e*lectroacoustic* a*esthetics* to describe sonic idiosyncrasies typical of *electroacoustic music*, either fully or partially, following the above definition and originating from Western music (Europe, USA) and propagated elsewhere. Such aesthetics embraced, and largely continue to embrace, the following:

- Emphasis on (new) timbres
- Non-equal tempered pitch material
- Noise sources
- Non-periodic rhythms
- Artificial creation of sound (synthesis)
- Usage of field recordings/found sounds

For ease of reading, this thesis may use the term 'electroacoustic content' to indicate the presence of 'electroacoustic music', 'electroacoustic compositional techniques' and/or 'electroacoustic aesthetics'.

Found Sounds

This thesis uses the term *found sounds* to describe audio recordings of sounds that are not performed, but are produced without intention; they are a by-product of naturally occurring events. Found sounds can be sounds of nature (animals or elements such as water or air) or of man-made origins (machines, human bodies). Another term commonly used for *found sounds* is 'field recordings'.

Cinematic Film

I use the term *cinematic film* to describe audiovisual creations of (on average) 1.5 – 2.5 hours duration that contain elements of narration and are intended for duplication and commercial distribution via cinemas and retail. In the context of this thesis, works of *cinematic film*:

- are audiovisual creations stored on time-based media (film reel, tape, digital video file);
- are not primarily conceived for scheduled broadcast (TV, internet);
- feature screen characters usually personified by actors, and consist of
- have three phases of production: pre-production (script writing, casting, organisation of production), production (filming), post-production (visual effects creation and picture edit, sound effects creation and sound mix), all of which involve different personnel (often numerous).
- Cinematic films have a synchronized soundtrack: different sonic elements that are usually distinguishable, such as dialog, music, sound effects (SFX), all of which are synchronized to the picture.
- This soundtrack is 'constructed' and designed: sound elements are independently recorded, manipulated and mixed together following an artistic concept that is usually developed and supervised by the sound designer, without the claim to be in any way 'realistic'.
- In the context of the cinematic film, they appear as *onscreen* or *offscreen* (source visible or not) and *diegetic* or *non-diegetic* (related and natural – or not – to what's seen on screen; definition will be provided).

Film Sound

The term *film sound* describes what the audience hears coming from the loudspeakers in a movie theatre during the presentation of a cinematic film. In this research, the term is aimed at a synergetic use, describing all sonic elements used in cinematic film; traditionally these are subdivided into music, dialog and sound effects. In this study, the term *film sound* is preferred to the term 'soundtrack' which can imply a separation of sound elements in a film: it is frequently used to describe an audio recording in album form containing the music of a film ('original soundtrack'). Precise and conclusive definitions of the term 'soundtrack' are rare but available: Jarrett writes that “the term 'soundtrack' is meant literally. It refers to every sound—to the collage of voices, noises, and music—that a movie-going audience hears coming through speakers, not just to a potentially marketable collection of music isolated from the film it accompanied.” (Jarrett 2000)

Aesthetics of Film Sound

In this thesis, the term 'aesthetics of film sound' describes the aesthetic concept based on which sound is created, manipulated and synchronized to the image in a cinematic film. The term 'film sound' implies every sonic aspect of a movie (dialog, sound effects, music) and its relation to the image. Given the disparity of image and sound as media, analyzing film sound for its own inherent aesthetics (and/or elements such as timbre, pitch, rhythm, dynamics, affect) may not yield results for the totality of film (image and sound, story/narrative, production and perception) - the aesthetic analysis of film sound is therefore conducted in the context of the relation of image and sound and the narration. Historical positions are presented in Weis and Belton (1985), specifically in the chapters on *Classical Sound Theory* and *Modern Sound Theory*. Flückiger (2001) and Martin (2010) summarize and update this research by discussing the film sound aesthetics of post-modern film as well.

In order to facilitate the understanding of this term, a brief overview over the history of film sound aesthetics will be presented, followed by a list of aesthetics relevant for this thesis.

Aesthetics of Film Sound in early sound film and classic Hollywood: from 1927

- With the birth of sound film (the ability to record audio directly onto film stock) came the synchronized, naturalistic and literal use of sound in support of the picture
- Undisrupted narrative: the film's time-space continuum is preserved even where sound goes 'against' the image (Martin 2010: 80) (e.g. by playing a sound the source of which is not shown)
- 'Extradiegetic' sounds such as voice-over and film score were established (Langlois 2012: 215). Prevalent even today, the classical film score is acoustic, often orchestral and draws on aesthetics of classic and romantic western music.
- Disney's *Fantasound* roadshow (1940) introduced multichannel sound (→ *Multichannel Sound and Sound Spatialization* p.90); a short-lived experiment with an effects channel located behind (Flückiger 2001: 56) or above the audience failed to establish multichannel sound as a standard largely due to its cost.
- The impact of audible speech caused film makers to call for a contrapuntal use of sound (Eisenstein, Pudovkin and Alexandrov 1985: 84); dialog was often seen as a danger, while noise is not (Claire 1985: 92)
- On the question of film music Adorno and Eisler (1944) stated that “no 8-measure period is truly synchronous with a photographed kiss”[10]. They criticized the standardization of melodic, literal and often *leitmotivic* film music as a “duplication or illustration of the visual track”[11] (Viejo 186) that “consistently comes into conflict with the clinical requirements of film”[12]. Adorno and Eisler advocated aesthetics of dissonance, polyphony (1944: 42) and counterpoint (30) instead, saying that “the more music follows its own aesthetic principles, the more it is adaptable to cinema”[13] (Viejo 2008: 191).

[10]“Keine achttaktige Periode ist wahrhaft synchron mit dem fotografierten Kuss. ”

[11]“En todas y cada una de (las malas costumbres) se relegaba la música de cine a un segundo plano en el que se limitaba a duplicar o ilustrar la acción visual.”

[12] “Die konventionelle Forderung nach Melodie und Wohllautendem gerät aber ständig in Konflikt mit den sachlichen Anforderungen des Films.”

[13] “ . . . la música moderna se adapta mejor al cine cuanto m ás siguiese a sus propios principios estéticos..”

Aesthetics of Film Sound in modern film[14]: from 1960s

- Hand cameras and portable audio recorders moved cinema production from the studio 'on location'. Thus the aesthetics of 'direct sound' gradually replaced the classic practices of post-production (Straub and Huillet 1985: 151)
- Direct sound helped to unlink and liberate sound from the image: sound recording was not bound to camera position and movement anymore, allowing a „ . . . manipulation and difference of the acoustic and the visual"[15] (Martin 2010: 87)
- Thus sound became equal to the image in its importance in film (Bresson 1985: 149)
- In Europe, the *nouvelle vague* aimed to reveal the artificial character of cinema and reflect on its construction within the film (Martin 2010: 88-89)
- The established conventions of traditional film music aesthetics were scrutinized by filmmakers such as Noël Burch (in Weis and Belton 1985: 207) who said that "its predetermined forms, its strong tonal polarities, and its range of relatively homogenous tone colors can provide only an autonomous continuity existing alongside that of the images"; he positively evaluated the use of music that is "an organic and integral part of the overall formal texture" such as Japanese classical music and contemporary Western serial music. Adopting a more radical stance, Andrei Tarkovsky suggests to "renounce all music"[16] in favor of a meticulous organization of sound.

[14] The terms 'modern film' and 'postmodern film' are used in reference to Martin's detailed and thorough overview over the development of film sound aesthetics (2010).

[15] "Letztendlich eröffnete der Direktton den Filmemachern des direct cinema ebenso wie denen des cin éma vérité und der Neuen Wellen die ästhetische Möglichkeit einer Manipulation und Differenz von Akustischem und Visuellem."

[16]"Pour qu'une image cinématographique puisse atteindre tout son volume, il semble préférable, en effet, de renoncer a la musique" (Tarkovsky qtd. in Langlois 2012: 365).

Aesthetics of Film Sound in postmodern film: mid-1970s

- Inspired by the european *nouvelle vague, New Hollywood* started making sound-conscious films (Martin 2010: 91); among the *movie brats* (Flückiger 2001: 13), Walter Murch coined the term *sound designer* and formalized and established an official title and profession for the person in charge of the aesthetic concept of sound in a film
- Multichannel sound was realized with Dolby technology (*Dolby SVA*), enabling sound to become a 'spectacle' in film (Flückiger 2001: 50); its standardization (→ *Table 27* p.94) and sophistication lead to aesthetics of the simultaneous unity and disruption of image and sound: the illusion is both perfected (by enclosing the spectator in the diegesis, through sound) and revealed (by geographically removing sound from image) (Martin 2010: 97)
- Where previously the image was dominant or of equal status, sound now held a certain power over the image in that it could “create” images (Martin 2010: 93 f.) by manifesting in sound what the spectator will see later[17]
- The *confrontation and consolidation of classical and modern aesthetics of (film) sound*[18] *(Martin 2010: 210)* ultimately allowed filmmakers to place sound in a dialectic relation with the image where it can at the same time synchronize to, disrupt and dominate the image

[17] As an example, Martin (2010: 93) describes the opening scene of Star Wars, where a spaceship can be heard long before it appears on the screen. Through the use of multichannel sound, the spatialization is 'naturalistic' - the spaceship comes from behind and flies 'over' the spectators onto the screen.

[18] “Dabei rückt der postmoderne Film nicht nur das Akustische in den Vordergrund, sondern deutet auch an, was der Film der Zweiten Moderne weiterführt, nämlich die Konfrontation und Zusammenführung von klassischer und moderner Tonästhetik.”

Aesthetics of film sound supported by electroacoustic content

This thesis focuses on aesthetics of film sound that are exclusively or partly created, supported and/or suggested by electroacoustic content. In an approximate order of frequency of occurrence with electroacoustic content, these include:

- **Acousmêtre**: The term's author Michel Chion (1994: 129) describes as *acousmêtre* the voice of a primarily invisible screen character that can be omniscient, omnipresent and omnipotent. In the context of this investigation, the concept of *acousmêtre* will be broadened to illustrate manifestations - through sound - of a person, an object or abstract phenomena such as memories or imaginations.
- **Subjectivization** suggests an individual (listening) perspective, rather than a global, omniscient point of view. *Subjectivizations* are the acoustic equivalent to the POV (point of view) shot (Flückiger 2001: 362).
- **Counterpoint** describes a use of sound that is 'dissonant' (in relation to the image: image and sound differ in expression, aesthetics or character), non-naturalistic and/or asynchronous (image and sound do not occur at the same moment in the fiction) (Eisenstein, Pudovkin and Alexandrov 1985: 84).
- **Dominance shift**: sound dominates the narrative over the image: crucial information comes from the soundtrack, e.g. by telling the story or foreshadowing story events (Martin 2010: 93).
- **Spectacle:** the complete exhaustion of the technological possibilities of sound through the production and playback of complex and dynamic sound mixes with a large number of sounds of different timbres, frequency ranges and levels is described as a *spectacle* by Flückiger (2001: 13).
- **Stylization and standardization:** the continuous repetition of similar sounds and sonorities in different films creates stereotypes, while leading to a decline of creativity in film sound production (Flückiger 2001: 119). Such sounds include punches and gunshots, but also the use of the *Theremin* in sci-fi films.

- **Playing the action** is film sound that is noticeable as a mix of naturalistic sound effects and speech, and film music that synchronizes and corresponds to visible or otherwise obvious events, emotions and movements in rhythm, harmony, melody, timbre and instrumentation.
- **Mickey Mousing** is a term that stems from the use of music in animated cartoons. It describes the exact matching of film sound (usually music) to visual movement in film action (Bordwell and Thompson 1985: 189), usually with a comical effect. *Mickey Mousing* is an exaggeration of *playing the action.*

Sound Design

The term *Sound design* describes the conceptual and technical structure applied to mix, edit and combine all elements of film sound. It includes technical and aesthetic decisions made as to what sounds can be heard, how loud they are, how they are synchronized and where they are played in a spatialized sound field of two or more channels (surround sound)[19].

[19] "The tasks of the sound designer include the development of a master plan for the film's sound in the areas of dialog and effects, the communication with the composer, the creation of single sounds and their mixing, as well as the coordination of work flow and objectives of different departments, including foley and dubbing." ("Die Tätigkeit des Sound Designers umfasst die Erarbeitung eines tonästhetischen Gesamtkonzepts für die Bereichen Sprache und Geräusche, der Kommunikation mit dem Komponisten, die Kreation von einzelnen Klängen und ihre Montage sowie die Koordination von Arbeitsprozessen und -zielen der verschiedenen Abteilungen inklusive Geräuschemacher und Nachsynchronisation") (Flückiger 2001: 18). "While Walter Murch initially conceived the term to describe the way he "hung" sound in the theatrical environment, its range of meanings expanded as it was taken up by other sound artists and by the popular press. Sound design also came to represent the design of specific sound effects (laser blasts and rumbling spacecraft), which were often achieved through innovative recording and editing techniques." (Whittington 2007: 95)

Onscreen/Offscreen and Diegetic/Non-Diegetic

Among various efforts to classify sounds in cinematic film (Chion 1994, Bordwell 2010), these four terms are, arguably, among the ones most widely used. They describe the relation of sounds to objects on the screen that may or may not be their source[20]. Chion (1994: 73) provides comprehensive and detailed definitions[21].

Onscreen and *offscreen*: Sounds whose source is visible on the screen are *onscreen*; sounds whose source is invisible are *offscreen*.

Diegetic and *non-diegetic:* Diegetic sounds belong to the time/space construct (the 'story') of the film. Their source has the potential to be visible, and the audience reasonably believes that screen characters can hear such sounds. They are *onscreen* or *offscreen*. *Non-diegetic* sounds do not belong to this construct, and for this reason are neither *on-* nor *offscreen* – they have no potential for a physical relation with objects on the screen.

Commonly, dialog is *diegetic* and mostly *onscreen*. Sound effects are *diegetic* and *onscreen*, but also often *offscreen*. The most common elements of *non-diegetic* sound in cinematic film are the traditional film score and the narrator (voice-over).

[20] They do **not** inform their placement on a certain speaker in a stereophonic speaker setup (→ *Multichannel Sound and Sound Spatialization* p.90).

[21] This thesis and other research works suggest that definitions of *diegetic* and *non-diegetic* are not absolute; in fact, employing electroacoustic content in cinematic film has caused them to be revised. I will discuss this later (→ 2.5 *Findings* p.96).

Electroacoustic Content in Contemporary Cinema

Electroacoustic techniques have become common tools in designing and creating film sound. Applied to all elements of film sound – not only music - they have greatly informed the creation and manipulation of the film's *diegetic* and *non-diegetic* sound elements. Great potential for film sound aesthetics and perception comes from the work of *musique concrète* founder Pierre Schaeffer (1910-1995) and specifically his concepts of the *sound object* and *reduced listening.* In recognizing and appreciating a musical potential in any sound, and shifting the listening focus from cause or meaning to the physical parameters of it, sounds in film experience a new 'freedom' from the restriction to a certain function ('dialog') or origin ('car moving left to right'), or any relation to the image at all.

Techniques of sound spatialization, pioneered by composers such as Karlheinz Stockhausen (1928-2007) and Edgar Varèse (1883-1965), have informed cinema surround sound formats such as *Dolby Stereo* (1976) and *Dolby Atmos* (2012). Multichannel sound in cinema not only provides for a more immersive experience for the audience; techniques of spatialization have also promoted a diversification of film sound in allowing the co-existence of sounds of similar frequencies and amplitudes in different spaces without masking each other.

Electroacoustic aesthetics and techniques uniquely support a cohesive sound montage that melts the traditional separation of dialog, music and sound effects. Sounds have become equal in their potential for cinematic film. Importantly, the cinema has always been a place where sound can be listened to in high quality. “For much of its history, the motion picture theater offered sound equal or superior to that heard anywhere” (Handzo).

Experimental Non-Cinematic Time-Based Audiovisual Media

Experimental non-cinematic time-based audiovisual media is an umbrella term, used in this thesis to distinguish art forms "situated between fine arts and cinema"[22] from cinematic film. The term comprises mainly artistic forms of audiovisual creations for which a number of different terms exist, such as video art, film art, experimental TV, experimental film, experimental video, avant-garde film or avant-garde video. Although not cinematic film as per the previous definition, and not the focus of this research, brief attention will be given to works that intersect with or pioneer electroacoustic compositional techniques and aesthetics mentioned in this thesis.

> What specifically marks video art, compared to film and television? This question motivates many a critical discussion these days, but to my knowledge no response has truly been formulated.[23] (Chion 1994: 161)

Although 'video art' and other genres of e*xperimental non-cinematic time-based audiovisual media* are difficult to describe in a general manner, some comparison with cinematic film can be made. Commonalities can include the production and output medium (time-based, film); the fact that they are audiovisual productions (with a dedicated audio portion synchronized to the image); an overlap of personnel (the avant-garde composers Louis and Bebe Barron or the filmmaker David Lynch are known to have worked on and produced a number of 'art films'); and the use of some electroacoustic compositional techniques and aesthetics on their film sound.

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[22] " . . . an art form situated between fine arts and cinema (the industry), whose various terms try to qualify it refer to a part or the whole of the genre: pure cinema, absolute cinema, art cinema, underground cinema . . . " (" . . . un art situe a mi chemin entre les arts plastiques et le cinema en tant qu'industrie et dont les nombreux termes pour tenter de le qualifier désignent tout ou partie de ce genre: cinema pur, cinema absolu, cinema d'art, cinema underground . . . ") (Langlois 2012: 387)

[23] "Video artists themselves are in no hurry to define the specific nature of video, which of course is their right. They often work with live feeds, participating in the spectacular and performative aspects of the medium. Alternatively they may produce tapes that more closely resemble films (except the circulation of these tapes is not as strongly codified as film screenings usually are)." (Chion 1994: 161)

Such media, however, differ radically from cinematic film in their conditions of production (individual artists vs. production companies) and distribution (galleries/curators vs. distributors). While in cinematic film, the production process follows established patterns of organization and structure, the creation of video art or experimental film lends itself to a more non-linear and intuitive development of ideas.

Another potential difference is the presentation medium: cinematic film is always presented on one screen, either in a movie theatre or at home. *Experimental non-cinematic time-based audiovisual media* are not limited to one screen in a fixed setting, but can be displayed on a number of screens, displays or walls; in a variety of spaces; and on a variety of media. Rather than filling an existing, established watching and listening environment, a new context, often as an art installation[24] is created. Michel Chion suggests that here, the image itself is movement, while in cinematic film the movement happens within the image.[25]

The sound of this type of audiovisual production is diverse and does not always follow a common format; it can and often does include electroacoustic content. Moreover, the absence of aesthetic and budgetary control through a production apparatus favors an experimental approach, often resulting in creative and progressive ways of employing sound. Sounds can be recorded along with the picture (the recorded soundtrack of an original video recording) or independently produced.

Examples

Following is a summary of selected works of *experimental non-cinematic time-based audiovisual media* that employ electroacoustic techniques that will be discussed in this thesis. They will be introduced in the order of the appearance of the technique in this thesis.

[24] This also leads to a higher difficulty to access, archive and research such media. Art installations cannot be copied and distributed as cinematic film is. Research therefore often depends on secondary resources.

[25] "At the risk of oversimplifying, let us therefore say that film may have the movement in the image, such movement is one of its defining dimensions, one that can enter into dialogue and debate with the others; while, perhaps because of its nature, the video image in itself, born from scanning, is pure movement: a movement that is more prone to visual verbiage, since it has no inertia to combat." (Chion 1994: 162)

Dots (experimental animation short, 1940) is an early work by Scottish visual artist Norman McLaren. McLaren is known to be one of the protagonists of *optical synthesis* (→ p.35), a technique of synthesizing sound by painting directly on the film reel, frame by frame: like the image, sound is animated. Another, if earlier, animation is *L'Idee, realized* by Berthold Bartosch in 1932. The music for *L'Idee* (English: *The Idea*) was composed by Arthur Honegger and features the *Ondes Martenot*, an early instrument of *electronic synthesis* (→ p.38), in what is considered by some the first appearance of an instrument of electronic synthesis on film.

Of importance for this thesis is the work of Bebe and Louis Barron, avant-garde musicians who experimented with sound-producing electronic *handmade circuits* (→ p.55). Their music was first heard on film in *Bells of Atlantis* (1952), an experimental short film by Ian Hugo. Released two years before *Bells of Atlantis*, *Maskerage* (1950) is an experimental short film by Dutch filmmaker Max de Haas, the sound of which consists of original music from Pierre Schaeffer, founder and protagonist of *musique concrète*. Maskerage is an early example for *tape manipulation* (→ p.60) where found sounds are cut and spliced, sped up and slowed down, and reversed. More recent is the experimental animation *In Absentia* (2000). A collaboration of filmmakers Stephen and Timothy Quay (UK) and Karlheinz Stockhausen, *In Absentia* features synthesized sounds and voice recordings that were manipulated by techniques of *signal processing* (→ p.79).

Examples *Experimental Non-Cinematic Time-Based Audiovisual Media*
Dots (1940 UK/USA, Dir. Norman McLaren)[26]
L'Idee (1932 France, Dir. Berthold Bartosch, Mus. Arthur Honegger)[27]
Bells of Atlantis (1952 USA, Dir. Ian Hugo, Mus. Louis and Bebe Barron)[28]
Maskerage (1950 Netherlands, Dir. Max de Haas, Mus. Pierre Schaeffer)[29]
In Absentia (2000 UK, Dir. Quay Brothers, Mus. Karlheinz Stockhausen)[30]

Table 6: Examples Experimental Non-Cinematic Time-Based Audiovisual Media

[26] James 1986: 84
[27] Langlois 2012: 111
[28] Holmes 2012: 104
[29] Langlois 2012: 259
[30] Quay and Quay 2000

TECHNIQUES AND AESTHETICS

2.1 Synthesis

Sound synthesis is the artificial creation of sound. Its history and development is closely related to the history of cinema and electroacoustic music. Synthesis is the result of collaborations between musicians and scientists; its novelty lies in quantifiable control over amplitude, pitch, duration, timbre and (depending on device) the possibility for a single person to simultaneously produce several different tones and voices. Most importantly, synthesis allows the creation of entirely new timbres. From its early forms onwards, synthesized sound has frequently been used in cinematic film.

Background: aesthetic and technological contexts of early sound synthesis

Efforts to produce sounds artificially have come from different directions, motivations and contexts. Italian painter Luigi Russolo (1885-1947) spearheaded the Italian Futurism movement that called for the "freeing of music from its tonal prison" (Holmes 2012: 15) for the benefit of integrating ambient sounds and noises into music. This was partly achieved with the *Intonarumori* – mechanical devices designed to produce different sounds, a first concert of which was given in 1914. Edgar Varèse was aware of these 'noise machines' when he included sirens in otherwise instrumental music in pieces such as *Amériques* (premiered in 1926).

Already in 1906, Thaddeus Cahill (1867-1934) had given concerts with his *Telharmonium*, considered by many the first instrument of *electronic synthesis*[31]; with this, he laid the foundation for electronic instruments such as the *Theremin* and the *Hammond Novachord*, forerunners of modern synthesizers. A few years after the *Telharmonium*, the predecessor for recording audio on film (*sound-on-film*) led to experiments with *optical synthesis*, the artificial creation of sound through optical and electrical processes. The discussion of electroacoustic aesthetics and compositional techniques in cinematic film in this thesis will begin with this technique.

[31] Interestingly, early synthesis did not trigger new compositions; in its infancy, it was mainly used to play existing, usually classical music. Possible reasons for this will be discussed later (→ 2.5 *Findings* p.96).

Aesthetics of Sound *Synthesis* in Cinematic Film

Extending the range of sounds commonly accepted as 'music', early synthesized sounds introduced new timbres to the existing musical literature. Their function in cinematic film could be, as a start, to surprise and awe; and the more these sounds were used, the better they became integrated with the film narrative, its protagonists and other elements. Artificial sounds engaged with each other and with the picture, thus starting to form an organic network. Under certain circumstances, such artificial 'music' established closer relationships than violins and trumpets could possibly do: the 'artificial' was accepted as 'natural' in the fictional context of a film.

Over time and in often exceptional cases, synthesized sounds were not recognizable or identifiable anymore: while the early *Theremin* had sounded like a 'strange' instrument (but an instrument nevertheless) in films of the 1940s, the 'electronic tonalities' in the film *Forbidden Planet* (1956) could not be attributed to a source of music; yet, they were music. Sound synthesis obscured the process of sound creation. The keen listener would not only ask 'What sound is this?'; she or he might also want to know 'Who makes this sound? With what device? How complex is the production of this sound?', attempting to find the answer through the only means momentarily possible: listening. By obscuring its source, sound transformed from being a vehicle for expression to being expression itself.

Optical Synthesis (non-real time)

Optical synthesis (also known as *drawn sound* or *animated sound*) is an early form of sound synthesis allowing the artificial creation of sounds by means of drawing graphical representations of sound waves and photographing them onto film as black and white patterns. Its importance for this thesis stems from its contributions to the aesthetics of synthesized sound, the possibility of exact synchronization of sound and image and a strong awareness of the relation of sound to image and vice versa (Langlois 2012: 144).

Background: Optical Sound Recording

Recording sound on film became possible after efforts by different groups of people in Germany, France and the USA[32]. Generally credited as the most important figure in its invention is the American Lee De Forest (1873-1961), whose *Phonofilm* was released in 1919 (Holmes 2012: 44).

Sound is recorded onto film in various stages (→ Fig. 1). First, a microphone converts sound (minute changes in air pressure) into electricity. The resulting electrical current controls the position of (and therefore the opening between) two small ribbons. Light shines through this opening and is exposed (in varying width) on a photographic film that runs by it. A higher level of air pressure on the microphones results in a higher amplitude of electrical current, a larger opening between the ribbons and consequently a larger area of exposure. Changing instantly, the graphical pattern resembles the modern waveform. The playback process reverses this chain of events: light shines through the exposed film, resulting in a varying signal (more light where more film has been exposed and vice versa). A photocell converts the varying light into an electrical current which is amplified and, by means of a loudspeaker, converted to sound.[33]

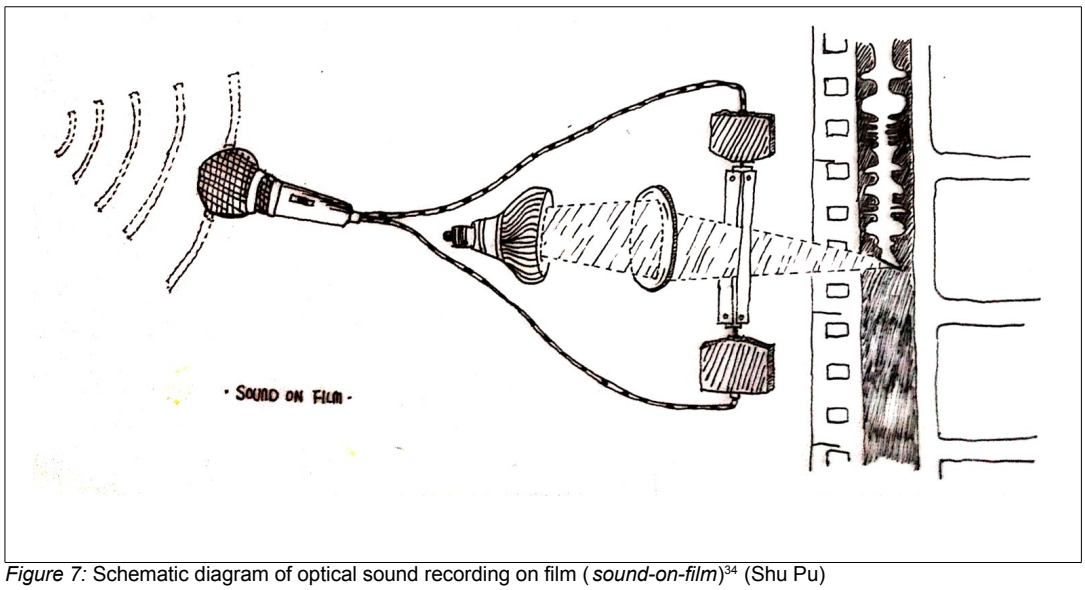

Figure 7: Schematic diagram of optical sound recording on film (*sound-on-film*)[34] (Shu Pu)

[32] Flückiger (2001: 30) provides a detailed overview on the development of sound in film, while Douglas Gomery (1985) gives a very detailed account of its licensing and patenting history.

[33] This type of exposure, where the resulting pattern is a waveform, is called a *variable area*. Another method, based on the same principle, is called *variable density*, where different densities of black/white color on a greyscale represent the amplitude of a sound, rather than the area exposed.

[34] Sound Recording and Reproduction (Sound on Film), James 1986: 76, Langlois 2012: 145

From Sound-on-Film to Optical Synthesis

Langlois (2012: 146) describes in a practical example the principle of optical synthesis: when a grain of dust is on a film reel, a click will be heard over the loudspeakers. This click is produced optically: a photocell reads a momentary change of light on the film, resulting in a spike on the electrical current controlling the speaker output. An optical phenomenon becomes audible: this is the basic idea of *optical synthesis*.

Intrigued by this phenomenon, visual artists first scratched and drew, and later photographed large-size designs directly onto the film. One second of film was created by drawing and/or photographing several lengths of 'sound' – an intense workload simplified partly by using pre-fabricated templates. Optical synthesis is also called d*rawn* or a*nimated* sound: like a visual animation, its production takes place frame by frame, and is not done in real time. The advantage of this tedious production process is control over time at a level of precision that “cannot be achieved by musical instruments that are operated by hand.”[35]

While the pioneers of *optical synthesis* – Oskar Fischinger (Germany 1900-1967), Yevgeny Alexandrovitch Sholpo (Russia 1891-1951) and others – used it to mainly re-arrange, emulate and synthesise existing classical music (Langlois 2012: 155), the technique was further developed by artists such as the brothers John (1917-1995) and James (1921-1982) Whitney (USA) and Norman McLaren (UK 1914-1987). They propagated a new aesthetic that included non-periodic patterns of sound, making use of the large potential of *optical synthesis* for timbre creation. With this, they laid the groundwork for later techniques of electronic synthesis and tape manipulation.

The principle of *optical synthesis* has inspired devices of synthesis such as the British *Oramics*, the Russian *Variaphone* and the Russian *ANS.* Among these three, the *ANS*'s contributions to cinematic film stand out and will be discussed in this thesis (6.1.2 *ANS*).

[35] „Ausserdem lässt sich eine solche Exaktheit der Takte bei den von Hand bedienten Musikinstrumenten nicht erreichen.” (Pfenninger 1932)

	Examples Optical Synthesis
Film	*Tönende Handschrift* (1931 Germany, Rudolf Pfenninger)[36] *Ornament Sound Experiments* (1932 Germany, Oskar Fischinger)[37] *Five Film Exercises* (1944 USA, The Whitney Brothers)[38] *Blinkity-Blank* (1954 Canada, Norman McLaren)[39]

Table 8: Examples Optical Synthesis

Electronic Synthesis

Electronic synthesis describes the artificial creation of sound by electronic means in real time. Often realized with prefabricated, ready-made *electronic instruments* or *synthesizers* that usually feature interfaces for note creation (control over pitch, amplitude and time via keyboard) and timbre (knobs and faders), *electronic synthesis* is based on the principle of managing and manipulating electrical current. Timbre is achieved by adding or subtracting overtones to or from a fundamental frequency or noise source.

Synthesizers commonly emulate acoustic instrumental music, being played like an acoustic instrument (keyboard, wind controller). The distinctiveness of each device lies in its multi-timbral (and at times polyphonic) possibilities. Film music that imitates acoustic instrumental music with synthesizers is commonly known as *synth scores*.

Only a small part of the music created by instruments of electronic synthesis can be considered electroacoustic by the earlier definition. Those representing pioneering applications of electroacoustic content in cinematic film will be discussed here.
They play a major role in the history of film sound and especially electroacoustic content in film. Appearing in significant films, they have been shaping aesthetics of film sound simultaneous to the evolution of electronic synthesis.

[36]Langlois 2012: 150, James 1986: 84

[37]Langlois 2012: 156

[38]Langlois 2012: 166

[39]Langlois 2012: 175, James 1986: 84

Background: early sound synthesis

One of the earliest instruments of electronic synthesis is the aforementioned *Telharmonium*[40], a large, stationary apparatus capable of producing polyphonic[41] music that its inventor Thaddeus Cahill first patented in 1895. Since the instrument was practically immovable, and recording and playback technologies were in their infancy, Cahill's (largely unsuccessful) plan was to transmit music over the telephone network.

Around the same time, American inventor Lee De Forest's (1873-1961) invention of the vacuum tube in 1907 (Holmes 2012: 18) laid the foundation for signal amplification, resulting in the appearance of a number of instruments of electronic synthesis about 20 years after the *Telharmonium.* From the late 1920s onward, the *Theremin*, the *Trautonium*, the *Ondes Martenot*, and the *Hammond Novachord* – to different degrees performed on and written for after their invention – at the time also featured in cinematic film, as will be discussed on the following pages. Electronic synthesis evolved from these early instruments through more experimental stages (→ *Handmade Circuit Building* p.55) to commercially mass-produced *synthesizers* as they are known today.

Theremin

Arguably the most famous early device to synthesize sound electronically is the *Theremin*. It was used in numerous films, predominantly in the 1940s and 1950s; a large number of these films belong to the science fiction genre. Re-built by synthesizer manufacturer Robert Moog (1934 – 2005) in 1948 and released later, the *Theremin* is still produced today.

The monophonic *Theremin* was invented by the Russian Léon Theremin (1896-1993)[42]. Also known as *Aetherophone*, it is played 'through the air' – with one or two hands, avoiding any physical contact – making it possibly the first electronic instrument (Holmes 2012: 26) controlled by gesture.

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[40] Patented in 1895, the *Telharmonium* was presented to the public and 'operational' between 1900 and 1908. No recordings of it exist (Holmes 2012: 8, 12). The *Telharmonium* used the *tone wheel* technology where the frequency of an electrical signal was varied by means of rotating a jagged disk by it; each bump in the disk changes the electrical signal, so that the frequency changes according to the number of bumps and the speed at which they pass by the coil.

[41] Capable of playing two or more notes at the same time

[42] Lev Sergeyevich Termen (Ле́в Серге́евич Терме́н)

Two antennas sense the performer's hand position in mid-air, controlling pitch and volume. Performers act as a ground in an electronic circuit, with their hands varying the frequency of one or two oscillators[43].

The *Theremin* was patented in 1920 in Moscow and 1927 in New York; it started appearing in film scores in the early 1930s in Russian productions such as *Odna* (Soviet Union 1931) – according to Langlois (2012: 102) the first Soviet sound film – and *Komsomol* (GDR/Soviet Union 1932). Its most prominent appearances in cinematic film took place in the 1940s and 1950s in Hollywood films such as *Spellbound* (1945) and *The Day The Earth Stood Still* (1951). Albert Glinsky, author of "Theremin: Ether music and Espionage" writes:

> In the infancy of sound film just after its first gurgles and cries in the late '20s, Soviet composers began to discover the instrument. For underscoring scenes of mystery, terror, of the macabre, its tumultuous, disembodied electronic howl was irresistible . . . With Robert E. Dolan's 1944 score for "Lady in the Dark", the Theremin arrived in Hollywood and began to inch closer to the psychological foreground in motion picture soundtracks. (Glinsky 2000: 253)

In most cases integrated in the otherwise acoustic, orchestral film score, the *Theremin* was appreciated for its 'eerie' sounds and ability to suggest to the audience dark, sinister features in a screen character. Its music would be called "music of the spheres", "voice of ether", "air music" or music from "elsewhere" (Langlois 2012: 102); its 'second' name *Aetherophone* suggested the creation of sound out of air, and contributed to the somewhat mystical character of the device[44].

Miklós Rózsa, Hollywood film score composer who often worked with Samuel Hoffman, a popular *Theremin* instrumentalist of the time, wrote the music for *The Lost Weekend* (1945), a film about an alcoholic. The score "evoked just the right psychological aura. Hoffmann was called in again to coax Rózsa's morbid, pathological undertones from the *Theremin*. In the intense score, the instrument became, in Rózsa's words, 'the official "voice" of dipsomania'"(Glinsky 2000: 255).

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[43] The *Theremin* operates by beat-frequency (heterodyne) technology. Two signals oscillate – one at a fixed frequency, while the other is determined by the distance of hand to antenna. The difference between these two frequencies results in pitch or amplitude of the *Theremin*.

[44] "In short, Theremin's name for his invention suggested an otherworldly origin despite its sound basis in material reality." (Schmidt 2010: 29)

Its suitability for films of suspense and thrill paved the way for the *Theremin's* usage in science fiction films; the instrument soon

> (…) emerged as the hallmark of alien space creatures and ghoulish acts. The trend began in 1950 with Ferde Grofé's score for "Rocketship X-M", where the composer used Hoffmann's skills to paint a Martian landscape beheld by a team of space scientists. Bernard Herrmann's classic 1951 score for "The Day the Earth Stood Still" made the Theremin's whine and buzz the undertone for the menacing arrival of a flying saucer and its inhabitant… (Glinsky 2000: 286)

While the instrument quickly became overused as the signature sound for aliens, ghosts and deranged states of mind, *The Day The Earth Stood Still* marks a unique occurrence. Carefully integrated into the orchestral film score, yet recognizable as an independent sonic element, the *Theremin* emphasizes and deepens the narrative of human's first encounter with extraterrestrials.

The Day The Earth Stood Still (1951)

The alien robot emerges from the spaceship, only moments after its humanoid (but nonetheless alien) passenger has been injured by (human) soldiers. In an atonal sonority brass, strings and the *Theremin* play sustained notes, low in pitch and almost monophonic, in a regular rhythmic pattern; the *Theremin* can be clearly distinguished through its characteristic tremolo and glissando. Interval pairs of 4ths and 5ths of dissonant relation rise in pitch as the robot descends the spaceship gangway, with most of the human crowd dispersing hysterically. As the gangway folds back into the ship and the robot surveys the situation while opening his visor, these intervals fall back to a lower pitch range.

At first viewing, the music supports the image by *playing the action*: an alien machine (atonal sonorities in low registers) threatens to attack (the music moves from low to high register, before falling back to low register: initial shock and subsequent relief). Among the instruments heard, the *Theremin* stands out because of its tremolo and glissando: while other instruments 'jump' from note to note, the *Theremin* 'glides' almost gracefully. Paradoxically, such irregular, 'human' expressions of music are usually associated with neither machines nor electronic music; yet it is precisely the 'human' quality of the timbre that identifies the robot as alien, and the music as electroacoustic (were it not for the tremolo and the glissandi, the *Theremin* would stand out less among the acoustic instruments). The sound of the *Theremin* therefore cautiously transcends its role as extradiegetic film music as if entering the screen along with the alien robot.

This ambiguous relation between sound and image is, in the author's opinion, the capital strength of electroacoustic content in film. *The Day The Earth Stood Still* shows a classical aesthetic in early cinematic film that benefits from the (in musical composition and integration with the orchestra) well-directed use of an instrument of electronic synthesis. Later and lesser known films have contributed to a standardization of the *Theremin* sound, relying solely on its iconic tremolo to inform the audience of the imminent appearance of an alien force.

The *Theremin's* 'futuristic' sound also became widely known in popular culture[45], where new technology was met with curiosity (and not necessarily the demand for new, avant-garde music (→ 2.5 *Findings* p.96). The *Theremin* was “(…) associated with the popular sensibility that technology was transforming society in ways that were unprecedented” (Schmidt 2010: 28).

While the music of the *Theremin* is rarely electroacoustic according to the provided definition, the instrument deserves mention in this research. As the first instrument of electronic synthesis to appear in a large number of films, it has expanded notions of what could be considered part of the sound world understood aesthetically as 'music'. Its ability to represent an 'otherness' (to be the aforementioned voice of, for example, a psychological condition) may furthermore be seen as an early example for the aesthetic concept of *subjectivization* – the focussing of the film's narrative on the perspective of a single screen character through sound and image. The *Theremin* has thus opened the gates for future occurrences of electroacoustic content in cinematic film.

	Examples *Theremin*
Film	*Odna* (1931 Soviet Union, Grigori Kozintsev, Leonid Trauberg)[46]
	Komsomol (1932 Soviet Union/East Germany, Joris Ivens)[47]
	The Lost Weekend (1945 USA, Billy Wilder)[48]
	Spellbound (1945 USA, Alfred Hitchcock)[49]
	The Day the Earth Stood Still (1951 USA, Robert Wise)[50]

Table 9: Examples *Theremin*

[45] The *Theremin* has been frequently used in popular music by bands such as *The Beach Boys* and *Air*; it is still manufactured and performed on today.

[46] Langlois 2012: 102

[47] Glinsky 2000: 253

[48] Holmes 2012: 25, Langlois 2012: 129

[49] Holmes 2012: 24, Langlois 2012: 129

[50] Holmes 2012: 25

Ondes Martenot

The monophonic *Ondes Martenot* was developed by the French Maurice Martenot (1898-1980) in 1928. It is similar to the *Theremin* in that it uses the same technology (beat-frequency). Different, however, is its design and playability: operated with the right hand, a ring slider can be moved horizontally over the drawing of a keyboard, allowing microtonal glissandi along the pitches of the virtual keyboard. The left hand controls amplitude with a pressure-sensitive pad. Later versions of the *Ondes Martenot* introduced left-hand timbral controls, a real keyboard and knee or foot pedals for amplitude. Since its invention, the instrument has been used in art music and popular music. Arguably the most famous contemporary 'ondiste'[51], Thomas Bloch, is performing and recording worldwide.

The *Ondes Martenot* appears on film soundtracks from the early 1930s. While not as popular as the *Theremin*, it has been used on a number of famous films, among them *The Ten Commandments* (1956) and *Lawrence of Arabia* (1962). Significantly, one of its earliest appearances in cinematic film is not a film score, but a sound effect: in *La fin du monde* (1931) it blends in with recordings of a storm, adding a high frequency component to it.

	Examples *Ondes Martenot*
Electroacoustic Music	*Song of the Second Moon* (1957, Dick Raaijmakers, Tom Dissevelt)[52]
Film	*La fin du monde* (1931 France, Abel Gance)[53]
	The Ten Commandments (1956 USA, Cecil B. DeMille)
	Lawrence of Arabia (1962 UK, David Lean)[54]
	Ghostbusters (1984 USA, Ivan Reitman)[55]

Table 10: Examples *Ondes Martenot*

[51] The name *Ondes Martenot* is French (from 'ondes' = waves). It was originally called *Ondes Musicales* ('Musical Waves'). Players of the instrument are therefore called 'ondistes' in French. Different composers wrote music for the *Ondes Martenot*, among them Olivier Messiaen whose works written for the *Ondes Martenot* include: *Fête des belles eaux* (1937), *Trois petites liturgies de la presence divine* (1943-44), *Turangalila* (1946-48), *Feuillets inédits* (date of composition unknown, published 2001*).*

[52] Holmes 2012: 458

[53] Langlois 2012: 108

[54] "Lawrence of Arabia", "Wavemakers - International Film Festival Rotterdam"

[55] "Ondes Martenot"

Trautonium

Developed by the German Friedrich Trautwein (1888-1956) in collaboration with German composer Paul Hindemith (1895-1963) in Berlin from 1928 - 1930[56], the *Trautonium*, and especially its later model, the *Mixtur-Trautonium*[57], differs from the *Theremin* and the *Ondes Martenot* in featuring complex timbral controls. The amplitude of harmonics to their root frequency could be controlled, making the device an early example for subtractive synthesis (Holmes 2012: 33, Mackay 1981: 18). In cinematic film, the *Trautonium's* appearances are rare but significant, as in Alfred Hitchcock's (1899-1980) *The Birds* (1963).

On the *Trautonium's* interface, a wire runs a few millimeters above a plate; when the performer's hand causes the two to touch, an electronic circuit closes and produces current in a neon-tube oscillator which in turn generates a tone. Pressing down the wire on different positions of the plate produces tones of different frequencies, allowing glissando movement and tremolo. Amplitude of these tones is controlled by a foot pedal. The initially monophonic[58] *Trautonium* produced a sawtooth waveform

> . . . that was rich in harmonic sidebands. This waveform distinguished the sound of the Trautonium from that of the Theremin and Ondes Martenot, both of which used a beat frequency technology and produced waveforms with fewer harmonics. To take advantage of this unique characteristic of the neon-tube oscillators, Trautwein devised a set of filters, controlled by rotary dials, to adjust the amplitude of the harmonics in relation to the fundamental tone being played. This was an early experiment with subtractive synthesis – the careful reduction of sidebands to produce timbral changes in tone color. (Holmes 2012: 33)

[56] Hindemith wrote extensively for 'his' invention: “Hindemith's Concertino for Trautonium and Strings, written in 1931, is the earliest of full-scale works for the new electronic instruments, showing how its composer had an approach to composition which not only included respect for traditions of craftsmanship for which he is well known but also welcomed the new (something also seen in his experiments with variable-speed gramophone turntables).” (Mackay 1981: 64). The most prominent figure in the later stages of the instrument is Oskar Sala (1910 – 2002), who became the most famous composer and performer on the *Trautonium*, continuing performance and work on the instrument until his death in 2002. The *Trautonium* was also produced for home use by German electronics manufacturer Telefunken in 1932.

[57] Developed in 1952, the *Mixtur-Trautonium* could play six different combinations of waveforms generated by the oscillators.

[58] A second wire was added in 1934 to allow for two voices to be played simultaneously.

Originally conceived for the performance and recording of concert music, Oskar Sala's studio "soon became known as the solution for particularly difficult issues of image and sound synchronization".[59]

***Stürme über dem Montblanc* (1930)**

The instrument's use in the film *Stürme über dem Montblanc* (1930) - 26 years before „Forbidden Planet" - is one of the earliest appearances of an electroacoustic technique used to create a *diegetic* element of film sound (and not for *non-diegetic* film music): sounds of an airplane were produced by the *Trautonium*. Less sophisticated than the instrument's prominent and much discussed appearance in Hitchcock's *The Birds, Stürme über dem Montblanc* nevertheless marks a pioneering effort in the history of both cinematic film and the *Trautonium*. One particular scene of the film illustrates its importance.

In this scene, a man is shown sitting on a mountain top smoking a pipe; an airplane is heard approaching and the man turns his head to search for it. He gets up and waves at the plane which passes by close to him. As the man continues to look at the plane, its engine fails: the propeller and the engine sound stop.

The airplane motor sound is heard as a sustained note around roughly 230 Hz (plus harmonics) produced by the *Trautonium* (Deutsches Museum). Irregular fluctuations in frequency and dynamics roughly correspond to changing perspectives and distances between camera and airplane, and suggest that the instrument was manipulated in realtime. The choice of electronic synthesis as a substitution for a recording is plausible, given the fact that recording an airplane engine requires resources and technology that in the 1930s were difficult to come by (audio recordings were restricted to studio environments and the instrument's proximity to a mechanical horn).

As the engine fails, the sound stops abruptly and the spectator is left in complete silence. Given the visual context, the spectator might expect sounds like propeller fluttering, engine rattling or wind. The silence reveals the artificial character of the construction: the engine itself is heard, but sounds that are normally masked by the engine are ignored.

[59] „ . . . und bald wurde mein Studio bekannt für die Lösung besonders schwieriger Ton-Bild-Synchronprobleme." (Sala in Weck 2010)

While disappointing the listener, this 'logic error' becomes a 'Freudian slip' as the rather crude imitation of an airplane sound has been convincing until its absence.

The Birds (1963)

References to other occurrences of the instrument in cinematic film are rare, insufficiently documented and difficult to verify; Holmes (2012: 34) mentions the instrument's use in film scores but does not specify movie titles; Donhauser[60] claims that the *Trautonium* can be heard in over 300 films, among them *A fleur d'eau* (1963) and *Der Fluch der gelben Schlange* (1963). Neither of these two are mentioned in any major resource consulted for this dissertation. The sole exception for this general lack of research is Alfred Hitchcock's *The Birds* where the *Trautonium* was used to create sounds that embody birds' cries and wings flapping, and ambient sounds. Here, the pioneering use of electronic synthesis to create electroacoustic content beyond established conventions and aesthetics of film sound is recognized by scholars of film and electroacoustic music alike.

> Indeed, The Birds, together with Secret Agent and Rear Window, is one of the three most important Hitchcock films for sound. Its soundtrack deserves some extended analysis because it is the film in which Hitchcock combines the greatest interest in controlling sound with the greatest technical capacity to do so. Hitchcock's emphasis on sound effects is indicated by the fact that he forgoes background music in The Birds for the first time since Lifeboat twenty years earlier. (Weis and Belton 1985: 303)

	Examples *Trautonium*
Electroacoustic Music	*7 Triostücke für 3 Trautonien* (1930, Paul Hindemith)[61]
Film	*Stürme über dem Montblanc* (1930 Germany, Arnold Fanck)[62]
	The Birds (1963 USA, Alfred Hitchcock)[63]

Table 11: Examples *Trautonium*

[60] Tikhonova

[61] Elektronische Impressionen

[62] Deutsches Museum

[63] Langlois 2012: 132, Holmes 2012: 34

Hammond Novachord

Introduced in 1933 – around ten years after the *Ondes Martenot* and the *Trautonium* – the *Hammond Novachord* is known as the first commercially available polyphonic[64] synthesizer, also offering comparatively sophisticated control over timbre and envelope (amplitude behavior of played notes). Its iconic vibrato sound is featured in a number of cinematic films.

The *Hammond Novachord* was introduced at the 1939 World's Fair in New York. It was only the second of a long series of different models of Hammond organs (Faragher 2011: 13) among which it was commercially one of the least successful due to unreliability in performance (Holmes 2012: 32). Introducing the concept of timbre *presets*[65] in electronic music, Holmes (2012: 32) calls it the "forerunner of the modern synthesizer". Compared to the *Trautonium*, the *Hammond Novachord* was economic in design and used fewer vacuum tubes.

When appearing in cinematic film, the *Hammond Novachord* is often employed as a subtle modification or extension of timbre. Unlike the *Theremin* and the *Ondes Martenot*, both of which mainly appear as solo instruments, the *Novachord* blends in with the orchestra, therefore coloring an existing music.

Red River (1948)

One of the few films from the Western genre that features an electroacoustic technique, 8 years after one of the most prominent occurrences of the *Novachord* - Hitchcock's *Rebecca* -, *Red River* marks a unique appearance in a genre that is generally not known to employ electronic sound. While driving a herd of cattle to Abilene, *Red River's* protagonist patrols just outside the wagon corral erected by the settlers. Time (night), weather (misty – low visibility), place (outside the safe corral) and situation (imminent danger through Indians) create a setting of tension.

---

[64]The *Hammond Novachord* allows 72 voices (all notes on its keyboard) to be played at the same time.

[65]Presets are templates of control settings that represent and/or imitate a specific timbre, allowing the performer to switch timbres quickly. Timbre presets are significant in that they enable the user to maximize an instrument's potential without requiring her/him to fully understand each control function.

This tension is then picked up by the orchestral score in the common aesthetic of a classical film score where music is literal and *plays the action*, adapting dynamics, harmony, rhythm and timbre to synchronize to the picture. A succession of chords rise in pitch; the *Novachord's* tremolo sound – higher in register, yet subtle - can be clearly distinguished among the orchestra.

Somewhat surprising is the fact that the Novachord does enhance (and not disrupt) the narrative. A sound that is usually associated with supernatural or extraterrestrial forces here brings the spectator closer to a cowboy who is protecting people and cattle from Indians. Using aesthetics of *subjectivization*, the use of *Novachord* strengthens the suspense - not by alluding to frightening, mysterious forces, but by turning the spectator's attention towards a man's worries and concerns.

Rebecca (1940)

In contrast to this, the previously mentioned *Rebecca* uses the *Novachord* to indicate the presence of an external, bodiless force:

> The novachord, representing in this film the mental disorder or the fear of a supernatural presence, remains in the background, covered by melodies played by the violins, hidden in the shadow, ready to ambush and reappear in order to alert the ear, in an subtle, unconscious way, of the strangeness of a dramatic situation, and to create a symbiosis among all unsettling elements of the film.[66]

Similar to the *Theremin*, the *Novachord*'s merit in and contribution to the history of electroacoustic content in cinematic film lies not so much in a particular technique it employs. Rather, the instrument embodies the coming of an aesthetic in film sound where the focus on timbre (a 'sound') replaces the musical abstraction (a 'melody').

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[66] "Le novachord, instrument figurant ici le dérèglement psychique ou la peur de la présence surnaturelle, se tient alors en arrière plan, a l'abri des mélodies jouées aux violons, tapi dans l'ombre, en embuscade, prêt à surgir comme pour renseigner l'oreille, de façon inconsciente, sur l'étrangeté d'une situation dramatique et mieux coller aux décors somptueusement inquiétants du film." (Langlois 2012: 128)

	Examples *Hammond Novachord*
Film	*Gone With the Wind* (1939 USA,Victor Fleming)[67]
	Rebecca (1940 UK, Alfred Hitchcock)[68]
	Red River (1948 USA, Howard Hawks)[69]
	The Ten Commandments (1956 USA, Cecil B. DeMille)[70]

Table 12: Examples *Hammond Novachord*

ANS

The *ANS* is a Russian synthesizer built and developed between 1937 and 1957 by Yevgeny Murzin[71]. Its method of sound generation is based on the same principle as the earlier discussed *optical synthesis* (→ *Optical Synthesis* p.35), albeit significantly more complex: the *ANS* produces polyphonic sound according to the amount and location of light that is allowed to pass through an alterable surface. This surface can be moved on a horizontal axis, allowing full control over time without affecting timbre. Small is the number of composers that wrote music with and for the *ANS*[72] (including Alfred Schnittke, Stanislav Reiki and Edison Denisov); in cinema, it features prominently in the films of Russian director Andrei Tarkovsky[73] (1932-1986). Here, it provides rare but significant examples of film sound that cannot be assigned specifically to the *diegetic* (e.g. sound effect) or *non-diegetic* (e.g. music) categories, but represents a hybrid between the two.

In a complex system that is sparsely documented, light travels through and is modulated by sine wave prints, located on optical discs inside the machine, until it reaches the interface, a mastic-covered glass plate (→ *Figure 13* p.51). This plate is manipulated by scratching the mastic off certain areas. It is then moved (by hand or using a motor) on a horizontal axis. In front of the plate, photocells sense the amount of light that finally passes through the areas that have been scratched free, resulting in sine waves in a scale of 720 microtones spanning ten octaves, all of which can theoretically be played simultaneously.

[67]Howell and Wilson, Cirocco

[68]Langlois 2012: 128

[69]Cirocco

[70]"AudioNewsRoom"

[71]Евгений Мурзин (Yevgeny Murzin, 1914 - 1970)

[72]Named in honour of Russian Alexander Nikolayevich Scriabin (Алекса́ндр Никола́евич Скря́бин). Only two models of the *ANS* ever existed.

[73]*Андре́й Тарко́вский*

Moving the plate at different speeds results in different note duration, but no pitch changes. Considering its operation, the *ANS* is a hybrid between non-real time and real time synthesis. The fact that the mastic plate needs to be prepared makes it non-real time; its actual sound creation, however, is real time in the sense that it can be adjusted dynamically.

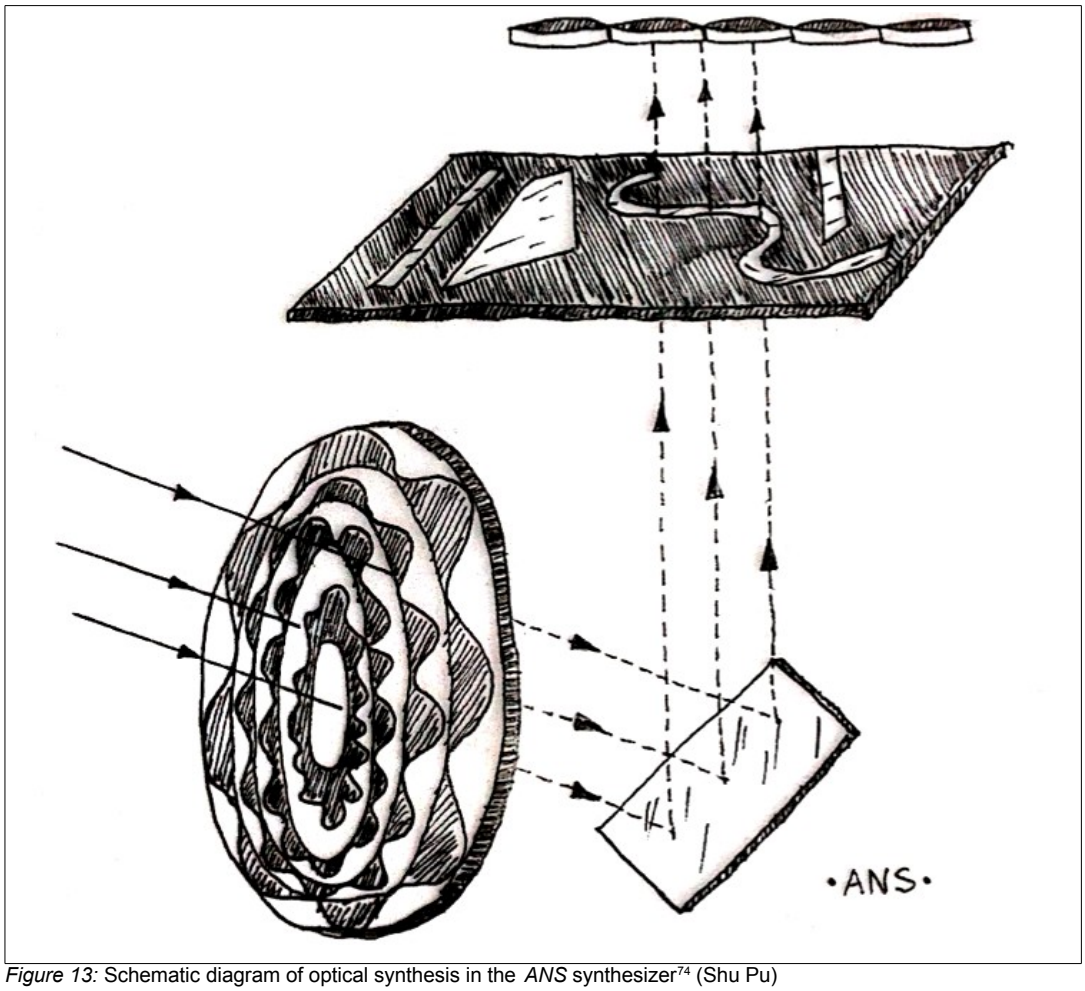

Figure 13: Schematic diagram of optical synthesis in the *ANS* synthesizer[74] (Shu Pu)

Eduard Artemyev[75] (born 1937), composer for the music in films by Andrei Tarkovsky, has used the *ANS* to create layers and textures of sound that often are difficult to identify as 'film music'. They "blend in with the sonic environment" (Chion 2009: 139) and can be 'mistaken' for sound effects such as ambient sounds. In the film *Solaris* (1972), the *ANS*'s sound is often said to represent 'The Ocean', a mysterious extraterrestrial force: " . . . the voice of the *ANS* machine comes out of the ocean, a giant conscious and reasoning organism with which the scientists on the spaceship are trying to make contact ("The Soundhunter" 2006) .

[74]Kreichi, Holzer

[75] Эдуа́рд Никола́евич Арте́мьев (Eduard Nikolaevich Artemyev)

Aesthetically, *Solaris* continues the existing (if delicate) trend of discharging the acoustic film score as the exclusive source of film 'music'. The *ANS* also stands for Tarkovsky's commitment to film sound, which this thesis will further illustrate (→ 2.5 *Findings* p. 96). Having worked with Artemyev on the score, *Solaris*, arguably the most prominent appearance of the *ANS* in cinematic film[76], is also one of Tarkovsky's best-known films.

Solaris (1972)

Early in the film, *ANS* sonorities provide a first encounter with the aforementioned 'Ocean', a supernatural entity that causes its 'victims' to conjure up people that passed away. In this scene[77] a man drives his car through a futuristic maze of highways. No dialog takes place; the images switch between black and white, while showing the highway as seen from the driver's seat and the driver from different angles. Initially, we hear drone-like sounds: sustained, low to mid frequency noise which can be believed to belong to the car (in a sci-fi film, cars are likely to have some kind of special engine). Soon after, sound 'pieces' - short motifs - are added to the background drone; these sound pieces are often high-pitched and fluctuate, in pitch. As they accumulate, the film sound increases in density (mix), mode of fluctuation (glissandi), register and sound level. At the same time, in the image frame appears a little boy, sitting behind the man. The scene ends as the sounds – now at their climax - underscore a wide shot of the city (at night) with a plethora of cars, highways and buildings.

The film sound effectively moves from the level of diegetic, literal narration (as car sound effect) to a different space. Speaking in the broader sense of Chion *acousmêtre*, we hear a voice the body of which is not visible. At the same time, sounds become the dominating element in the scene: long before we see the second passenger (who, in fact, exists only in the imagination of the first passenger), they foreshadow his presence. This asynchronous use of sound here is an example of the aesthetic of contrapuntal sound in film.

[76]In an email communication with the author (Artemiev) Eduard Artemyev's son Artemiy Artemyev confirms that the *ANS* was not used in the film *Stalker*.

[77]Often referred to as the 'highway scene', this sequence was shot in Tokyo, providing the backdrop for what in the film has to be a future city. (Gulesserian 2011)

	Examples ANS
Electroacoustic Music	*Bird's Singing* (ca. 1969, Edison Denisov)[78]
	Steam (ca. 1969, Alfred Schnittke)[79]
	ANS (2004, Coil)[80]
Film	*Solaris* (1972 Soviet Union, Andrei Tarkovsky)[81]

Table 14: Examples *ANS*

[78]Artemiev et al.

[79]Artemiev et al.

[80]Coil

[81]Artemiev, Langlois 2012: 362

Synthesizers and the Synth Score Genre

Early devices of electronic synthesis, the above mentioned *Theremin*, *Ondes Martenot* and their contemporaries, are the direct predecessors of synthesizers. In cinematic film, they have been used to emulate acoustic film scores – often diatonic, melodic music that in number of voices and arrangement carries strong resemblance to orchestral film scores. This type of film score is often called a synth score. The following list shows some of the historically significant synthesizer models instrumental to the genre of synth scores in cinematic film. However they were not – to my knowledge – used to produce electroacoustic content (as defined here) in cinematic film.

Year	Synthesizer	Films
1962	Mellotron	*Picnic at Hanging Rock* (AU 1975)[82] *Donnie Darko* (USA, 2001)[83]
1965	Moog Modular Synthesizer	*Clockwork Orange* (USA 1971)[84] *Midnight Cowboy* (1969)[85]
1970	ARP (Series)	*Close Encounters of the Third Kind* (USA 1977) *The Conversation*[86] (USA 1974)
1974	EMS (Synthi 100, VCS 3)	*The Shout* (UK 1978)[87]
1976	Yamaha CS-80	*Blade Runner* (USA 1982)[88]
1980-82	Oberheim OB-Xa	*Terminator* (USA 1984)[89]

Table 15: Synthesizers and the Synth Score Genre

[82]Thompson

[83]Everloving

[84]Holmes 2012: 379

[85]synthhead

[86] Walter Murch describes how he used an ARP Synthesiser to manipulate a voice-over so as to make it sound digitally distorted (Jarrett 2000).

[87]While it is not a film representative of the synth score genre, *The Shout* features images (and possibly sounds) of an EMS synthesizer as part of the story, the main character of which is a composer of electronic music.

[88]Synthhead, Zyser

[89]Amber, “Analogue Heaven - Terminator Soundtrack”

Handmade Circuit Building

This chapter describes *handmade circuit building* as a technique of creating electro-acoustic music from self-made sound-producing devices that are not developed and distributed commercially. In the early history of electroacoustic music, artists were interested in exploring the basic elements of electronic music production and their technological requirements. Many built their own electronic *circuits*, thus producing not only their own music, but also their own instruments.

Pivotal for the study at hand is the work of Louis and Bebe Barron, whose music was featured in *Forbidden Planet* (1956), often considered as the first cinematic film with an exclusively electronic score. Consisting of purely synthesized sounds, the Barrons' music represents early combinations of noise aesthetics with images. The Barrons were first and foremost avant-garde musicians; the fact that their music was possibly the first exclusively electronic film score ever underlines the significance of electroacoustic practices for cinema.

Bebe and Louis Barron: *Bells of Atlantis* and *Forbidden Planet*

Sound artists and studied musicians with an authentic interest in avant-garde music, the couple Bebe (1925-2008) and Louis (1920-1989) Barron were pioneers in their field: according to Holmes (2012: 98), theirs was the first American electronic music studio; their magnetic tape recorder, according to Bebe Barron (Chasalow 1997), was one of the first of those machines in the USA. The Barrons lived and worked in New York, where they produced one of the first[90] pieces of electronic music for magnetic tape composed in America, a work called *Heavenly Menagerie* (1950). Peers with John Cage (1912-1992) and David Tudor (1926-1996), they provided “technical assistance and studio facilities” (Holmes 2012: 100) to Cage, and collaborated with him on pieces such as *Imaginary Landscape No. 5* and *William's Mix* (both 1952).

[90] Holmes (2012: 98) writes that *Heavenly Menagerie* is “most likely” the first piece of electronic music for magnetic tape composed in America.

The Barrons were interested in cybernetics, 'organic' synthesis and a certain amount of naturalness and unpredictability in their work[91]; they wanted something with a life of its own. Louis Barron designed and built electronic circuits that produced sounds; Bebe Barron recorded and edited these sounds on magnetic tape.

> We used many circuits from Norbert Wiener's book Cybernetics; or, Control and Communication in the Animal and the Machine. We recorded and amplified the electronic activity and endlessly processed it. Since they were all mathematical equations they seemed to have a kind of order and organic rightness. Entropy and information theory contributed ideas on probability and randomness which we had to use since that was the only thing our circuits were capable of. We thought of our circuits as characters in a script and used the unfolding of pitches as they came out of the circuit. We didn't control the pitches at all . . . Each circuit we built had life spans of their own . . . And once they died we never could revive them. We always were innocent with the sense of wonder and awe of the beauty coming from the circuits – we would just sit back and let them take over. We didn't want to control them at all. We were in a very receptive state, like that of a child working with their eyes and minds open. (Chasalow 1997)

The Barrons' work attracted interest from filmmakers, and their two most notable contributions to cinematic film were the soundtracks for the previously mentioned *Bells of Atlantis* (1951) and *Forbidden Planet* (1956). *Bells of Atlantis*[92] is not only considered by some the first film with a fully electronic music score; it is also sometimes referred to as the first released piece of electronic music[93].

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[91] Langlois describes similarities of this philosophy to some of the themes of Forbidden Planet, where machines are capable of materializing subconscious desires: ”The Barrons' music, constructed, as they like to define it, on the model of human thinking, finds an unexpected application in the context of Forbidden Planet. ” (”La musique de Barron, construite a l'origine, comme ils aime le définir, sur le modèle de la pensée humaine, trouve dans le contexte de Planète interdite une application inespéré.”) (Langlois 2012: 329)

[92] Philippe Langlois' book *Les Cloches d'Atlantis*, the first book on electroacoustic music in film, is named after “Bells of Atlantis'.

[93] This statement by Langlois (2012: 326) potentially contradicts with Holmes (2012: 98, see earlier). Furthermore Langlois must be implying that it is the first piece of *synthesized* electronic music since there are earlier *musique concrète* pieces: *Etudes des bruits* (Pierre Schaeffer) were released in 1948, and *Symphonie pour un homme seul* (Pierre Schaeffer, Pierre Henry) are dated to 1949-50.

With the Barrons' score, *Forbidden Planet* is widely recognized as the first commercial feature film with an exclusively electronic film score[94] (Holmes 2012: 101; Langlois 2012: 328; Wierzbicki 2005: 41-42). Being a pioneering work, *Forbidden Planet*'s use of electroacoustic aesthetics and techniques will be mentioned in detail.

Forbidden Planet (1956)

The Barron's music consists of short, rhythmic bursts and sustained notes similar to wind instruments or violins, often with portions of noise, and vibrato or tremolo. The sounds often fluctuate in register, shifting pitch in micro steps (glissando). Signal processing techniques such as reverb and echo extend the sound in space and time. The Barrons's music is used for sound effects such as signal sounds and motion of machinery, technical instruments, robots and vehicles and the monster. In addition to this, the actual film score also comes from the Barrons who employ leitmotifs for the robot and the monster.[95]

The sounds always *play the action*: they reference the literal film action (e.g. light speed drops in the spaceship) and/or meanings and subtext (e.g. the monster's presence). They never leave the diegetic world, always keeping a relation to the image. The sound source, however, can not always be clearly identified: sounds that possibly come from the robot become film score as the image changes perspective.

This frequent occurrence of the *acousmêtre* is one of the film's main aesthetic achievements: sounds are fluid also in how they relate to the image; the same sound can be film score and, at the same time, diegetic effect. Abundant in (exclusively!) electronic sounds (both as music and sound effects), *Forbidden Planet* also foreshadows the mentioned aesthetics of spectacle: the celebration of sound through a complex sound mix that exhausts contemporary technology. The vocabulary of sounds created by the Barrons partially draws from the widespread association of electronic sounds with with the 'unknown' and 'alien'. In many regards novel, the film, however, clearly benefits from previous stylizations of alien sounds. Groundwork for such aesthetics was laid prominently by the *Theremin*.

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[94] For legal reasons, the Barrons' music for *Forbidden Planet* was credited in the film's opening titles as “Electronic Tonalities”, and not as film music (Wierzbicki 2005: 10).

[95] A detailed analysis of *Forbidden Planet*'s film score can be found in Wierzbicki (2005).

While the Barrons' music was new and experimental, in the context of *Forbidden Planet* it became accessible by a wide audience. Albeit employing new compositional techniques of making music, the aesthetics they created can be partially traced back to earlier trends:[96]

> Although the score for Forbidden Planet includes many segments that could only have resulted from the Barrons' unusual methodology, the fact remains that it is dominated by pronounced slides between one pitch and another, sustained tones enlivened by wide vibrato, and tone-colors that suggest the timbre of a voice. In the context of Forbidden Planet these musical ideas can easily be read as futuristic, yet they hark back to scores of the late 1940s, when such ideas were associated not with futuristic technology but with current trends in psychology. (Wierzbicki 2005: 28)

Gil Mellé: *The Andromeda Strain*

Gil Mellé (1931-2004) was a composer, jazz musician and visual artist. He composed a number of film scores, among them *The Andromeda Strain* (1971) in which extensive use of electroacoustic music is made. Although not documented in detail, Gil Mellé is known to have built his own synthesizers such as the *Electar* (Holmes 2012: 400), as he himself describes:

> Synthesizers, per se, were not available anywhere until 1969 . . . but I had been building them since 1959 in New York. Since they were not manufactured, one had to build one's own equipment, and so by the time I came to Hollywood I was literally the very first electronic composer in films. (Mellé in Larson 2005: 24)

Mellé calls his music for *The Andromeda Strain* the first fully electronic film score in cinema, claiming that the Barrons' music for *Forbidden Planet* is not electronic music: “The sounds were generated by ordinary test equipment that you would find in any television repair station. Ordinary test sine wave generators – and that's not electronic music” (Mellé in Larson 2005: 24). While it is questionable not to acknowledge some merit in the Barrons' work that came from “ordinary test equipment” and made it into a Hollywood feature film production,

[96] *Forbidden Planet* was the Barrons' only professional engagement with the Hollywood film industry. Their being hired for *Forbidden Planet* is often attributed to a series of fortunate coincidences (Holmes 2012 : 106) rather than any reputation the Barron's may have had in the film industry (see also Wierzbicki 2005).

Mellé's comment shows how difficult it is to find a singular acceptable definition of electroacoustic music. As a matter of fact, the Barrons' music and its appearance in a cinematic film 15 years before *The Andromeda Strain* was and is widely recognized as a unique achievement.

	Examples Handmade Circuit Building
Electroacoustic Music	*Cartridge Music (*1960, John Cage)[97]
	Rainforest IV (1968, David Tudor)[98]
	It's in the Air (1995, Felix Hess)[99]
Film	*Bells of Atlantis* (1951 USA, Ian Hugo)[100]
	Forbidden Planet (1956 USA, Fred M. Wilcox)[101]
	The Andromeda Strain (1971 USA, Robert Wise)[102]

Table 16: Examples Handmade Circuit Building

[97]Holmes 2012: 412

[98]Collins 2009: 48, 54

[99]Sieh

[100]Holmes 2012: 104, Langlois 2012: 326

[101]Holmes 2012: 105, Langlois 2012: 328

[102]Langlois 2012: 337, Larson 2005: 24

2.2 Tape Manipulation

Tape manipulation is the editing of a sound recording via its carrier medium in the time domain. It describes the process of changing the original order of playback by isolating a sound from its original context and placing it elsewhere. *Tape manipulation* also describes edits within a single recorded sound such as removing its attack or decay, or reversing the sound. It is not performed in real time; rather, it allows the non-linear organization and composition of sound. This thesis focuses on analog techniques that stem from manipulation of physical recording media such as film and magnetic tape. In the digital domain, these techniques have been refined and expanded, but not fundamentally changed.

Recording sounds on an editable medium and the possibility to cut, splice and overdub marks the transition from concerts to studio production; from instrument performance to composing with recorded sounds; from conducting an orchestra to a single person controlling a possibly infinite number of sounds. Before techniques of *tape manipulation* became available, creation and manipulation of sound could only be done in real time[103] and had to be planned beforehand. With the advent of *tape* m*anipulation* techniques it was possible to actually compose with individual pieces of recording[104].

This chapter will introduce techniques developed during the early stages of editable sound recording on film (*sound-on-film*) and magnetic tape (*musique concrète*). They have informed film sound editing and can be seen as the basis for creative outputs (for example as electroacoustic music) as well as more technical types of editing (dialog and sound effects editing in film).

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[103] Early works of electronic music such as *Trickaufnahmen* (1930, Paul Hindemith) and *Symphonie pour un homme seul* (1949-50, Pierre Henry and Pierre Schaeffer) were done with turntables

[104] Tape manipulation often happens on the level of a particular, single sound that later, by means of mixing, is combined with others. This is also a technical issue: a single sound can be individually edited (attack, decay and amplitude), a sum of sounds can only be edited in its totality.

Background: Film, the Origin of Edited Sound

In the history of early audio recording, the most prominent media are disc, film and tape. Early disc-based[105] mechanical recording technologies did not allow for any editing. “Up to this point, time in a recorded sense was linear, but could not be cut, reordered, restructured, juxtaposed. On a disc recording, it is not possible to extract a single sound, and place it in a different place temporally on the disc. The position of the sounds relative to one another is fixed” (Underwood 2008: 198).

The first editable sound-recording medium (roughly: 1920s) was the previously mentioned *sound-on-film*: sound represented graphically on celluloid film, recorded through the conversion of electricity to light and played back vice versa. The magnetic tape recorder (roughly: late 1940s[106]) was significantly less costly, more flexible, provided a higher recording quality and allowed instant recording and playback. It became the standard recording media and remained so until the availability of digital sound-recording technology.

It can be argued that techniques of tape manipulation stem from early *sound-on-film* cinema technologies: they precede the more formalized techniques of *musique concrète* by more than 15 years. The first recognized genre of electroacoustic, *musique concrète* focussed on magnetic tape as its recording medium, compositional tool, and output (Holmes 2012: 51). The application of tape manipulation techniques in cinematic film, developed with optical recording and perfected with magnetic tape, is frequent, diverse and has been constantly developing.

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[105] These early technologies include *the Phonautograph* (1857 Édouard-Léon Scott de Martinville, recording only, no playback, for scientific purposes); the *Phonograph* (1876 Thomas A. Edison, recording and playback, tin foil); and the *Gramophone* (1887 Emil Berliner, glass disc with layer of paint which would be inscribed).

[106] The most important dates for the development and invention of the magnetic tape recorder include: 1888 (American Oberlin Smith provided some insights on optical recording without traceable application); 1898 (Danish Valdemar Poulsen released his *Telegraphone* (steel wire, weak signal, first electromagnetic recording technology); 1929 (German Fritz Pfleumer patents magnetic tape coating); 1935 (German company AEG produced a magnetic tape recorder using paper tape).

Aesthetics of *tape manipulation* in cinematic film

The possibility to construct sound based on recorded material meant an orientation to the actual sound, and less on its context: the composer could meticulously analyze and then trim, extend or stretch at will. From such realizations of sound through microscopic manipulations of time accrued entirely new, irritating and complex listening situations.

Cutting and combining sounds in whatever order, regardless of logic or natural appearance, montage allowed the creation of a context: aesthetics shifted from the real (the natural: recording a forest) to the rendered[107] (the artificial: editing recordings that sound like insects, wind and trees). This sophisticated and established sound – hitherto merely a 'proof of reality' - as a means of critical expression.

Montage also allowed synchronization, and its very opposite: causal relationships could be intentionally made unnatural and create dissonance and detachment between image and sound. Thus removing the umbilical cord of synchronization between mouth and speech incidentally gave birth to the voice-over.

Where *synthesis* created new timbres, *tape manipulation* allowed radical changes of existing ones. Dissecting sounds by reversing them or changing their playback speed exposed physical characteristics that would otherwise go unnoticed. Sounds thus alienated from their original source started to accompany cinematic film in order to evoke altered states of mind, forces of nature, deformations of time perception and individualized, personal listening perspectives.

[107] Chion 1994: 95

Sound-on-film: Early Manipulations of Recorded Sound

Sound-on-film was the medium by which sound film was realized Even though the actual switch from silent to sound film was initiated with a disc-based system (Flückiger 2001: 31) where a turntable plays in synchronization with the film projector, *sound-on-film* became the standard for sound film soon after (Chion 2009: 51). In manipulating and editing sound and synchronizing it to the picture in a non-real time compositional process, filmmakers and their sound editors established techniques that led to a stronger identity of film sound – independent, yet related to the picture. New aesthetics appeared and would later be continued and perfected with magnetic tape.

One of the first important works of *sound-on-film* is the imageless film *Wochenende* (1930, English: *Weekend*) by German filmmaker Walter Ruttmann[108]. For the film, he collected 'found' sounds: dialog pieces and sounds recorded on construction sites and in trains were edited and mixed to form an early attempt at what later would be known as *musique concrète.*

Wochenende was a pioneering work, drawing attention to the new possibilities of sound editing. Sound stored on a tape medium, in conjunction with the image stored in the same way meant precise control over synchronization, which resulted in the critical evaluation of is artistic possibilities. “Synchronization enables the precise alignment of image and sound. It also allows detachment the sound from its original source. Thus the very practice of synchronization of sound with image suggests its reciprocity”[109] (Langlois 2012: 215).

This conscious treatment of synchronization also marks the origin of voice-over – spoken word that does not emanate from a screen character but, similar to *non-diegetic* film music, an 'external' entity, often in the form of a narrator: “The spoken word, after having been forcibly enslaved to lip movement, rapidly finds itself emancipated from synchronization by the introduction of the voice-over and the “subjective” or “interior” voice”[110] (Langlois 2012: 215).

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[108] Among Walter Ruttmann's best-known works is the 1927 film *Berlin: Symphony of a Metropolis*.

[109] "La synchronisation apporte, de plus, la possibilité de faire étroitement coïncider l'image et le son. Par extension, elle permet tout aussi bien de “décoller” le son de sa source originelle. Ainsi, la pratique même de la synchronisation du son avec l'image induit sa réciproque." (Langlois 2012: 215)

[110] "La parole, après avoir été impérativement asservie aux mouvements de bouche, se trouve rapidement émancipée de la synchronisation avec l'apparition de la voix off, “subjective” ou “intérieure”. " (Langlois 2012: 215)

The development of synchronization and voice-over are two examples of the sophistication of film sound. In this context, the 1930s are an important period (Langlois 2012: 216): uncertain as to what to make of the new possibilities for sound and picture editing, filmmakers experimented with noises and found sounds and their potential for *diegetic* or *non-diegetic* relationships with the image. Paradigmatic for this period are the films of French director Jean Vigo (1905-1934) such as *Zéro de conduite* (1933) and *L'Atalante* (1934).

Technological advance did not make *sound-on-film* obsolete. Even after magnetic tape became established as the primary tool to record and edit sound in the 1950s, *sound-on-film* remained the preferred technology to store a finished film sound mix on a film reel (Flückiger 2001: 53), such as with the *Dolby Stereo* format. Among artists and avant-garde filmmakers, *sound-on-film* techniques were use to created works of the previously mentioned *Optical Synthesis* (→ p. 35).

	Examples *Sound-on-Film*
Film	*Wochenende* (1930 Germany, Walter Ruttmann)[111]
	Zéro de conduite (1933 France, Jean Vigo)[112]
	L'Atalante (1934 France, Jean Vigo)[113]
	Le Tempestaire (1947 France, Jean Epstein)[114]

Table 17: Examples *Sound-on-Film*

[111] James 1986: 78, Langlois 2012: 88

[112] Langlois 2012: 183

[113] Langlois 2012: 337, Larson 2005

[114] Langlois 2012: 236

Musique Concrète

Musique concrète is the first recognized genre of electroacoustic music. It was created by the French Pierre Schaeffer (1910-1995; radio engineer, writer, broadcaster) and Pierre Henry (born 1927; trained composer). Together they started the era of “recorded sound” (Holmes 2012: 49) in electronic music; their work can be seen as the continuation of diverse efforts by Hindemith and Cage (turntable music), Varèse (avant-garde compositional techniques) and the italian futurists (the usage of non-musical sounds for musical purposes), who were exploring new possibilities in the composition and performance of music. Schaeffer's and Henry's goal was the construction of music with electronic technology.

The 'Sound Object'

The term *musique concrète* was coined by Schaeffer in 1949. Holmes (2012: 51) suggests that 'concrete' refers to a single, 'concrete' sound object; the process of composing therefore starts with a concrete sound rather than an abstraction of music through notation. In 'concrete' music, the 'sound object' is not subject to specific rules (meter, mode, timbre etc.), whereas classical, 'abstract' music starts with notations that only through performance are realized as sound. All sounds have the potential to be used in music: music can be made with material that is not harmonic or otherwise musical in the traditional sense of the word. Focussing on a sound's characteristics in amplitude, frequency and time, Schaeffer and colleagues furthermore tried to notate the three-dimensionality of sound, even experimenting with a translation into stave notation in order to facilitate the composition and production process. By formalizing strategies for music composition and classifying sound into categories (Holmes 2012: 50 ff.), Schaeffer developed a theoretical framework of *musique concrète.* This research was published in articles and books such as the *Traité des objets musicaux* (1966).

Early works by Schaeffer and Henry, such as *Etudes des bruits* (1948) and *Symphonie pour un homme seul* (1949-50) were done with the turntable, where 'edits' (fades, cuts etc.) and signal processing had to be done in real time. The availability of tape recorders a few years later meant greater work flexibility and higher recording and production quality. As a result, the tape recorder was not only the recording medium but also became the means to compose, edit and perform.

Musique Concrète and Cinema

In his early writings, Schaeffer focusses on radio and cinema, expressing his belief that radio can benefit from the experiences people have had with film sound. A strong attachment to cinema is also evident with Henry, who says that “it's to cinema that I owe my debut in musique concrète” (qtd. in Langlois 2012: 257)[115].

Both worked closely with filmmakers, often using the radio studio's equipment secretly at night (Langlois 2012: 258): cinema was not entirely accepted as an art form and not everybody was happy with Schaeffer's claim that a musical genre might, to a certain extent, have some roots in a “bastard art” (Langlois 2012: 255).

Techniques of editing sound based on an isolated piece of recording can be traced back to early, narrative works such as the aforementioned *Wochenende* (1930) and others[116]. *Musique concrète*, however, formalized techniques and aesthetics in electroacoustic music, and out of different musical genres stands out as a highly prominent influence on all elements of film sound. While the protagonists of *musique concrète* worked mostly on films that were not cinematic according to the above definition, their works provided inspiration for people who create sound in cinematic film: the term is often (if not consistently, nor always in correct reference to Schaeffer) used to describe editing techniques and film sound elements and aesthetics that focus on pieces of sound that are not inherently musical. Examples are Whittington's writing about George Lucas' *THX 1138*[117] (1971) and Gil Mellé in an interview with Randal Larson[118].

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[115] "Mes débuts dans la musique concrète, c'est au cinema que je les dois." (qtd. in Langlois 2012: 257)

[116] Film editor and sound designer Walter Murch sees similarities between the techniques of *musique concrète* and Orson Welles' earlier work in radio, saying that the latter is “ . . . a kind of musique concrète. Schaeffer’s innovation was to apply the then-new technology of magnetic tape to recording and assembling sound, and, then, to give performances in musical venues and call it musique concrète—concrete, as opposed to abstract, music. Nobody had done that before. It was a big revelation. But if you listened to what was produced for films and to much of what was done on the radio by innovators such as Welles, it was the same kind of thing.” (Murch in Jarrett 2000)

[117] "THX 1138, however, substituted music with musique concrète to attain its goal. While THX 1138 was not as culturally influential as 2001 – in fact, the film failed to reach much of an audience at all – it was highly influential in Hollywood sound circles." (Whittington 2007: 76)

[118] "Andromeda Strain also incorporated elements of musique concrète (natural sounds used musically), quite extensively – the main title included recorded sounds of bowling balls hitting pins, sounds from lumber mills, and so on." (Larson 2005: 24)

The employment of concrete sounds based on their sonic qualities, propagated by *musique concrète*, has had a major influence on the aesthetic of film sound. In many cases of cinematic film, recorded sounds are added to the film sound when they are diegetic and have an inherent sonic quality that is musically interesting. Recordings of trains are an example of that are frequently used in cinema[119]: train sounds are usually *diegetic* – they are a sonic part of the setting in a film scene. However, their function is not limited to describing a space; independent of the actual source, the train sound's own dynamics, its timbre and time structure adds a dramatic element to the narrative. Groundbreaking and pioneering adaptations of aesthetics of *musique concrète* in cinematic film come from Walter Murch, whose sound design on *American Graffiti* is iconic for New Hollywood's consciousness of film sound. The sound of a passing train here acts both as a sonic backdrop and as reinforcement of the narrative.

American Graffiti (1973)

The film's 'prank scene' features a montage of industrial sounds (train, engine, metal screeching, signal-horn), coyote and the film's signature music coming from car radios (American Grafitti's 'signature sound', as sound designer Walter Murch himself describes in Jarret 2013). All sounds are acousmatic – we do not see their source; yet we can identify it. Instead, the images show the car park and the protagonist's preparation of the prank. The sounds are composed so that they synchronize to the action: loud, low sound as a policeman opens a car door; a coyote's howl as we see the policeman striding through the empty car park; the low rattling of a motor as the protagonist sets off to move to the police car; signal-horn as he crawls under the car; steam venting as he reaches his target location. The steam venting sound is strikingly similar to a human exhalation of relief.

[119]"There's also an affinity historically between films and trains. The first film at which an audience paid to see a film was The Arrival of the Train, the Lumière Brothers. And the first feature was Porter's The Great Train Robbery. Somehow there is this affinity between trains and film. The two rows of sprockets are kind of like the two tracks. It's all a geared and mechanical kind of world, certainly when film started out. It's shifting now with digital machines, but if you look at old film equipment and listen to an optical printer while its going, you hear this clackity-clack, clackity-clack, clackity-clack sound. If you slow the projector down far enough, it will sound pretty much like a train, too. It's just that it's going so fast that you don't hear the separate clicks. The other thing about trains, which is what I mentioned with helicopters, is that they are very complicated, big mechanical objects that move at various speeds through space. As they do that they reveal a kind of chromatic array of the components out of which they are made. The very distant train has a very particular kind of sound; the close-up and idling train has another sound. Steam trains are more interesting sound-wise than diesels." (Murch in Jarrett 2000)

Increasing in amplitude, density and register, these sounds (similar to a freight train arriving) stop abruptly with the steam venting sound. Interestingly and arguably against logic, none of the previous sounds return. Followed by the protagonists breathing and a car radio playing far away, their absence, however, does not alarm the audience (unlike the previously mentioned use of the *Trautonium* in *Stürme über dem Montblanc* → *Trautonium* p.45, where the complete absence of sound is irritating). The sounds therefore serve exclusively to accompany the tension in the protagonist's preparation of the prank played on the cops.

American Graffiti is a 'coming-of-age' film, and it is not surprising to find a dose of humor in the story, its protagonist, and the way they speak and dress. Remarkable is the use of sound in this context: acousmatic ambient sounds (that are neither caused nor observed by the protagonist) *play the action* in an almost comical way. The aesthetic of Mickey Mousing comes to mind: cartoon figures move and dance around the picture frame, and the music is following their every step, jump, smile and laughter. Sonically being very much a work of *musique concrète* (and as such far from comical or whimsical), the sound aestheticizes the action while ridiculing the prank's victims: even the most obvious alarm sound does not alert them to the fact that there's a teenager crawling underneath their car.

More recently, applications of found sound in cinematic film can go as far as dispensing with the diegetic component: here, sounds are used purely based on what they sound like; a physical relation to the image is not present. The film *Inception* (2010) exemplifies aesthetics in contemporary sound design where sounds of entirely unrelated sources are mixed together to create a new, unique sound. In one of the dream scenes, the soundtrack consists of three layers of sound: one is the “literal debris (…): things that we see happening around” the actors. A second “subtext” layer with low-frequency sounds represents the “energy that causes all this to happen”; and the third layer is a mix of “organic” sounds such as moans and whale sounds that have been heavily manipulated (Richard King, Supervising Sound Editor/Sound Designer of *Inception,* in Coleman 2010).

Techniques

Sound-editing techniques developed on *sound-on-film* have been adopted and refined on magnetic tape. Since both media are 'tape' ('reel'), the editing process is similar: the tape can be cut and pasted using special glue tape. The following techniques therefore apply to both *sound-on-film* and magnetic tape as used in *musique concrète*.

Cut and Splice

This technique allows the editing of the recorded, natural order of events on a time line. A recording clip can be manipulated by removing its beginning, end or middle part; among a number of objects, this technique allows a cohesion of sounds that does not happen naturally in this order. Cutting and splicing is a fundamental editing technique that contributed greatly to film montage, eliciting discussions on synchronization between sound and image (Langlois 2012: 215). While previously, music and sound creation happened in real time, cutting and splicing the recorded material now introduced possibilities to create and manipulate sound on the basis of an existing recording. This not only allowed the economization of production processes (sound could now be recorded separately and combined later); furthermore (and paradoxically) music could now be composed in real time, introducing new aesthetic possibilities.

Similar to the *added value*[120] in the montage of image and sound, arranging two sounds next to each other on a timeline evokes a relationship between them. This has the potential to suggest a new context. A suitable example for this technique is the previously mentioned *Wochenende* (1930), in which the filmmaker Walter Ruttmann creates new associations by editing and mixing together sounds of different contexts[121]. A more recent example can be heard in *Killing Them Softly* (2012), a film with a convincing concept of sound design (especially in regards to its use of music: where employed, music is not secondary accompaniment but dominating force).

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[120] "By *added value* I mean the expressive and informative value with which a sound enriches a given image so as to created the definite impression, in the immediate or remembered experience on has of it, that this information or expression “naturally” comes from what is seen, and is already contained in the image itself. " (Chion 1994: 5)

[121] One important aspect for this kind of editing is time and/or duration of the sound . Chion mentions that while images can appear in short instances, sound depends on time. He refers to trimming and cutting as microediting of sound: "The microediting of sound often isolates and assembles only fragments of impersonal and devitalised sound for the simple reason that they are deprived of development in time. This problem is evident in Ruttmann's work, as brilliant as it is in some respects and undeniably of great historical significance. " (Chion 2009: 52)

Killing Them Softly (USA 2012)

During its opening sequence, two distinct pieces of sound are heard: parts of a speech by Barack Obama with applause at beginning and end, and electronic music of sustained, drone-like dissonant chords with irregular pulses. The two sounds are edited together with hard cuts and synchronized to the image where opening titles (production credits and movie title on black background) alternate with a slow-motion shot of a stressed-looking walking through a deserted industrial area. The man is wearing a jeans outfit, he is unshaved with disheveled hair; a cigarette hangs in his mouth. Wind is blowing pieces of paper and plastic rubbish about.

At first, parts of sentences are recognizable. Then, abrupt edits cut in the middle of words, rendering some of them difficult to recognize. Towards the end, parts of sentences can be heard again. The sequence ends with a complete sentence. The speech content of this sequence reads as follows:

> America / I say to the people of America / This moment is our chance to / co . . . / enou . . . / to make of our own lives what we will/It is/that pushes us forw . . . / the American promise alive / because that promise that's always set this country apart/ It's a promise that says each of us has the freedom to make of our own lives what we will[122]

From „the American promise alive" onwards speech and music sound together. The sequence ends with the applause and music crossfading with ambient sound effect (car passing by, animal and human footsteps). The image returns to normal playback speed.

The two sound elements are sonically very different: the speech fluctuates in rhythm, timbre and dynamics while the music is sustained and steady, with hardly any rhythmic element providing movement or change; this suggests stagnation, tension and unrest.

[122] Parts of these speech excerpts can be found in the tran script (Miller Center) to Barack Obama's Acceptance Speech at the Democratic National Convention on August 28, 2008.

Speech is usually perceived as information (and not sound). The contained (verbal) information plus the recognizability of the voice instantly places the film in a historical context – one that the image does not provide. Sound is dominant in this scene – what we hear places the picture in context, and not vice versa (at the end of the scene the image shows an shiny oversize election poster high above the protagonist, thus visualizing the superiority already established through sound). In addition to this shift of dominance – a common aesthetic in modern film sound - another aesthetic employed here is the contrapuntal use of sound: Obama's voice contrasts with the man walking in slow motion, and the masses applauding the politician contrast with innumerable pieces of rubbish floating and flying around the man.

	Examples Cut and Splice
Electroacoustic Music	*William's Mix* (1951-53, John Cage)[123]
Film	*Wochenende* (1930 Germany, Walter Ruttmann)[124] *Killing Them Softly* (2012 USA, Andrew Dominik)[125]

Table 18: Examples Cut and Splice

[123] Holmes 2012: 102

[124] James 1986: 78, Langlois 2012: 88

[125] No documentation available. The use of *cut and splice* techniques can be clearly recognized when listening to the mentioned scene in *Killing Them Softly.*

Looping

Another technique is *looping*: the repetition of a sound without any modification of timbre or amplitude of the original sound[126]. Sounds in nature rarely repeat exactly; there is usually some degree of variation in amplitude or timbre (a human performer usually cannot play the same note twice with the exact same intensity and timbre; sound is also colored differently by the space in which it is performed). The film *Blow Out* (1981) offers an example of looping where minimalist repetitions of noise are used for dramatic effect. Of interest for this investigation is the fact that the film uses the creation of film sound as the contextual backdrop of the story, broaching, among others, the issue of direct sound recording with portable audio technology.

Blow Out (1981)

A sound recordist's tape contains material that possibly serves as crime evidence. He plays back a tape in his office; upon realizing that the tape is blank (previous content, if any, must have been erased), he plays back tape after tape in all players available to him. From the middle of the room, the camera continuously does 360 degree pans, showing the increasing chaos of empty tapes covers and the sound editor hectically switching on tape players.

In total six loops can be heard: low freqency thuds, beeps, and noise bursts in different timbres, pitches and periodic rhythms. When the secretary enters the room and asks „Why don't you answer the phone?" the last loop is ironically revealed to be the actual phone ringing (and not a tape playing). When finally answering the phone, the sound recordist states that all his tapes are blank.

The 'cacophony' of loops is also audible when the camera follows the man outside the room[127]. At some point the sound turns into a 'flutter', suggesting that as the tapes end the players are not switched off but run idle.

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[126] Looping was used as a technique on early turntable compositions, where composers would create so-called *lock grooves* to make the needle jump back continuously. This technique was brought into prominence by Pierre Schaeffer.

[127] On a technical note it is worth mentioning that the adjustment of sound level between these two listening perspectives is not obviously noticeable, yet substantial: in both cases, the sound mix consists of the noise loops and dialog; in the editor's room, the looped noises have to be soft enough for dialog to be heard, while in the corridor, they need to 'spill' out of the room.

Sound dominates the narration: it informs the listener (spectator) of the scope of the damage, long before the film's dialog narrates what has happened. In a scene that is fairly dramatic (potential crime evidence has been erased) the film abstains from playing an additionally dramatizing sound element (such as a orchestral score). Rather, the erased and fluttering tapes function as a 'void' where important is not (only) what is actually heard, but what would be heard if those tapes were not erased. The repetitions of noise in minimalist, periodic patterns in this scene may also be viewed as a reflection on the volatile nature of film sound's primary data medium.

	Examples Looping
Electroacoustic Music	*Come Out* (1966, Steve Reich)[128]
Film	*Blow Out* (1981 USA, Brian De Palma)[129]

Table 19: Examples Looping

Playback Speed Manipulation

Changing the playback speed of the tape (projector or tape player) results in change of pitch and therefore timbre. Controlling this manually enables the composer to change pitch over time, for example to imitate an acoustic glissando. After its introduction in *musique concrète* in the 1950s, the technique of slowing down and speeding up sounds has become a common aesthetic in electroacoustic music in cinematic film, put to use in versatile ways through devices such as the *Phonogène* (developed by Pierre Schaeffer and Jacques Paullin in 1953). It is often used to synchronize with the image in scenes of slow-motion, in this way also providing a tool for *subjectivizations* (changes in the listening perspective); and it allows the adjustment of sound elements in pitch or speed to other elements of sound and/or the image.

[128] Holmes 2012: 286

[129] No documentation available. In *Blow Out*, sounds repeat periodically and create a mix of distinct sound loops. No documentation is available to the author as to whether the audio has been produced by actual looping or by means of repeated, timed playback; the former is the more efficient and more exact method.

Frank Warner (Sound Designer for the 1980 film *Raging Bull*) controlled playback speed manually to get a more humanized, less artificial effect: “In doing it by hand you can't control something precisely like you can with a variable electrical control. So a slip of my hand could be magic that just happened.” (qtd. in Flückiger 2001: 286-287). Often quoted for its excellent sound design (Flückiger 2001: 365), *Raging Bull* offers a suitable example for the technique of playback speed manipulation in the scene where La Motta fights Sugar Ray Robinson in what later would become known as the 'Saint Valentine's Day Massacre'.

Raging Bull (1980)

During a short moment in this scene (20 seconds), image and sound slow down. The previously heard sounds (commentator, audience cheering and screaming, fighters moaning, punches etc.) fade out and give room to low frequency sounds which, upon closer listening, can be identified as the protagonist's voice (moaning) and some background hum (perceived as room tone).

At first, the speed remains at a consistent (low) rate. Heavy breathing now sounds like animal growls; the low-pitched room tone gives the typical low frequency rumble that, played at high amplitude, can be physically felt. As Sugar Ray Robinson initiates a punch, playback speed increases dynamically - synchronized to the acceleration of the punch - ending in the return to normal playback speed.

It is plausible that the sound manipulation here was a (successful) attempt to convey the very nature of the fight. On the soundtrack, the human fighters sound like (have become) savage animals who act on instinct and respond to the 'gut feeling' of sensing a threat (a feeling that the audience shares as they physically feel the low frequency sounds).

Found throughout the film (Flückiger 2001: 365), aesthetics of *subjectivization* here shift the narration perspective to that of the heavily stricken protagonist: risking unconsciousness, his perception changes as vision and hearing focus on the adversary. As another aesthetic device, sound is possibly on a par with the image, if not dominating it: the images tell us that this fight is happening in a boxing ring, but the sounds reveal the truly violent nature of what for the spectator is a sports event.

In *2001: A Space Odyssey* (1968), the shutting-down of board computer HAL is exemplified by a gradual decrease of speed and pitch of his voice[130]. The effect is carried to the extreme when HAL sings a children's song in its now unnaturally low voice.

More recently, the manipulation of playback speed can be found in *Inception* (2010), a film in which frequent transitions into and out of dreams are associated with different perceptions of time. In an early scene of the film, Leonardo DiCaprio is woken up from a dream by being dunked in a tub of cold water. The process of waking up is exemplified by the slow-motion fall into the tub, and his subsequent resurfacing from beneath the water, now awake. Both actions are accompanied by sounds that slow down and speed up in a non-linear fashion; audible are rhythmic patterns at different frequencies, but also the characteristic change in timbre.

Adjustment of pitch and time

Given the fact that *playback speed manipulation* results in both a change of frequency and of speed (and duration) of a sound, this technique is often applied to sounds when they require synchronicity to film music. Gates and Rudy (2006) describe that in *Black Hawk Down* (2001), this happens with the (*diegetic*) sounds of helicopters, the rotor blades of which are synchronized to the pulse of the (*non-diegetic*) film score. In *The Godfather II* (1974), the sound of a motor boat is adjusted to be in tune with the film score (Jarrett 2000). Here, the objective is a change of centre frequency of the original sound so that it is in harmonic relation with the film score. In the film *There Will Be Blood* (2007), both variations of the technique can be heard. In one scene, the cry of a baby is adjusted to the pitch centre of the music; in a later scene, the sound of a locomotive engine is adjusted to fit the pulse of the music.

[130]Holmes (2012: 373) writes that parts of this this scene were inspired by Karlheinz Stockhausen's electroacoustic piece *Hymnen* (1966-67).

Reverberation

Yet another approach to using playback speeds creatively comes from sound designer Walter Murch (born 1943). While experimenting with recording sounds at different playback speeds, he has found a means to create artificial reverberation.

> If you are in an ordinary size room and play the voice at four times speed – so you've sped it up four times – and you record it and the other tape is also running at this very fast speed. Then, when you play the second recorder back at normal speed, you get the original sound but you get the space of the room as if it were four times larger than it really is. It's something to do with the physics of recording a sound at that speed and then slowing it down. The original voice returns to normal, but the space of the room balloons outward to 4 times the size that it really is. Even though this sound that you're listening to was recorded in a living room, it sounds like it was recorded in a large space. (Murch 2007)

	Examples Playback Speed
Electroacoustic Music	*Omaggio a Joyce* (1958, Luciano Berio)[131]
	Hymnen (1966-67, Karlheinz Stockhausen)[132]
Film	*2001: A Space Odyssey* (1968 USA, Stanley Kubrick) [133]
	Raging Bull (1980 USA, Martin Scorsese)[134]
	Inception (2010 USA, Christopher Nolan)[135]

Table 20: Examples Playback Speed

[131] Holmes 2012: 80

[132] Holmes 2012: 76

[133] Langlois 2012: 333

[134] Flückiger 2001: 286

[135] Coleman

Reversal

Reversing a sound can be realized by changing the direction of the tape, so that the playback mechanism will first read the 'end' of the recording. The aesthetic interest lies mainly in the timbral and amplitudinal characteristics of a sound and their reversal when the decay plays first, and attack later. A sound with a long decay will take an unnaturally long time to 'start', while the common fast attack results in an equally unnatural abrupt ending.

Reversing sounds offers the possibility of revealing their inherent acoustic characteristics, since the listening process is likely to be focussed on the sound itself – and not its possible cause – when its source or origin is obscured. Different levels of recognizability ('What is that sound?') mean different degrees of abstraction of sounds.

While reversing sounds is one of the signature techniques of composing with magnetic tape, its first appearances in cinematic film go back to the earlier *sound-on-film* format: in the film *Rapt* (1934) a thunderstorm is represented by sounds that are reversed at different speeds. The film *Zéro de conduite* (1933) uses several reversed recordings; among them is a double reversal.

Double Reversal

The concept of *double reversal* is to perform an action reversed and record it, and then reverse the recording itself. In music, a piece is re-notated and performed (and recorded) backwards (retrograded: SOUND – DNUOS). The recording then is reversed, resulting in a melodically and harmonically correct, yet 'alienated' version of the original manuscript, since each sound in itself (attack and decay) is reversed. A well-documented early example for a double reversal applied in cinematic film is *Zéro de conduite* (1933); its well-known 'dormitory' scene features a *double reversal* applied to its film score.

Double reversal can also be applied to the image: in the TV series *Twin Peaks* (1990), filmmaker David Lynch (who is mainly known for his works in cinematic film) uses a double reversal in picture and sound. Parts of the second episode's dream scene have been recorded in reverse: actors move and speak as if following a 'retrograded script'. During post-production, this footage has been reversed, resulting in the correct sequence of events and speech, even though the latter is hard to understand (the sequence is subtitled) and movement seems unnatural.[136]

Another variation of *double reversal* is 'reverse reverb', where a sound is reversed, processed through a reverberator, and reversed again, resulting in the placement of the reverberation before the attack of the sound.

	Examples Reversal
Electroacoustic Music	*Cinq Études de Bruits: Violette* (1948 France, Pierre Schaeffer)[137]
	Symphonie pour une homme seul (1949-50 France, P. Henry, P. Schaeffer)[138]
Film	*Zéro de conduite* (1933 France, Jean Vigo)[139]
	Le Tempestaire (1947 France, Jean Epstein)[140]
	Twin Peaks (1990 USA, David Lynch)[141]

Table 21: Examples Reversal

[136] Visually, this effect can best be imagined by a reversal of gravity. Like the attack of a sound, an action starts at a clearly defined point, and all subsequent actions happen in a decay-like manner, like the 'fading' of an explosion of energy. Thus, movement, like sound, is subject to the notion of beginning (strong, pointy, precise, defined, controlled) and end (fade out, reverb, uncontrolled, spatial). Clapping our hands, we control the initial movement, while after that our hands relax and 'fade away' from the intensity of the initial action. Reversing attack and decay, or beginning and end of an action, puts the point of precision and control at the end of an action, making it start out of 'nowhere'. Hence the 'awkward', 'strange', 'unnatural' feeling we get when hearing and seeing reversed things – even if they have initially been retrograded. We don't see how an action starts; we only see and hear how it ends. Actions look like they are being done by an unseen force, rather than the 'actor' – a passive, yet forceful action. The above mentioned scene in *Twin Peaks* includes a short dance by which underlines the surreal character that the images achieve through the double reversal.

[137] Holmes 2012: 54, 170

[138] Holmes 2012: 55

[139] Langlois 2012: 183

[140] Langlois 2012: 236

[141] Langlois 2012: 191

2.3 Signal Processing

Signal processing is the dynamic manipulation of virtually all of a sound's aspects, typically timbre, dynamics and pitch. Sounds can be changed in amplitude and frequency, and they can be repeated at varying intervals. Signal processing does usually not manipulate time structure as t*ape* m*anipulation* does, and thus leaves sounds more recognizable.

The techniques of *signal processing* can be applied to existing sound sources (recordings) or real time inputs[142]. Used in commercial audio production (often subtly) to attenuate timbre and amplitude in order to enhance a certain sonic quality, electroacoustic music typically applies signal processing to more radical extents – even intending an unrecognizable manipulation of the original sonic character of a sound. Originally analog, digital *signal processing* has mimicked existing techniques and introduced new ones. The most prominent (and, for this thesis, relevant) include: *dynamics manipulation*, *compression*, *filtering* (*EQ*), *reverberation* and *delay*.

Aesthetics of *signal processing* in cinematic film

Signal processing is frequently used in cinema, where it is applied to either the sum of all sounds, for instance to shape the space in which a sound is heard, or a single sound (a sound effect, a piece of dialog etc). Used for the purpose of *subjectivization* (Flückiger 2001: 362), it defines a listening perspective, both in terms of location (what kind of space do we hear?) and individual perception (who hears?). *Subjectivization* is a significant aesthetic in cinematic film: in order to shift the focus of narration to a particular perspective (usually a screen character), sound (and image) no longer give a globally realistic account of the narration (where the spectator hears and sees 'everything' in an 'unfiltered' way); rather, the perception is personalized, expressed through a potentially radical manipulation of image and sound. Techniques of *signal processing* represent a nowadays common way to realize the aesthetic of *subjectivization*; however, early techniques such as the *Theremin* (→ p.39) have achieved similar effects.

[142] Not applicable to cinematic film, real time signal processing is a common technique in electroacoustic music, with Pierre Boulez's *Réponse* (1981) being a prominent example.

The dynamic manipulation of timbre changes the frequency spectrum of a sound while it plays (and is listened to), resulting in an 'active' sound – almost comparable to a glissando - that can have an appeal beyond its existing 'narrative'. In conjunction with the image and the temporal context created through montage in cinematic film, such dynamic manipulations of sound have become representative for narrative elements of motion and transformation. Filtering, for example, the high frequencies out of a sound and back in have become the signature aesthetic for different states of consciousness in a screen character.

A crucial technique for sound in cinematic film, *reverberation* has not only been chief in defining sound 'spaces'. To a greater degree, it has been employed to create spatial, temporal and emotional distance, placing sounds and allowing them to flow along a continuum of intimacy and remoteness.

Dynamics Manipulation

Dynamics manipulation is a basic and possibly the most common technique of *signal processing*. It is used to fade sounds in and out, to adjust an individual level in a complex mix, or to attenuate or boost a group of sounds or even the entire mix.

Amplification can also work on the amplitude envelope of a single sound. The amplitude curve of a sound – describing how a sound starts, develops, and ends – is manipulated, possibly resulting in the complete alienation of the sound from its source. An example is the final chord of The Beatles' *A Day In The Life* (from the 1967 album *Sgt. Pepper's Lonely Hearts Club Band*), the amplitude of which is manipulated to the effect that the chord seems to be held for an unnaturally long time.

The creative possibilities of manipulating the dynamics of sound have been explored early. In the famous 'knife' scene in Alfred Hitchcock's *Blackmail* (1929) only the word 'knife' is intelligible out of different words of normal speech, suggesting a personalized perception – a *subjectivization* rather than an objective hearing – of the dialog.

Compression

A technique of adjusting different amplitude levels within a specific range of sound(s) is called *compression.* Here, the difference in amplitude between soft and loud parts is reduced, resulting in a minimized dynamic range. Compression can be used to make a soft voice seem loud(er). Francis Ford Coppola's *Rumble Fish* (1983) carries this to an extreme: throughout the film, Mickey Rourke speaks in an extremely low voice, at times even whispering. As a result of compression, we hear the voice equally well (but seemingly very soft) among other (seemingly loud) sound sources – dialog, sound effects and film music played by a band – giving the impression of a person that is at the same time soft-spoken and authoritative.

Rumble Fish (1983)

Flückiger (2001: 365) calls the sound of *Rumble Fish* “exemplarily rich”, referring also to the consistent use of aesthetics of *subjectivization* throughout the film. As a matter of fact, the sound of *Rumble Fish* belies and often outrivals its black and white imagery in creating a dense, dynamic and highly narrative mix through the sophisticated and conscious use of signal processing techniques. It therefore deserves detailed mention.

The character portrayed by Mickey Rourke in *Rumble Fish* can't see colors and is partly deaf. As he passes through crowds of people at an amusement fair and a nightlife district we hear mainly dialog and sound effects (ambience: crowd, diegetic music, arcade game sound). However, the sound mix is not realistic: seldom does the film sound give a faithful audio impression of what the image shows (often only one or two voices are heard even though there are many people around; now ambient sounds are loud and clear, now hardly audible). Some sounds are processed with changing degrees of reverberation without any claim to fidelity with the image; others are entirely removed from it (sounds of a child crying, a cuckoo clock and a woman yelling).

The technique of compression applied to the protagonist's voice fulfills several functions. On one hand, his deafness becomes believable: his hearing is directed 'inwards', as a soft tone of voice is sufficient for him to hear and feel himself talking. In addition, his soft voice also portrays a certain weakness due to his physical challenges, while at the same time commanding respect: his authority is natural and does not require him to be loud.

The use of reverb suggests the distance at which the protagonist perceives his environment; changing the ratio of dry to wet sound allows the spectator to now hear through the protagonist's impairment, later without it. The acousmatic sound objects – the crying child, the cuckoo clock and the woman yelling - allude to memories the protagonist and his brother discuss.

In richness, treatment and variation of sound material, the sound of *Rumble Fish* is a *spectacle* (→ *Terminology/Aesthetics of Film Sound* p.19), comparable in sophistication (if not in commercial success or production scope) to films like Star Wars. Sound is on a par with if not dominating the picture: in addition to the 'obvious' challenges of the protagonist - color-blindness (black and white images) and deafness (selective, subjective mix) - his character is conveyed as much through the sound design as through his words and actions. While the image remains black and white (and only occasionally and partially colored), the sound mix is 'colorful' throughout.

Distortion

Finally, *distortion* describes an over-amplification to the point where the sound is 'deformed'. Distortion introduces frequencies not present in the source sound resulting in a 'noisy' sound. The more distortion, the less original signal and the more noise there is. In one scene of the film *Cop Land* (1997), parts of the film sound are distorted to represent a physical pain felt by the protagonist (again resulting in a partial *subjectivization* of the narrative).

	Examples Dynamics Manipulation
Music	*A Day In The Life* (1967 UK, The Beatles)[143]
Film	*Blackmail* (1929 UK, Alfred Hitchcock)[144]
	Rumble Fish (1983 USA, Francis Ford Coppola)[145]
	Cop Land (1997 USA, James Mangold)

Table 22: Examples Dynamics Manipulation

[143] "A Day in the Life"

[144] Weis and Belton 1985: 287

[145] No documentation available. Techniques of *dynamics manipulation* can be clearly recognized when listening to *Rumble Fish* and *Cop Land.*

Filtering (Equalization or Multi-Band Amplification)

Filtering can be described as the manipulation of amplitude in a limited frequency range: filters either boost or attenuate a portion of the audio signal's frequencies. *Filtering* leads to a modification of timbre. By cutting low and high frequencies, the human voice, for example, can sound as if coming out of a small speaker such as a telephone.

When applied dynamically – with parameters changing in real time – *filtering* results in aural aesthetics that suggest a change of listening perspective (one example of the mentioned *subjectivization*). In this case, filtering is usually applied to groups of sounds (e.g. all ambient sounds) or even all film sound. When this change of perspective is synchronized to follow the camera to a different geographical position[146], filtering can imitate the response of sound in different spaces (in reality, sound is affected by the configuration, size and surface materials of a space).

In the second type of *subjectivization*, film characters with intense psychological or physical experiences temporarily 'take over' the way the audience hears the film. This is often achieved with *filtering*. In the above mentioned scene of the film *Cop Land*, the protagonist, already deaf in one ear, has his remaining 'good' ear damaged as well. In the subsequent scenes, sound effects and dialog are filtered; sounds are 'muffled', making the protagonist's hearing impairment audible to the audience. The same happens in *There Will Be Blood* (2007), where the technique is applied in a similar scene: the protagonist's son loses parts of his hearing as a result of a nearby explosion. In a particular moment, the sounds of the explosion are filtered to indicate a *subjectivization* of the narrative (the audience hears what the injured boy hears).

Filtering sounds to indicate a shift in the apparent aural perspective has become a common aesthetic in film sound. They can also happen on a much more abstract or even unrealistic level. Dreams or distortions of time are subjects of filtering, where the real time reduction of the frequency band suggests a transformation of state. For the film *Speechless* (2012), the author of this thesis manipulated bits of speech by filtering them in different ways.

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[146] Michel Chion (*Film, a Sound Art:* 53) calls this the *X-27 effect*: an established sound continues over picture edits that may include a change of location, as long as the sound can be believe d to be heard in the new location (e.g. moving from one room to the next).

Fading them in and out during a dream scene shifts the listening perspective from the 'omniscient' audience to the dreaming protagonist.

	Examples Filtering
Electroacoustic Music	*Glissandi* (1957, György Ligeti)[147]
	Linear Contrasts (1958, Vladimir Ussachevsky)[148]
Film	*Cop Land* (1997 USA, James Mangold)[149]
	There Will Be Blood (2007 USA, Paul Thomas Anderson)
	Speechless (2012 Hong Kong, Simon Chung)[150]

Table 23: Examples Filtering

Reverberation

When occurring naturally, *reverberation* is a " . . . prolongation of the sound, where individual reflections are not discretely perceivable" (Holmes 2012: 229). Depending on the space, these reflections may be filtered. When created artificially, a sound is repeated at minute intervals that will be perceived as reflections. Flückiger (2001: 59) provides a concise overview over the history of reverberation in cinematic film, where reverberation adds the component of space to a sound. Mixing reflections into the 'dry' (original, non-reflected) signal suggests a space in which the signal sounds. The sound thus becomes 'wet' (it contains a high ratio of reflection), indicating that its source is at a distance.

In the electroacoustic music piece *Studie II* (1954), Karlheinz Stockhausen treats synthesized sounds with reverberation, resulting in a more resonant and refined decay pattern that resembles and imitates acoustic sounds in acoustic spaces.

[147]Holmes 2012: 172

[148]Holmes 2012: 115

[149] No documentation available. The result of *filtering* can be clearly recognized when listening to *Cop Land* and *There Will Be Blood.*

[150] The author of this dissertation is the sound designer of *Speechless*.

The same technique is used in cinematic film; most frequently it is a basic tool to create spaces of different sonic qualities. In addition to this, *reverberation* is employed as a means to align sounds on a continuum of intimacy and spaciousness. In *Saving Private Ryan* (1998), voice-overs read condolence letters that the spectator sees being typed in an army office. A non-real time collage (different voices read different letters, blending into each other without finishing full sentences) indicates the vast number of these letters. All voice-overs are treated with reverberation; instead of a 'dry', intimate voice the reverberation suggests distance and a lack of intimacy. At the end of the film, another condolence letter is read – this time addressing the recent death of the protagonist. In this instance, no reverberation is used, suggesting the closeness of protagonist to audience.

The potential of reverberation to express distance and proximity (or even intimacy) aesthetically is most exemplary in the film *Gattaca* (1997). In the film, most indoor shots at the protagonist's workplace are accompanied by sound that is treated with *reverberation*. In that environment, voices always reverberate – even when they speak softly and share confidential information – giving the viewer the impression that even a whisper can be heard clearly anywhere.

	Examples Reverberation
Electroacoustic Music	*Studie II* (1954, Karlheinz Stockhausen)[151]
Film	*Gattaca* (1997 USA, Andrew Niccol)[152] *Saving Private Ryan* (1998 USA, Steven Spielberg)

Table 24: Examples Reverberation

[151] Holmes 2012: 72

[152] The use of *reverberation* can be clearly recognized when listening to *Gattaca* and *Saving Private Ryan.*

Delay

The term *delay* describes artificially created discrete repetitions of a signal; as such, *delay* is a simulation of *echo*[153]. In the tradition of electroacoustic music, *tape echo* is a technique in which the output of a magnetic tape player is fed back into its input, resulting in a (somewhat degraded) repetition of the sound. *Tape delay* extends this technique to two or more tape players, allowing longer periods of time between the discrete signals. The aural characteristic of delay (and its distinguishing mark compared to looping) is a decay in amplitude and a shift in the ratio of signal to noise.

When *delay* happens naturally, its signal repetitions may differ sonically from the original[154]. In cinematic film, it is rarely used, unless a certain degree of artificiality is intended. This happens more often in film music than in dialog or sound effects.

	Examples Delay
Electroacoustic Music	*Four Aspects* (1960, Daphne Oram)[155]
	I of IV (1966, Pauline Oliveros)[156]
Film	*Forbidden Planet* (1956 USA, Fred M. Wilcox)[157]
	Stalker (1979 Soviet Union, Andrei Tarkovsky)[158]

Table 25: Examples Delay

[153] The term e*cho* commonly describes the acoustical phenomenon of naturally occurring reflections of a signal with a distinct time span in between them, perceived as individual repetitions. *Echo* repetitions decay in amplitude and can be filtered (certain frequencies are attenuated); *delays* often simulate *echoes*. The two terms are sometimes used interchangeably.

[154] → *Tape Manipulation/ Techniques/ Cut and Splice* p.69

[155] Holmes 2012: 84

[156] Holmes 2012: 166

[157] Holmes 2012: 101

[158] The use of *delay* and/or *echo* can be clearly recognized when listening to *Stalker.*

Acoustic Signal Processing

In *acoustic signal processing*, the sonic characteristics of a space are utilized to acoustically manipulate an existing sound. Typically, the sound is played back through a monitor speaker and re-recorded; it will be 'naturally' filtered by the space it is playing in. Early sound recording and production studios used so-called 'echo chambers' – rooms designed for reverberant acoustics – or other suitable spaces (staircases, bathrooms etc.) for this purpose.

Alvin Lucier's *I'm sitting in a room* (1969) is a famous example for *acoustic signal processing* in electroacoustic music. Lucier recorded his own voice and played the recording back in the same space; he recorded that playback, and again played it back and recorded it. This process was repeated again and again, to the effect that the speech became unintelligible, while the resonant frequencies of the recording space stood out. In cinema, Walter Murch has coined the term “worldizing” for the acoustic processing of a sound “so that it seemed to be something that existed in real space” (Murch in Jarrett 2000). He used the method prominently in the film *American Graffiti*[159](1973).

[159] "George and I took the master track of the radio show and played it back on a Nagra in a real space—a suburban backyard. I was fifty-or-so-feet away with a microphone recording that sound onto another Nagra, keeping it in sync and moving the microphone kind of at random, back and forth, as George moved the speaker through 180 degrees. There were times when microphone and speaker were pointed right at each other, and there were other times when they were pointed in completely opposite directions. So that was a separate track. Then, we did that whole thing again." (Murch in Jarrett 2000)

Acoustic signal processing requires careful choice of microphone, its placement and polar pattern (sensitivity field determining the recording axis). Creative use of miking includes the moving of the sound source (done by Karlheinz Stockhausen in 1958[160]) or even the microphone, as was the case for the light saber sounds for the *Star Wars* (1977) series.

> In creating the sound effects of the light sabers for Star Wars, Ben Burtt (sound designer for Star Wars) first recorded the raw sound of a stalled electrical motor ("Grrrrrr"). He then added the sound of a television power supply for high frequency sweetening ("Hummm"). However, to encode the recording with a spatial component, Burtt replayed these sounds at half-speed through an amplifier to a speaker and re-recorded them using a shotgun microphone, which he wielded like a sword at various angles in front of the speaker. Because this microphone had a lobed pickup pattern – meaning it was highly directional in its focus – the re-recorded sound floated on and off axis, offering the shimmering oscillation and electronic "whooshes" of the Jedi light saber. (Whittington 2007: 97)

[160] Holmes describes a technique developed by composer Karlheinz Stockhausen: "Kontakte (1958) was a piece for four-track tape. While recording this work in the studio, Stockhausen wanted to create the effect of sounds spinning around the listener at various speeds. To achieve this effect, he mounted a loudspeaker on a manually rotated platform and set up four microphones – one for each tape track – around the platform. Whatever sound he played through the rotating loudspeaker was then recorded onto four individual tape tracks. " (Holmes 2012: 75)

To the present day, and in spite of large sound libraries readily available, sounds are recorded anew for each film; *foley* artists record 'body sounds' (footsteps, clothes, object manipulation), and sound designers re-record sound effects in naturally reverberant spaces. Acoustic signal processing and the creative use of recording technology are essential to the aesthetics of sound in cinematic film in order to place objects in a reverberant environment, and/or to create the sense of dynamic movement.

	Examples Acoustic Signal Processing
Electroacoustic Music	*I'm sitting in a room* (1969, Alvin Lucier)[161]
	Rainforest IV (1968, David Tudor)[162]
Film	*American Graffiti* (1973 USA, George Lucas)[163]
	Star Wars (1977 USA, George Lucas)[164]

Table 26: Examples Acoustic Signal Processing

The past chapters of this thesis have illustrated how electroacoustic techniques are used to create sound through synthesis (1930s); to manipulate recorded sounds and process them (1950s); and to move them into a spatial perspective through acoustic signal processing (1960s). These techniques have resulted in new film sound aesthetics, where sounds have become individual objects that, potentially detached from its sound source, can be assigned to new relationships with other sound elements and/or the image. Having discussed methods of sound creation while roughly following the course of history, the final technique to be discussed in this thesis deals with the presentation of sounds and, more precisely, their placement in a three-dimensional space: multichannel sound, standardized and widely applied in cinematic film in the 1970s.

[161]Collins 2009: 61, 320

[162]Collins 2009: 48, 54

[163]Jarrett 2000

[164]Whittington 2007: 97

2.4 Multichannel Sound and Sound Spatialization

The term *multichannel sound* describes the use of more than two discrete audio signals that are transmitted over individual loudspeakers within a listening environment. While playing the same signal over several speakers is merely a way to allow a larger group of people to listen to the same signal at the same amplitude – a distributed amplification – stereophonic[165] and *multichannel sound* aims to place different sounds in different locations, thus providing an enhanced spatial listening experience. This process is also called *spatialization*. After a unique (if impractical and economically not lucrative) effort to introduce multichannel sound for cinematic film in 1940 (Disney's animation film *Fantasia*), it was established as a technique in electroacoustic music in the 1950s, and finally became standardized for cinema in the 1970s.

The general advantage of multichannel sound is the possibility to distribute sounds in a more life-like setting. Multichannel sound 'imitates' nature where sound sources (and reflections of sound) are distributed all around the listener.

In contrast, a monaural 'performance' of sounds in nature – where all sounds come from a single source – is virtually impossible; however, a monaural sound mix does just that by placing all audio to come from one and the same speaker; a 2-speaker ('stereo') mix uses two speakers. Monaural listening environments (for decades the standard in cinematic film) struggle with muddy sound, phase cancellation and the risk of loud sounds masking weaker ones. The only way to counter this is to carefully select and reduce the number of sounds of similar frequency ranges, and to “line them up like pearls on a thread” (Flückiger 2001: 37[166]).

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[165] Other, more popular terms for *multichannel sound* are *stereophonic* (s*tereo*) *sound* and/or *surround sound*.

[166] Flückiger's thoughts on the early limitations on film sound caused by primitive recording technology apply to monaural sound as well: “The technical limitations did, however, have a positive effect: they resulted in a more economical use of the soundtrack. Each element had a clear narrative function, established with great care and integrated in a sensible manner. Complex layerings of sound object as in Applause (1929, Rouben Mamoulian) were exceptional. Instead, sound objects were lined up like pearls on a thread.” ("Die eingeschränkten technischen Möglichkeiten hatten jedoch auch einen positiven Effekt, denn sie bedingten eine ausgeprägte Ökonomie auf der Tonspur. Jedes Element hatte eine klare erzählerische Funktion, die mit groesster Sorgfalt aufgebaut und sinnvoll in den Kontext integriert wurde. Komplexe Schichtungen verschiedener Klangelemente wie in Applause (USA 1929, Rouben Mamoulian) waren die absolute Ausnahme. Stattdessen wurden die Klangobjekte wie Perlen auf eine Schnur hintereinander aufgereiht.") (Flückiger 2001: 37)

Multichannel Sound in Electroacoustic Music

While multichannel sound has commercial standards for cinematic film, there are no such standardizations in electroacoustic music[167]. Here, sound spatialization can be designed at liberty. A multichannel piece can be composed for a particular space, allowing performance only in that space; it can also use a multichannel setup that can be recreated for the purpose of performance in different venues.

German Karlheinz Stockhausen's *Gesang der Jünglinge* (1955-56) is composed for five channels and performed with five loudspeakers surrounding the audience and it is often considered the first electroacoustic piece with multichannel sound. Stockhausen's *Kontakte* (1958) was a four-channel piece with one loudspeaker in each of the four corners of the performance space. Edgar Varèse's *Poème Electronique*, a three-channel piece to be performed on 400 speakers was composed for the Philips Pavilion[168] of the Brussels World Fair in 1958.

A slightly different approach to multichannel sound in electroacoustic music can be found in the piece *Réponse* (1981) by Pierre Boulez, where the audience, six soloists and loudspeakers surround the ensemble. In addition to sounding acoustically, the solo instruments' sounds are picked up by microphones, processed and then played back over the loudspeakers.

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[167] Not officially standardized but commonly used are formats such as 4-channel and 8-channel.

[168] The Pavilion was designed by the architect Le Corbusier.

Multichannel Sound in Cinema

Fantasia (1940), the first serious attempt at multichannel sound in cinematic film, predates Stockhausen's *Gesang der Jünglinge* by 15 years. The multichannel sound technology used in *Fantasia*, *Fantasound,* was a unique and isolated attempt at providing multichannel sound in a cinematic context; a single film shown in one specific venue that had to travel in order to reach audiences, *Fantasound* was a complex and costly undertaking that, after a few performances, had no further propagation. After *Fantasia* it took more than 30 years for cinematic film to implement a widely accepted and technologically and economically feasible standard for multichannel sound with the introduction of *Dolby Stereo* in 1976. Recognized as pioneering films with multichannel sound are *Star Wars* (1977) and *Apocalypse Now* (1979): “When asked about the prototypes of new aesthetics of film sound, theoreticians and practicians from the US point, in astounding unanimity, to these two productions which (by now) have gained (…) cult status”[169] (Flückiger 2001: 13). The films' respective opening scenes (in *Star Wars* the previously mentioned spaceship flying 'over the heads' of the audience onto the screen; in *Apocalypse Now* the protagonists' alcohol intoxication in his hotel room) are often cited examples for the innovate use of multichannel sound.

A common aim of multichannel sound in cinema is to fully immerse the spectator in sound while keeping a logical relation to the image ahead. The space of cinematic film has always been a square 'peep box', with the audience facing the screen at the front. Filmmakers, sound designers and scholars have been discussing the necessity to keep attention focussed towards the screen, while taking full advantage of the three-dimensional space for sound placement[170].

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[169] “Befragt nach den Prototypen einer neuen Tonästhetik verweisen Theoretiker und US-amerikanische Praktiker in verblüffender Einmütigkeit auf diese beiden Produktionen, die mythisch überhöhten Kultcharakter angenommen haben.”

[170] Technical challenges that sound designers face when producing multichannel sound include the differences of acoustics of production studios compared to those of theatre spaces. Another consideration is the *sweet spot* (the 'best' listening location in the centre of all speakers). The larger the audience, the more difficult it is to provide the same aural experience to a large group of spectators.

Multichannel standards in cinematic film predefine the number of audio tracks available for the film sound mix and the number and position of corresponding speakers in the movie theatre, usually expressed in numbers ('5.1', '7.1' etc.). The challenge for cinematic film has been to find a convention for *which* sounds should go *where.* Considerations for this are, among other things, the cinema space as the listening environment, the question of continuity and the listening perspective. Sounds coming from the back of the audience may be 'true' to the filmic construction, but do they not interrupt the watching and listening situation which is focussed on what's happening in front of the audience? If sounds move according to camera position, what happens if the camera changes perspective? And finally, who is listening – the omniscient spectator or a screen character?

Michel Chion criticizes the attempt to make cinema more realistic through the overambitious use of sound spatialization, claiming that the “in-the-wings-effect” (sounds “lingering” in the surround speakers when their sources are about to enter or after they have exited the picture) and other “offscreen trash” (1994: 83; see also Flückiger 2001: 56) interfere with the artificial world created in a film. Generally, critics of multichannel sound have been voicing the fear that multichannel sound's objective is to 'imitate reality' and thus to suppress the artificial character of cinema.

In response to this claim, it is important to distinguish: multichannel sound does indeed attempt a basic imitation of a 'natural' listening environment (where sounds come from and/or can be perceived as coming from) all directions; however, it does not necessarily imitate the reality of one particular sonic situation or context (unless wanted by the filmmaker). If anything, multichannel sound has introduced the potential for a new aesthetic of sound, where the number of different sounds played, and their spatial placement, can been multiplied. Just like the introduction of *Dolby* (and its increase in dynamic range) has lead to new possibilities to employ silence in film sound, multichannel sound has widened the continuum between 'realistic' and 'artificial' sound placement.

Multichannel Sound Standards in Cinema

Multichannel standards for the film itself (on a carrier medium like film print, disc or hard drive) and the presentation venue (the movie theatre and home theatre systems) have been developed since 1940. At first, discrete signals were played from speakers distributed behind the screen (*Fantasound,* 1940); then, an effect speaker was added at the back of the audience (*CinemaScope,* 1953); then, speakers were added to the right and left walls (*Todd-AO,* 1955 and *Dolby Stereo,* 1976); finally, speakers were mounted on the ceiling (*Hamasaki*, 2005 and *Auro*, 2011). Following is a historical overview of the most common multichannel sound standards.

Year	Name	Field	No. of Channels	Format	First release
1940	Fantasound (Mark series)	Cinema	3.0	Optical	*Fantasia* (USA 1940)[171]
1953	CinemaScope	Cinema	4	Magnetic	*The Robe* (USA 1953)[172]
1955	Todd-AO	Cinema	6	Magnetic	Oklahoma! (USA 1955)[173]
1971	Quadraphonic	Audio	4.0	Magnetic, Vinyl	*Pink Floyd: Dark Side of the Moon* (UK 1973)[174]
1976	Dolby SVA (Dolby Stereo)	Cinema	4.0	Optical	*A Star is Born* (USA 1976)[175]
1976	Dolby Stereo 70 mm Six Track	Cinema	5.1	Magnetic	*Logan's Run* (USA 1976)[176]
1992	Dolby Digital	Cinema	5.1	Digital	*Batman Returns* (USA 1992)[177]
1993	DTS	Cinema	5.1	Digital	*Jurassic Park* (USA 1993)[178]
1993	SDDS (Sony Dynamic Digital Sound)	Cinema	7.1	Digital	*Last Action Hero* (USA 1993)[179]
2005	Hamasaki 22.2[180]	Television	22.2	Digital	Demonstration at 2005 World Expo Aichi, Japan
2010	Dolby Surround 7.1	Cinema	7.1	Digital	*Toy Story 3* (USA 2010)[181]
	10.2	Cinema	10.2	Digital	*Seven Swans* (USA, 2005)[182]
2011	Auro 11.1	Cinema	11.1	Digital	*Red Tails* (USA 2012)[183]
2012	Dolby Atmos	Cinema	64	Digital	*Brave* (USA 2012)[184]

Table 27: Multichannel Sound Standards in Cinema

[171] Flückiger 2001: 46

[172] Flückiger 2001: 47

[173] Flückiger 2001: 49

[174] Calore

[175] "Dolby Stereo"

[176] "Dolby Stereo"

[177] "Dolby Digital"

[178] Flückiger 2001: 55

[179] Flückiger 2001: 55

[180] Hamasaki, Hiyama, and Okumura

[181] "Dolby Surround 7.1 Movies"

[182] "Seven Swans"

[183] "Auro 11.1 Movies | Barco"

[184] "Dolby Atmos Movies"

	Examples Multichannel Sound
Electroacoustic Music	*Gesang der Jünglinge* (1955-56, Karlheinz Stockhausen)[185]
	Poème Electronique (1958, Edgar Varèse)[186]
	Réponse (1981, Pierre Boulez)[187]
Film	*Fantasia* (1940 USA, Producer: Walt Disney)[188]
	Star Wars (1977 USA, George Lucas)[189]
	Apocalypse Now (1979 USA, Francis Ford Coppola)[190]

Table 28: Examples Multichannel Sound

[185] Holmes 2012: 74

[186] Holmes 2012: 358

[187] Holmes 2012: 289

[188] Flückiger 2001: 45

[189] Martin 2010: 91

[190] Martin 2010: 91, Flückiger 2001: 13, 383

2.5 Findings: The potential of electroacoustic music as a language of sound in cinematic film

The examples of electroacoustic compositional techniques and aesthetics in cinematic film brought forward in this thesis show that from the early days of sound film until the present day, these techniques and aesthetics have become a part of cinematic film, often following their first appearance in electroacoustic music (in few exceptional cases the opposite is true: basic *tape manipulation* techniques, for example, can be found in cinematic films of the 1930s, around 15 years before their sophistication in *musique concrète*). Mainstream, commercially oriented methods of film sound production have slowly been absorbing avant-garde aesthetics in a process that asks filmmakers to rethink the role of sound in cinematic film.

Having invaded films of different genres and historical periods in a variety of forms since the 1930s, the soft voice of electroacoustic music now challenges the prevalent belief in the sonic supremacy of the instrumental film score:

> Instrumental music is an art so autonomous that it's much more difficult to integrate it into a film in such a way that it becomes an organic part of it. That's why its utilization often is a compromise; music will always be considered to be an illustration. But electronic music has the capacity to dissolve within sound, to hide behind other sounds, to be the indefinite voice of nature or of confused emotions; to be like breathing. (Andrei Tarkovsky qtd. in Langlois 2012: 365[191])

Like many forms of art and entertainment, cinematic film is, among other things, a means of communication between the filmmaker and the audience in which the former engages the latter. Unique to cinema are the means by which audience engagement is achieved: on the level of narration, story elements create tension and trigger anticipation, often through identification with screen characters. Villains elicit sympathy with their victims, murderers want to be found out, the 'just' verdict reached and the bomb defused before it's too late.

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[191] “La musique instrumentale est un art si autonome, qu'il est beaucoup plus difficile pour elle de s'intégrer au film, au point d'en devenir une partie organique. C'est pourquoi son utilisation comporte très souvent un compromis, parce qu'elle passera toujours pour une illustration. Mais la musique électronique a cette capacité de se dissoudre dans le son, de se cacher derrière d'autres bruits, d'être la voix indéfinie de la nature, ou celle des sentiments confus, d'être comme une respiration.” (qtd. In Langlois 2012: 262)

With the development of cinema technology, the audience has also been engaged in a physical way. The enhancement of the spatial component has meant that the image has become wider (*Cinemascope's* widescreen); sound sources in more loudspeakers started to surround the audience for multichannel sound; in 3D film, depth has been added to the image. As a consequence, the cinema experience has become more and more immersive for the spectator. Film directors have an interest in the participation of the audience with their work, as Walter Murch describes:

> You provoke the audience to complete a circle of which you've only drawn a part. Each person being unique, they will complete that in their own way. When they have done that, the wonderful part of it is that they re-project that completion onto the film. They actually are seeing a film that they are, in part, creating: both in terms of juxtaposition of images and, then, juxtaposition of sound versus image and, then, image following sound, and all kinds of those variations. (Jarrett)

This type of audience participation can be similar to electroacoustic music where unfamiliar sounds provoke thought. Many pieces of electroacoustic music call for *reduced listening* – a mode of listening in which sounds themselves – their timbres[192] - are important, and not the cause and meaning of a sound in a specific context. *Reduced listening*, a term coined by Pierre Schaeffer, is a listening mode that "takes the sound – verbal, played on an instrument, noises, or whatever – as itself the object to be observed instead of as a vehicle for something else" (Chion 1994: 29). This provocation is at the foundation of electroacoustic music.

[192] The material presented in this investigation lends itself to further discussion of the affect of timbres of electroacoustic film sound as opposed to classical (orchestral) acoustic film music. See Eerola for research on "affect dimensions" of isolated acoustic instrument sounds (Eerola, Ferrer, and Alluri 2011).

This contrasts with typical Hollywood film scores, where interpretations are often predefined. 'Blockbuster' film scores provide a musical abstraction of storyline and emotions. Meaning here comes from an existing musical convention and not the sound itself. Film score composers can draw on a vocabulary of triggers which will elicit general assumptions within the audience. To a certain extent, the audience has been conditioned to associate a specific music with a specific emotion[193].

An (extreme) example is the phenomenon of *mickey-mousing*, where not only emotions, but also actions of screen characters are mirrored in the music: glissandi accompany jumps, percussion hits illustrate the subsequent fall; high-pitched, fast melodies in major mode are used for playing kids, and sustained minor chords for a worrying adult. Worthy of note is also the amount of film music in mainstream productions of cinematic film: while the running time of *The Hobbit* (2012) is 169 minutes, its soundtrack album (i.e. the film music released on CD) has a duration of 115 minutes. The actual amount of film music in the film may be higher, considering that the CD release may avoid repetitions or similar variations of a certain piece. The film score is omnipresent and occupies the sonic space by sheer quantity, leaving little room for the audience to digest the events in the film (and for the ears to rest).

In contrast to this, contexts of 'reduced listening' don't impose meaning; rather, they create spaces for interpretation. Ambiguities and unfamiliarities trigger the audience to question, interpret and take guesses; every listener will create a unique context of perception and understanding. The engagement is more subtle and without the customary prescription of interpretation and global, all-embracing significations.

[193] The emotions we experience in a typical film score are not inherent to the sonic material (the physical qualities of a sound) we are presented with. Rather, it's the fact that certain sounds are always linked to the same events that make us believe a sound to be representative of that event. I would like to relate this thought to Flückiger's idea of acculturation: “The hedonistic aspect, the pleasure caused by a sound or a composition of sound, is not bound to physical law, as Helmholtz believed, but it is a consequence of acculturation and individual evaluation.” (“Der hedonistische Aspekt, der Genuss, den ein Klang oder eine Klangkomposition bietet, ist an keine festen physikalischen Gesetzmäßigkeiten gebunden, wie Helmholtz glaubte, sondern eine Folge der Akkulturation und der individuellen Wertung.”) (Flueckinger 2001: 274)

The result can be a more personal involvement with the audiovisual material "to create meaning beyond the surface of the narrative" (Rudy 2007:1), and, as Tarkovsky argues, a sound that is possibly more appropriate for cinema:

> For a cinematographic image to reach its full volume, it seems preferable to renounce all music. Strictly speaking, the world transformed by cinema and the world transformed by sound are two parallel worlds that are in conflict with each other. A sonic world, meticulously organized, is essentially musical. It's on this path that the real music of cinema is hidden . . . I find the sonorities of the world so beautiful that I believe that if we learn to understand them, cinema won't need music anymore.[194] (Tarkovsky qtd. in Langlois 2012: 365)

Where critics have condemned cinema technologies such as sound film, *Dolby* noise reduction and multichannel sound, electroacoustic techniques and aesthetics have shown the potential for a distinctive language of sound in cinematic film – a language that is fully aware of these technologies, and (at least partially) exhausts them.

The unfolding of electroacoustic music's potential for and in cinematic film has been (and is) a long process, in which several conditions needed to be fulfilled. This process saw first experiments (and culture clashes) with new sonorities, their application in certain film genres and, more recently, the sophistication of film sound as an entity in which distinct elements – dialog, music, sound effects – interact with and blend into each other.

New Sounds, Old Melodies

The development of music technology in the 20th century has been the foundation for electroacoustic music and its progression as a new aesthetic in music and sound. New technologies, however, do not necessarily mean instant changes in aesthetics. While cinema has been at the forefront of integrating new technology, it has made little efforts to exhaust the aesthetic possibilities awarded by new technologies. A delay can be detected between the introduction of a new technology, and its application for a truly novel purpose.

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[194] "Pour qu'une image cinématographique puisse atteindre tout son volume, il semble préférable, en effet, de renoncer a la musique. Parce que strictement parlant, le mon de transformé par le cinema et celui transformé par la musique son deux mondes parallèles et en conflit l'un avec l'autre. Un monde sonore minutieusement organisé est déjà musical dans son essence. C'est dans cette voie que se cache la vraie musique au cinema. (…) Je trouve la sonorité du monde si belle, que si nous apprenions a l'entendre correctement, le cinema n'aurait plus besoin de musique." (Tarkovsky qtd. in Langlois 2012: 365)

As mentioned in the introduction to the chapter on *synthesis* (→ p.34), most early devices for synthesis were used to create new timbres, yet hardly anyone wrote truly new music for them. Much to the disappointment of avant-garde composers such as John Cage and Edgar Varèse (Holmes 2012: 17, 21) these instruments were often used in very conventional ways; they imitated acoustic instruments to play classical pieces in an equally classical orchestra or ensemble setting[195].

Langlois (2012: 108) sees one reason for this in the aim to get these instruments recognized as veritable music instruments: only by playing classical music could they be acknowledged as such. On the conservative side of things lies also the commercial reality of the cinematic film where workflow, technical and aesthetic decisions often follow established contexts and templates, and where few people are willing to risk potentially costly experiments with unknown factors.

Holmes (2012: 350), on the other hand, writes of electronic music as a "testing ground for new aesthetic ideas about the art of musical sound". It is possible that in this testing ground, artists first relate to known, existing content with which to experiment, before moving on to entirely new materials.

Yet another possible explanation comes from Kreuzer (2001: 117) who argues that technological novelties are often used in whatever way is most convenient, and in contexts that already exist (the technology is used for the sake of being used), while aesthetics are usually developed later: whenever innovations happen, progressive forces clash with conservative ones[196]. Playing old melodies on new instruments is a compromise between the two[197].

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[195] Interestingly, while the early *Intonarumori* (noise machines → 2.1 *Synthesis* p.34) produced noise and non-musical sounds in mechanic ways, early electronic instruments were used to play tonal music or even emulate acoustic instruments.

[196] Another discrepancy between technical evolution and its application may be CinemaScope. It introduced widescreen cinema in 1953 along with stereophonic – multichannel – sound. Only widescreen, however, survived, leaving audiences with monaural sound until the 1970s. "Where technical innovation takes place, the evaluation of results differs strongly. The history of film has shown this from the very beginning. Those believing in progress have enjoyed the diversification of tools and techniques, while traditionalists have fought against the replacement of the existing by innovation." ("Wo technische Innovation stattfindet, gehen die Bewertungen der daraus resultierenden Ergebnisse stark auseinander. Das hat die Geschichte des Films von Anfang an gezeigt. Fortschrittsgläubige erfreuen sich an der Erweiterung der Gestaltungsmittel, Traditionalisten kämpfen dafür dass das Alte nicht von der Innovation verdrängt wird.") (Kreuzer 2001:117)

[197] Significant in this context is Wendy Carlos' music album *Switched-On Bach*, an album consisting entirely of compositions by Bach, played on synthesisers.

The genre of science fiction film generously employed the *Theremin* – a 'new' instrument – in musically very conventional ways. Productions like *The Day The Earth Stood Still* relied on the instrument to "materialize the immaterial – [but] these new sonorities [were] not necessarily representative of new musical aesthetics[198]" (Langlois 2012: 100). The science fiction genre, however, was most welcoming to new sounds, and it was in this genre that techniques of electroacoustic music grew from sonic trinkets to a serious aesthetic in cinematic film.

Electroacoustic Music and Film Genre

Early electroacoustic content in cinematic film can be found above all in science fiction, mystery films and thrillers. Here, early experiments were made, new sonorities permitted, and the audience led to accept films in which the film music was exclusively electronic. As mentioned above, the introduction of electroacoustic content into film sound had to be justified; genres such as science fiction and thriller could provide this justification.

Science fiction, avant-gardism and cinema "(…) owe much to the discourses of modernism that were in play (…)" (Schmidt 2010: 27) when, inspired by events such as the *Exposition Universelle* in Paris 1900, the world was indeed looking into the future. People's lives changed at a more rapid pace: modern means of communication gradually found their way into their homes (telephone, radio, TV) and with them the ability to connect to far away cultures. Technology was becoming sophisticated, complex and powerful. Cinema itself was a wonder of technology with the coming of sound film and early (if only partially successful) experiments of 3D cinema – both in the 1920s – and first attempts at multichannel sound (Disney's *Fantasia* 1940).

[198] "Since their appearance, composers integrate these devices in their film scores in order to materiali ze the immaterial. However, the application of these novel sonorities is not necessarily synonymous with a new musical aesthetic . . . "). ("Dès leur apparition, les compositeurs intègrent ces appareils a leurs partitions de cin éma afin de matérialiser l'immatériel. Pour autant, l'emploi de ces sonorités nouvelles n'est pas forcement synonyme de renouveau en terme d'esthétique musicale . . . ") (Langlois 2012: 100)

Science fiction film created a playground for experimentation in film sound and film music (Wierzbicki 2005: 22), opening the field for electroacoustic music. Futuristic technologies, mystical, remote territories and alien creatures with supernatural powers were the perfect vehicle for unfamiliar, new sonorities. For the general audience, these sounds very likely made more sense in a science fiction film than in a concert hall. The genre welcomed new technologies: *multichannel sound* (developed in electroacoustic music) was established in cinematic film through the science fiction genre[199].

Science fiction film also benefited from the aura that surrounded the makers of electroacoustic music. Avant-garde musicians themselves were like the 'aliens among us': technology-savvy people far removed from the average audience's everyday life. Gifted with strange powers and the ability to control technology, they discovered and explored new territories.

The noteworthy popularization of experimental, 'underground' music in a mainstream medium[200] also contributed to a diversification and sophistication of film sound. Where noises were crafted with the same artistry and attention to detail as previously music was, they could be more than just a sound effect. Likewise, music was no longer limited to a *non-diegetic* role 'outside' the colorful world of aliens, spaceships and planets. As a result, the traditional borders between dialog, music and sound effects began to melt. Films such as *Forbidden Planet, The Birds* and *Solaris* provided new cinematic experiences not only through the sounds they used, but also how these sounds related to what happened on the screen.

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[199] "Concurrently, new multichannel technology allowed filmmakers to strategically deploy these sounds within the theatrical exhibition space to create new types of spectacle and sensations. It is not surprising that this multifaceted model of sound design is best exemplified by and often mediated by a genre that is about the exploration and definition of constructed spaces, the science fiction genre. For this reason, Star Wars emerged as a pivotal film that exemplified and solidified the means and model of sound design." (Whittington 2007: 95)

[200] Film theorists saw no contradiction in this clash of sub- and mass culture: "Eisler and Adorno wrote of the affinity between King Kong and the avant-garde with absolutely no sense of conflict or irony. That is, even though they clearly viewed cinema as mass art, at least in its western industrial carnation, they did not hesitate at the prospect of incorporating the new, cutting edge music in the populist cinema." (Schmidt 2010: 26)

Music or Sound Effect? Interdiegetic Sound

Traditionally, the different elements of film sounds are created and employed in strict separation from each other. In the production process, dialog, music and effects are often edited and mixed by three different teams[201]. In the theatre space, they sound on different speakers (dialog is usually placed on the centre channel and sounds that do not require active listening are placed on the surround speakers). Finally, in relation to space and time of the film, sounds are either part of what we see (*diegetic*) or part of an external continuum (*non-diegetic*), such as an omniscient commentary.

Electroacoustic techniques and aesthetics in cinematic film have been shown to possess the potential to blur the borders between these separations, especially between the *diegetic* and *non-diegetic* sphere in film sound. Sounds may belong to more than one sphere, and/or to create a new sphere altogether: a piece of film music could be perceived as such, or as a sound effect (or vice versa). A connector and 'synchronizator' between the images and film sound, this piece floats between *diegetic*, on-screen action and the *non-diegetic*, metaphorical and invisible continuum.

This phenomenon has introduced a new dimension of film sound – the *interdiegetic*[202] place. Similar to Chion's *acousmêtre* (→ *Terminology/Aesthetics of Film Sound* p.19), *interdiegetic sounds* share the ambiguity of being neither inside, nor outside the image, but are not restricted to being voices.

In the classical film score, the sound source has almost no potential for a physical (and non-comical) relation to visual elements. Only the musical abstraction has a justified (if not realistic) place in the film: we accept the soft, melodious strings in the sonic background of a romantic scene, but completely ignore the violinist. However, if a sound source can be believed to exist in the image (clearly visible or not), it is obviously close to the objects on screen.

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[201] "During the period of sound-on-film, the sound mix had its limitations, partly because of the quality of the recording media, but especially because whole scenes, that is, pieces of about 10 minutes, had to be mixed in one go. The workflow developed in that time – one Re-Recording Mixer for Dialogue, Music and Effects – is still in use in Hollywood today." (" . . . der Mischung [waren] während der Lichttonära relativ enge Grenzen gesetzt, teilweise aus Gründen der Materialqualität, vor allem aber weil ganze Akte, das heisst rund 10-minuetige Teile, in einem Durchgang gemischt werden mussten. Die damals entwickelte Arbeitsteilung zwischen je einem Mischtonmeister (Re-Recording Mixer) fuer Sprache, Musik und Geräusche ist heute in Hollywood noch üblich.") (Flückiger 2001: 60)

[202] I first read this term in Rudy (2007). While he extends the concept of film sound in different narrative places by introducing concepts such as *pan-diegesis* and m*eta-diegesis*, this research uses of the term *interdiegetic* to describe any instance where sound can be identified as diegetic or non-diegetic. Interdiegetic connections can also be created artificially, such as the comical "mickey-mousing" (described in Bordwell and Thompson 2001: 302).

Here, the relation between sound source and screen objects is not abstract, but immediate. Electroacoustic music can replace the musical abstraction of acoustic film scores with concrete sounds[203] that can *be* there – in the film. If this potential is fulfilled, electroacoustic music has the unique ability to 'synchronize' to the image and at the same time still assume the function of film music: an aestheticized commentary of the narrative. This provides for a design of film sound that is more dynamic, organic and fluid compared to traditional acoustic film scores.

Prime examples of this include film music of the aforementioned *Forbidden Planet*[204] (where sound effects are part of the film score and vice versa); electronic sounds in *The Birds*[205] (accompanying the birds and therefore often described as sound effects; upon closer listening, however, they reveal themselves to be overly artificial and not necessarily synchronized); synthesized sounds from the *ANS* in *Solaris* (where parts of Artemyev's film score do not stand out as film music, but remain in the background, providing a credible ambient sound for a spaceship); and Gus Van Sant's *Elephant* (2003), in which electroacoustic music pieces provide different *found sounds* (rainforest, train station) that blend with the film setting (a high school).

Such pioneering works of cinematic film are the result of collaborations between sound 'makers' and filmmakers where the former is given the time, liberty and resources necessary to work creatively; and where the latter engages in this collaboration. In commercial film making, such collaborations are more often exceptions than they are the rule. The examples of electroacoustic music in cinematic film mentioned in this thesis, however, represent those exceptions, and it is through these and similar projects that the development of film sound has been carried forward.

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[203] The similarity to the discussed *musique concrète* is more than obvious.

[204] Wierzbicki (2005: 27) writes about Forbidden Planet: “Electronic sounds did not simply accompany ”foreign” narrative objects; in many cases, they seemed to emanate directly from them.”

[205] “The bird sounds are often so stylized that if the visual source were not provided, the sounds could not be identified. The effect of the resulting ambiguity is to universalize the noises.” (Weis and Belton 1958: 306)

Collaboration and Creativity, Production and Workflow

> Film music . . . presents a tremendous opportunity for collaboration. It would be ideal for the director, the cinematographer, the editor, and the composer to be in on the picture from the start so that they could exchange ideas. (Louis Barron in Wierzbicki 2005: 36)

Inventive sound work has to be initiated[206] and backed up by those actually creating the film: filmmakers and producers need to interact with the person in charge of film sound. Ideally, the sound designer is, to some extent, part of the filmmaking progress from the beginning; likewise, the director is aware of, familiar with and/or interested in the sound design process.

Flückiger (2001: 19)[207] stresses the importance of time and creative leisure in the process of film sound design. Progress, according to her, does not necessarily depend only on financial resources, as long as ideas and knowledge can unfold and are not suffocated by budgetary restrictions, time constraints and potentially outdated production chains. Such artistic freedom is often inherent to audiovisual productions such as those described in chapter 5. In cinematic film, however, such experiments are rare and a privilege, both in contemporary cinema as well as early sound film (Langlois 2012: 137)[208].

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[206] “The push had to come from the director—somebody like Hitchcock or Welles—who said, "I am interested in sound." Otherwise, the tendency was to do a journeyman-like job and not spend too much money because they'd already jumped over the post so to speak, since there was sound to begin with. The really creative use of sound was something that took time.” (Murch in Jarrett 2000)

[207] “Time, creative leisure and an individual workflow seem to be important elements of the new aesthetic. Incidentally, it becomes obvious that progressive concepts can sometimes be realized with modest technical means, as long as ideas and knowledge can unfold and are not suffocated by budgetary restrictions and obsolete production chains.” (“Zeit und kreative Musse in Verbindung mit einem individualisierten Arbeitsprozess erscheinen als wichtige Determinanten der neuen Ästhetik. Ganz nebenbei wird hier auch deutlich, dass fortschrittliche Konzepte manchmal mit den bescheidensten technischen Mitteln erreicht werden können, wenn Ideen und Wissen genügend Freiraum erhalten, um sich zu entfalten, und nicht von vornherein durch ökonomische Zwänge und erstarrte Arbeitsmechanismen erstickt werden.”) (Flückiger 2001: 19)

[208] “In the beginning of sound cinema, those composers that had the luxury to experiment on the soundtrack were rare and privileged: they benefit from exceptional situations, independent investments or willing . . . directors.” (“Aussi, dans le contexte des débuts du cinema parlant, les compositeurs qui ont le loisir d'expérimenter sur le plan sonore sont rares et privilégiés: Ils ont pu profiter de situations exceptionnelles, d'investissements indépendants, ou de réalisateurs «consentants» voire «pratiquants» ”.) (Langlois 2012: 137)

In the reality of filmmaking, the sound designer and/or music composer are seldom involved in any creative decision-making regarding the overall aesthetics of the film. The typical film production process is filled with templates of workflow (the previously mentioned separation of dialog, sound effects and music editing), aesthetic expectations (*temp-tracks*[209]) and budgetary limits. It often neglects sound during pre-production[210] and during the shooting (*production*), while the importance and attention given to the story and the image is unquestioned[211].

The earlier mentioned lack of sound film research (→ *Objectives and Scope* p.18) is paralleled by a certain ignorance of sound in the practice of filmmaking:

> Many feature film directors tend to oscillate between two wildly different states of consciousness about sound in their movies. On one hand, they tend to ignore any serious consideration of sound (including music) throughout the planning, shooting, and early editing. Then they suddenly get a temporary dose of religion when they realize that there are holes in the story, weak scenes, and bad edits to disguise. Now they develop enormous and short-lived faith in the power and value of sound to make their movie watchable. Unfortunately it's usually way too late, and after some vain attempts to stop a haemorrhage with a band-aid, the Director's head drops, and sound cynicism rules again until late in the next project's post production. (Thom 1999)

[209] *Temp-tracks* are pieces of music that directors and/or film editors employ to test images or scenes with different types of music before the composer is asked to start composing. It is not uncommon that the score composer is then asked to recreate the mood of a particular music, rather than providing an independent composition.

[210] Speaking about the role of film music composers in sound films of the '30s and '40s, Langlois (2012: 138) suggests it was "hard to imagine a film project where the sound person is involved from the beginning". (" . . . il apparaît très difficile d'envisager un projet musicale concerte avec le metteur en scène, poncé de l'origine d'un film. ")

[211] An interesting approach to explain this comes from Sergi (2004: 75) who states that during production, most departments and people are working for the image (camera, light, props, wardrobe, makeup, continuity...); during post-production, that ratio becomes very different, with sound receiving far more attention than during the actual filming.

Prominent exceptions to the 'standard treatment' of sound in film have resulted in pioneering works in cinematic film. For *Eraserhead*, about one third of all sounds used in the film were produced – to a large extent by its director David Lynch – before the actual film was shot (Langlois 2012: 375); *Forbidden Planet*, the first film with an entirely electronic score, was “breaking Hollywood precedent” (Wierzbicki 2005: 9) in that the composers worked in their own studio, and they were given complete artistic and aesthetic freedom. Working with Russian composer Eduard Artemyev on the sound of several of his own films (*Solaris*, *Stalker*), Andrei Tarkovsky has been continuously investigating the film sound he employs, gradually replacing music with sounds. Final mention shall be made of Walter Murch who is arguably the pioneer of modern sound design in cinematic film. His impact on film sound results not only from his artistry of sound design itself, but also the fact that Murch was editing the picture of numerous films as well, working in close collaboration with their directors and producers (e.g. Francis Ford Coppola, George Lucas).

Conclusion

Techniques of sound and image creation in cinematic film have been constantly evolving, leading the audience from black and white 'silent' cinema to widescreen 3D films with multichannel sound. The basic relationships between image and sound and their treatment in cinematic film, however, largely remain the same as they were a century ago (even before the birth of sound film). Investigating the role of electroacoustic content in cinematic film reveals pioneering exceptions of these relationships and supports an understanding and appreciation for the possibilities of sound in cinematic film. Judging from this, it seems to be yet early days for an exhaustion of the creative potential of sound in cinema.

This thesis has pointed out the fundamental role that technology has played in film sound, and the resulting aesthetic diversification and sophistication. Of great importance is the acknowledgment that technology is both tool and limitation: where technologies are employed solely for the sake of being employed, their product fails to fulfill the aesthetic mission for which they might have been intended.

In the film *Black Hawk Down*, synthesized imitations and actual recordings of helicopter sounds are used as the leitmotif. The film's sound design showcases a wide array of techniques and aesthetics, among which are those discussed in this thesis. This part of the film's sound – the sound design – succeeds in being a creative expression with a life of its own, adding to the narrative and complementing it artistically.

In addition to winning an Oscar in the category *Best Sound* (74th Academy Awards, 2002), the film has received academic attention: Rudy (2004:1) has written about elements of its sound design that "traverse seamlessly between the sound effects montage and the traditional orchestral sound score", making them *inter-diegetic*.

This sound of *Black Hawk Down* is mixed with music consisting of an acoustic and synthesized orchestral film score and different pieces of popular music (rock and pop songs). The score (by Hollywood composer Hans Zimmer) follows a largely western aesthetic of film score mixed with vocal references to Arabic music; the rock and pop songs (a small part of which appear as *diegetic* music) cover different genres such as rock, reggae and hip hop.

Both film score and songs appear in large quantities; the sound design has to share its 'space' with a rather eclectic mix of music. While the aesthetic merit of the sound design is unquestioned, I argue that its complexity and artistry will, in many cases, go unnoticed and – worse – be suffocated by the sentimental and comparatively unsophisticated music. *Black Hawk Down* is, therefore, a prime example for the status quo of sound in cinematic film: a unique and distinct sound is available, but made quasi-obsolete by existing conventions of production and aesthetics.

Prospects

The interplay of technology and aesthetics has led to a film sound that is not merely a naturalistic juxtaposition of dialog, music and sound effects, but a coherent, artistic composition that is as much musical as it is conscious of its narrative mission in relation to the image. The emancipation of film sound as an independent entity, synchronized (or not) to the image (and vice versa) with the advent of modern film in the 1960s has lead to a context in which films can be listened to as much as they are watched.

Often dating back to the beginnings of sound film in the late 1920s, hierarchies and criteria that qualify a sound other than its very own sonic character seem at times counterintuitive. Such classifications according to production method, author, diegetic function or speaker placement remain, however, widespread. Reassessing these largely technical conventions in both theory and practice holds potential for a focusing on the aesthetic purpose and a wider understanding in general.

The perseverative use of the traditional film score deserves rethinking, especially where it coincides synchronously with noises and dialog. The question of ubiquitousness and therefore vertical sound design (at any given moment) extends to and implies the question of density of film sound over time (horizontal composition): dynamic and versatile sound mixes with changing sound levels and quantities of sound objects can be seen as the counterpart of different shots and perspectives in the image, highlighting their importance for the reading of the film[212]. The complete abandoning of classical or popular music in film is not suggested, but a conscious balancing with other elements of film sound is.

[212] „The acoustic dynamic, that is the tension between the softest and highest sound level, and the organization of sound levels in between can be seen as counterpart of the image perspective. Similar to the perspective, (the acoustic dynamic) is a structural device for the organization of the acoustic space that forces the listener to a specific reading." ("Die akustische Dynamik, das heisst die Spannung zwischen grösstem und kleinstem Pegel und die Organisation der Pegel dazwischen kann als Gegenstück zur Perspektive des Bildes aufgefasst werden. Ähnlich wie die Perspektive ist sie ein strukturelles Mittel zur Organisation des akustischen Raums, das den Hörer unausweichlich zu einer spezifischen Lesart zwingt.") (Flückiger 2001: 243)

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La Petite Lise (1930 France, Dir. Jean Grémillon)

Blackmail (1929 UK, Dir. Alfred Hitchcock, Dist. UK: BIP, USA: Sono Art-World Wide Pictures)

Romance Sentimentale (1930 France, Dir. Sergei M. Eisenstein/Grigori Aleksandrov)

Enthusiasm (Symphony of the Donbass) (1930 Soviet Union, Dir. Dziga Vertov)

Stürme über dem Montblanc (1930 Germany, Dir. Arnold Fanck)

Odna (1931 Soviet Union, Dir. Leonid Trauberg/Grigori Kozintsev, Mus. Dmitri Shostakovich, Dist. Soyuzkino)

La fin du monde (1931 France, Dir. Abel Gance)

Tönende Handschrift (1932, Dir. Rudolf Pfenninger)

Komsomol (1932 Soviet Union/East Germany, Dir. Joris Ivens, Mus. Hanns Eisler)

Counterplan (1932 Soviet Union, Dir. Sergei Yutkevich/Fridrikh Ermler, Mus. Dmitri Shostakovich)

Ornament Sound Experiments (1932 Germany, Dir. Oskar Fischinger)

Zéro de conduite (1933 France, Dir. Jean Vigo, Dist. Gaumont)

King Kong (1933 USA, Dir. Merian C. Cooper/Ernest B. Schoedsack, Dist. RKO Radio Pictures)

The Kidnapping (Rapt) (1934 France/Switzerland, Dir. Dimitri Kirsanoff, Mus. Arthur Hoérée)

Liliom (1934 France, Dir. Fritz Lang, Mus. Jean Lenoir, Franz Waxman)

L'idée (The Idea) (1932 France, Dir. Berthold Bartosch, Mus. Arthur Honegger)

Stärker als Paragraphen (1936 Germany, Dir. Jürgen von Alten)

Love on the Wing (1939 UK, Dir. Norman McLaren)

Rebecca (1940 UK, Alfred Hitchcock, Mus. Franz Waxman, Dist. United Artists)

Five Film Exercises (1934/44 USA, Dir. John and James Whitney)

Lady in the Dark (1944 USA, Dir. Mitchell Leisen, Mus. Kurt Weill, Dist. Paramount Pictures)

The Lost Weekend (1945 USA, Dir. Billy Wilder, Mus. Miklós Rózsa, Dist. Paramount Pictures/Universal Studios)

Spellbound (1945 USA, Dir. Alfred Hitchcock, Mus. Miklós Rózsa, Dist. United Artists)

The Spiral Staircase (1946 USA, Dir. Robert Siodmak, Mus. Roy Webb, Dist. RKO Pictures)

Le Tempestaire (1947 France, Dir. Jean Epstein)

The Red House (1947 USA, Dir. Delmer Daves, Mus. Miklós Rózsa, Dist. United Artists

The Pretender (1947 USA, Dir. W. Lee Wilder, Dist. Republic Pictures)

The Road to Rio (1947 USA, Dir. Norman McLeod, Mus. Robert Emmet Dolan, Dist. Paramount Pictures)

Red River (1948 USA, Dir. Howard Hawks, Mus. Dimitri Tiomkin, Dist. United Artists)

*Rocketship X-M (*1950 USA, Dir. Kurt Neumann, Mus. Ferde Grofé Sr., Dist. Lippert Pictures)

*Now is the Time (*1951 Canada, Dir. Norman McLaren)

The Day the Earth Stood Still (1951 USA, Dir. Robert Wise, Mus. Bernard Herrmann, Dist. 20th Century Fox)

The Thing from Another World (1951 USA, Dir. Christian Nyby, Mus. Dimitri Tiomkin, Dist. RKO Radio Pictures)

Astrologie ou le miroir de la vie (1952 France, Dir. Jean Grémillon, Mus. Pierre Henry)

Bells of Atlantis (1952 USA, Dir. Ian Hugo, Mus. Louis and Bebe Barron)

The 5000 Fingers of Dr. T. (1953 USA, Dir. Roy Rowland, Mus. Frederick Hollander, Dist. Columbia Pictures)

It Came from Outer Space (1953 USA, Dir. Jack Arnold, Mus. Irving Gertz, Dist. Universal Studios)

Blinkity Blank (1955 Canada, Dir. Norman McLaren)

Rear Window (USA 1954, Alfred Hitchcock, Dist. Paramount Pictures)

The Mad Magician (1954 USA, Dir. John Brahm, Mus. Arthur Lange, Dist. Columbia Pictures)

Jazz of Lights (1954 USA, Dir. Ian Hugo)

Day The World Ended (1955 USA, Dir. Roger Corman, Mus. Ronald Stein, Dist. American Releasing Corporation)

Symphonie Mécanique (1955 France, Dir. Jean Mitry, Mus. Pierre Boulez)

Forbidden Planet (1956 USA, Dir. Fred M. Wilcox, Mus. Louis and Bebe Barron, Dist. MGM)

The Man Who Knew Too Much (1956 USA, Dir. Alfred Hitchcock, Dist. Paramount Pictures/Universal Pictures)

The Ten Commandments (1956 USA, Dir. Cecil B. DeMille, Mus. Elmer Bernstein, Dist. Paramount Pictures)

Earth vs. the Spider (1958 USA, Dir. Bert I. Gordon, Mus. Albert Glasser, Dist. American International Pictures)

Silent Star (1960 GDR/Poland, Dir. Kurt Maetzig, Mus. Andrzej Markowski)

Lawrence of Arabia (1962 UK, Dir. David Lean, Mus. Maurice Jarre, Dist. Columbia Pictures)

No Exit (1962 USA/ARG, Dir. Tad Danielewski, Mus. Vladimir Ussachevsky, Dist. Zenith International Films)

The Birds (1963 USA, Dir. Alfred Hitchcock, Mus. Oskar Sala/Remi Gassmann, Dist. Universal Pictures)

Kwaidan (1964 Japan, Dir. Masaki Kobayashi, Mus. Toru Takemitsu, Dist. Toho)

The Woman in the Dunes (1964 Japan, Dir. Hiroshi Teshigahara, Mus. Toru Takemitsu, Dist. Toho)

The Saragossa Manuscript (1965 Poland, Dir. Wojciech Has, Mus. Krzystof Penderecki, Dist. Film Polski)

Line of Apogee (1968 USA, Dir. Lloyd Michael Williams, Mus. Vladimir Ussachevsky)

2001: A Space Odyssey (1968 USA, Dir. Stanley Kubrick, Dist. MGM/Warner Bros.)

Shame (1968 SWE, Dir. Ingmar Bergman, Dist. Lopert Pictures Corporation)

Doppelgänger/Journey to the far side of the sun (1969 UK, Dir. Robert Parrish, Dist. Rank Organization/Universal Pictures)

Synchromy (1971 Canada, Dir. Norman McLaren, Prod. National Film Board of Canada)

The Andromeda Strain (1971 USA, Dir. Robert Wise, Mus. Gil Mellé, Dist. Universal Pictures)

Walkabout (1971 AUS/UK, Dir. Nicolas Roeg, Dist. 20th Century Fox)

THX 1138 (1971 USA, Dir. George Lucas, Sound Montage Walter Murch, Dist. Warner Bros. Pictures)

Solaris (1972 Soviet Union, Dir. Andrei Tarkovsky, Mus. Eduard Artemyev, Dist. Visual Programme Systems)

Frogs (1972 USA, Dir. George McCowan, Dist. American International Pictures)

American Graffiti (1973 USA, George Lucas, Dist. Universal Pictures)

High Plains Drifter (1973 USA, Dir. Clint Eastwood, Dist. Universal Studios)

The Legend of Hell House (1973 UK, Dir. John Hough, Mus. Delia Derbyshire, Dist. 20th Century Fox)

The Conversation (1974 USA, Dir. Francis Ford Coppola, Dist. Paramount Pictures)

The Godfather 2 (1974 USA, Dir. Francis Ford Coppola, Mus. Nino Rota, Dist. Paramount Pictures)

Close Encounters of the Third Kind (1977 USA, Dir. Steven Spielberg, Dist. Columbia Pictures)

Eraserhead (1977 USA, Dir. David Lynch, Sound Effects David Lynch/Alan R. Splet, Dist. Libra Films International)

Star Wars (1977 USA, Dir. George Lucas, Sound Des. SFX Ben Burtt, Dist. 20th Century Fox)

The Demon Seed (1977 USA, Dir. Donald Cammell)

The Deer Hunter (1978 USA, Michael Cimino, Dist. Universal Pictures/Columbia/Warner)

Midnight Express (1978 USA, Dir. Alan Parker, Mus. Giorgio Moroder, Dist. Columbia Pictures)

The Shout (1978 UK, Dir. Jerzy Skolimowski, Mus. Tony Banks, Dist. The Rank Organisation)

Stalker (1979 Soviet Union, Dir. Andrei Tarkovsky, Mus. Eduard Artemyev)

Apocalypse Now (1979 USA, Dir. Francis Ford Coppola, Sound Designer Walter Murch, Dist. United Artists)

The Shining (1980 USA, Dir. Stanley Kubrick, Mus. Wendy Carlos et. al., Dist. Warner Bros. Pictures)

Raging Bull (1980 USA, Dir. Martin Scorsese, Supervising Sound Effects Editor Frank Warner, Dist. United Artists)

Blow Out (1981 USA, Dir. Brian De Palma, Dist. Filmways Pictures)

Liquid Sky (1982 USA, Dir. Slava Tsukerman, Mus. Brenda I. Hutchinson)

Rumble Fish (1983 USA, Dir. Francis Ford Coppola, Dist. Universal Pictures)

A Visitor to a Museum (1989 Land: Soviet Union/Switzerland/West Germany, Dir. Konstantin Lopushansky, Mus. Viktor Kisin/Alfred Schnittke)

My Left Foot (1989 Ireland/UK, Mus. Elmer Bernstein, Dist. UK: Granada Films, Miramax)

Twin Peaks (1990 USA, Dir. David Lynch, Dist. Republic Pictures/CBS Television Distribution)

Barton Fink (1991 USA, Dir. Ethan and Joel Coen, Dist. 20th Century Fox)

The Double Life of Véronique (1991 Poland/France/Norway, Dir. Krzysztof Kieślowski, Dist. Miramax)

Blue (1993 UK, Dir. Derek Jarman, Dist. Basilisk Communications Ltd)

Farinelli (Italy/Belgium/France 1994, Gérard Corbiau, Dist. Sony Pictures Classic)

The English Patient (1996 UK/USA, Dir. Anthony Minghella, Editor Walter Murch, Dist. Miramax Films)

Cop Land (1997 USA, Dir. James Mangold, Dist. Miramax Films)

Gattaca (1997 USA, Dir. Andrew Niccol, Dist. Columbia Pictures)

Saving Private Ryan (1998 USA, Dir. Steven Spielberg, Dist. Paramount Pictures)

In Absentia (2000 UK, Dir. Timothy and Stephen Quay, Mus. Karlheinz Stockhausen, Dist. Zeitgeist Films)

Black Hawk Down (2001 USA, Dir. Ridley Scott, Mus. Hans Zimmer, Dist. Columbia Pictures)

Elephant (2003 USA, Dir. Gus Van Sant, Dist. Fine Line Features)

Paranoid Park (2007 USA, Dir. Gus Van Sant, Dist. IFC Films)

There Will Be Blood (2007 USA, Dir. Paul Thomas Anderson, Mus. Jonny Greenwood, Dist. Paramount Vantage/Miramax Films)

Sunshine (2007 Dir. Danny Boyle, Mus. John Murphy/Underworld, Dist. Fox Searchlight Pictures)

Inception (2010 USA, Dir. Christopher Nolan, Dist. Warner Bros. Pictures)

Speechless (2012 China/Hong Kong, Dir. Simon Chung, Sound Des. Sebastian Seidel, Dist. Breaking Glass Pict.)

Killing Them Softly (USA 2012, Dir. Andrew Dominik, The Weinstein Company)

The Silent War (2012 China/Hong Kong, Dir. Alan Mak/Felix Chong, Dist. Mei Ah Entertainment)

Elysium (USA 2013, Dir. Neill Blomkamp, Dist. *TriStar Pictures)*

The Last Stand (USA 2013, Dir. Kim Jee-woon, Dist. Lionsgate)

The Numbers Station (UK/USA 2013, Dir. Kasper Barfoed, Dist. Image Entertainment)

Dallas Buyers Club (USA 2013, Dir. Jean-Marc Vallée, Dist. Focus Features)

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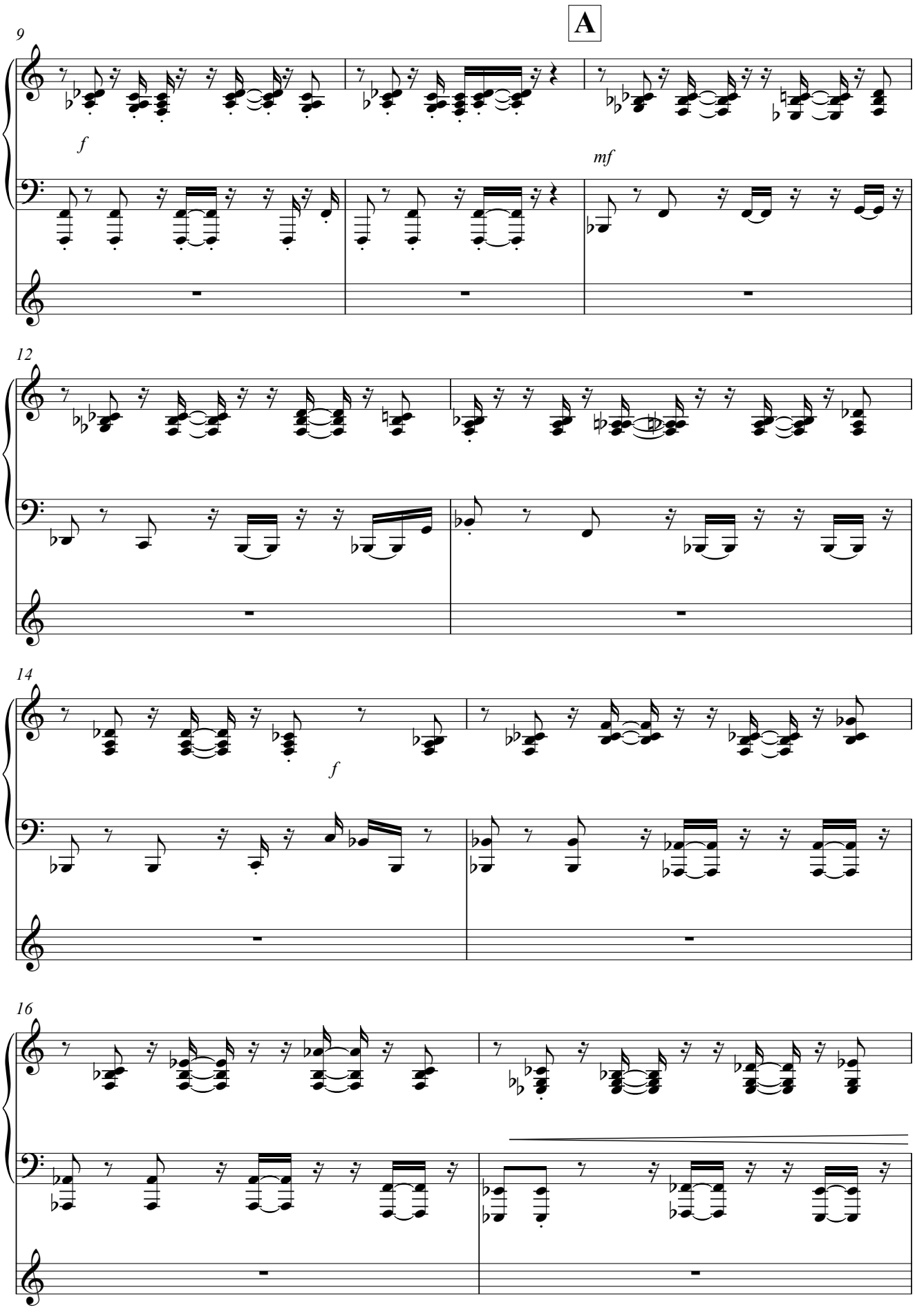
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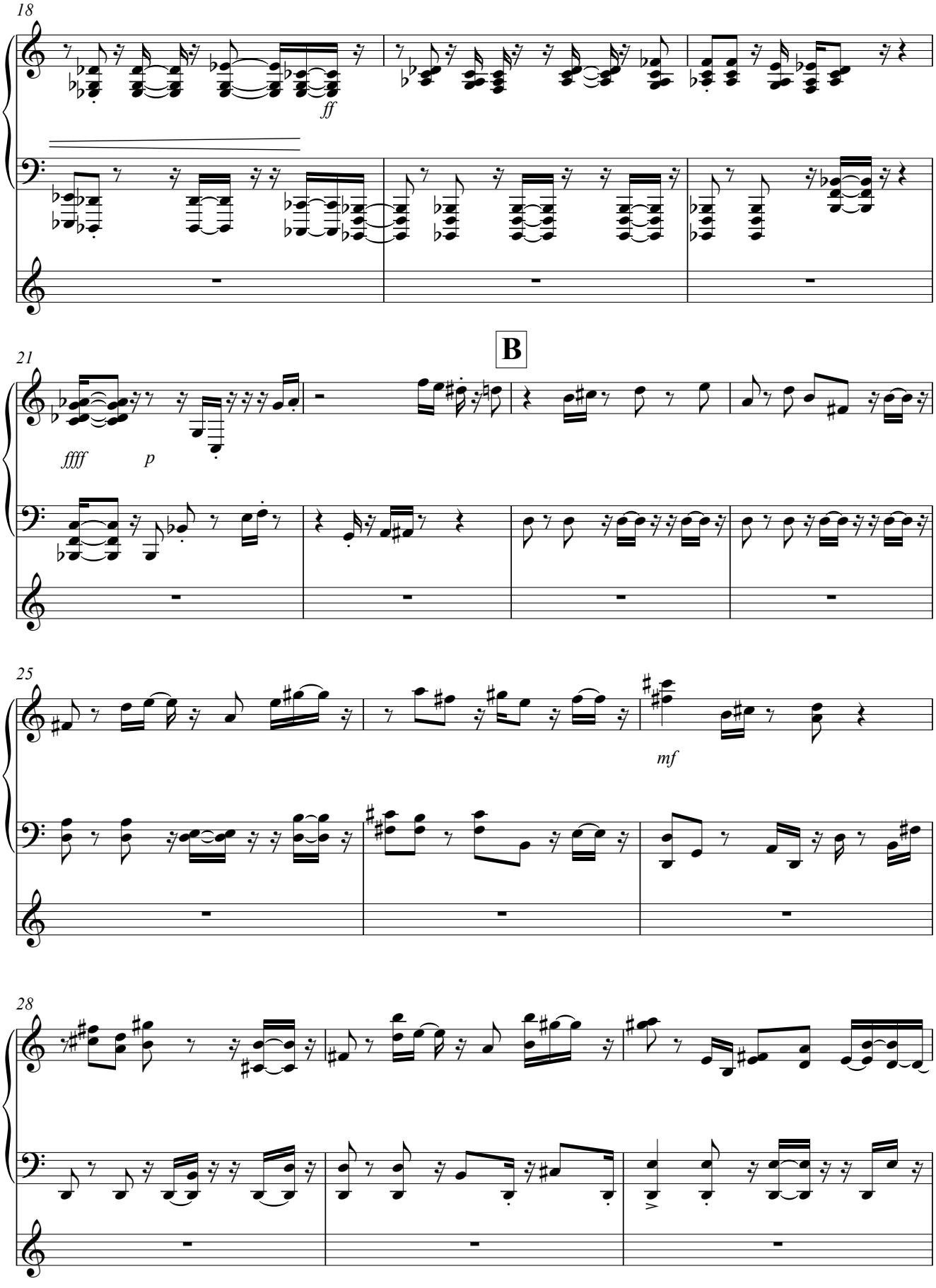
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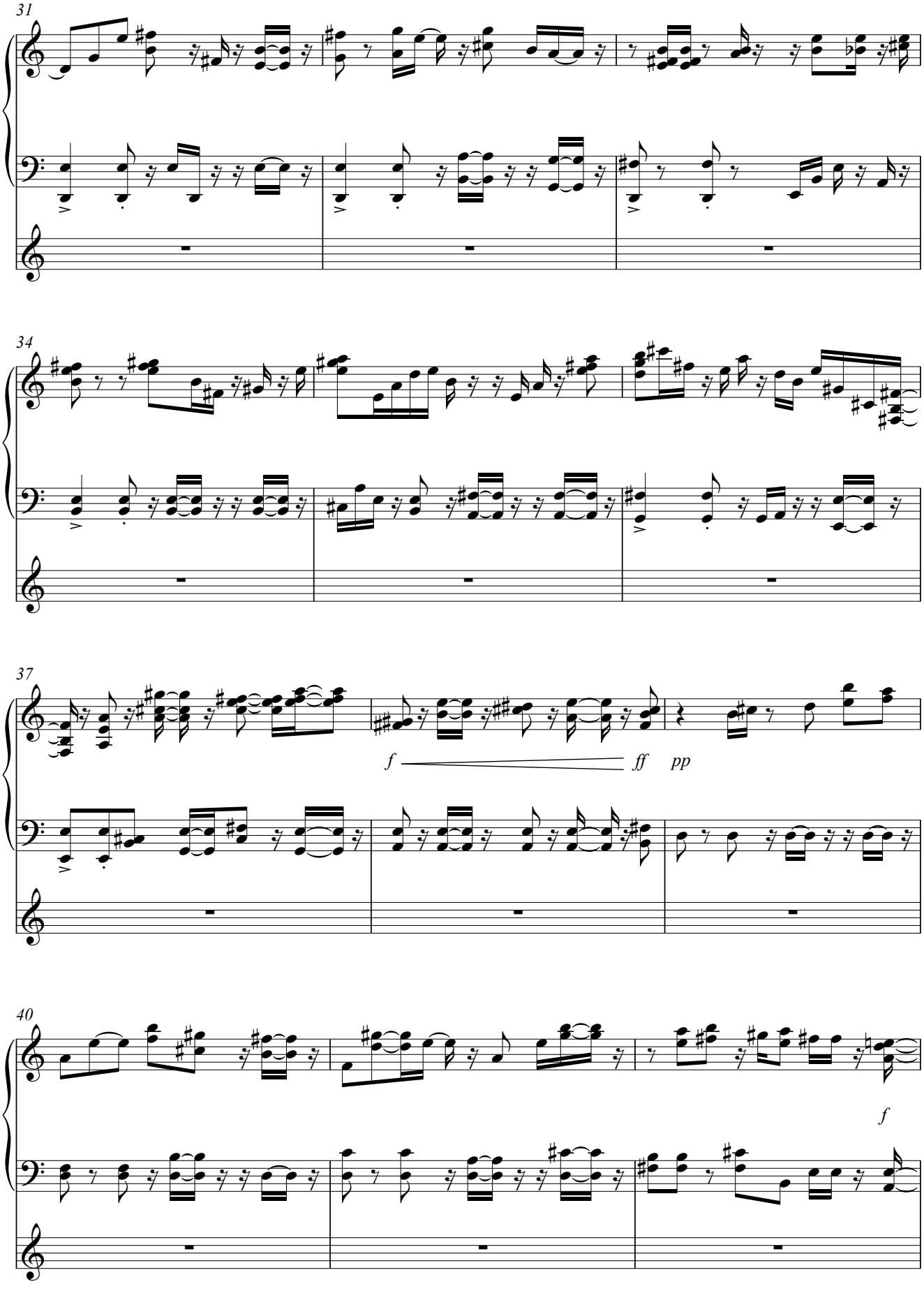
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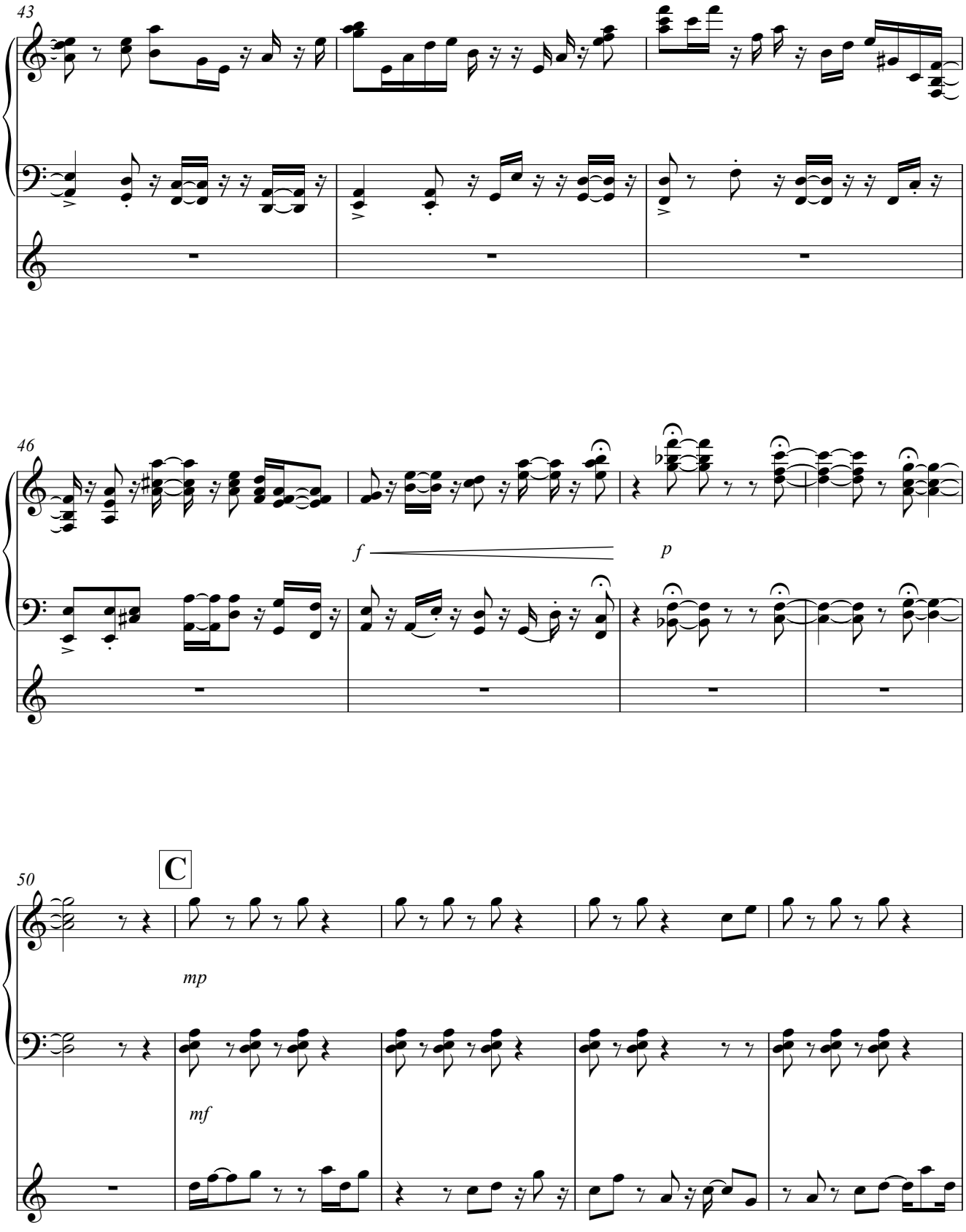
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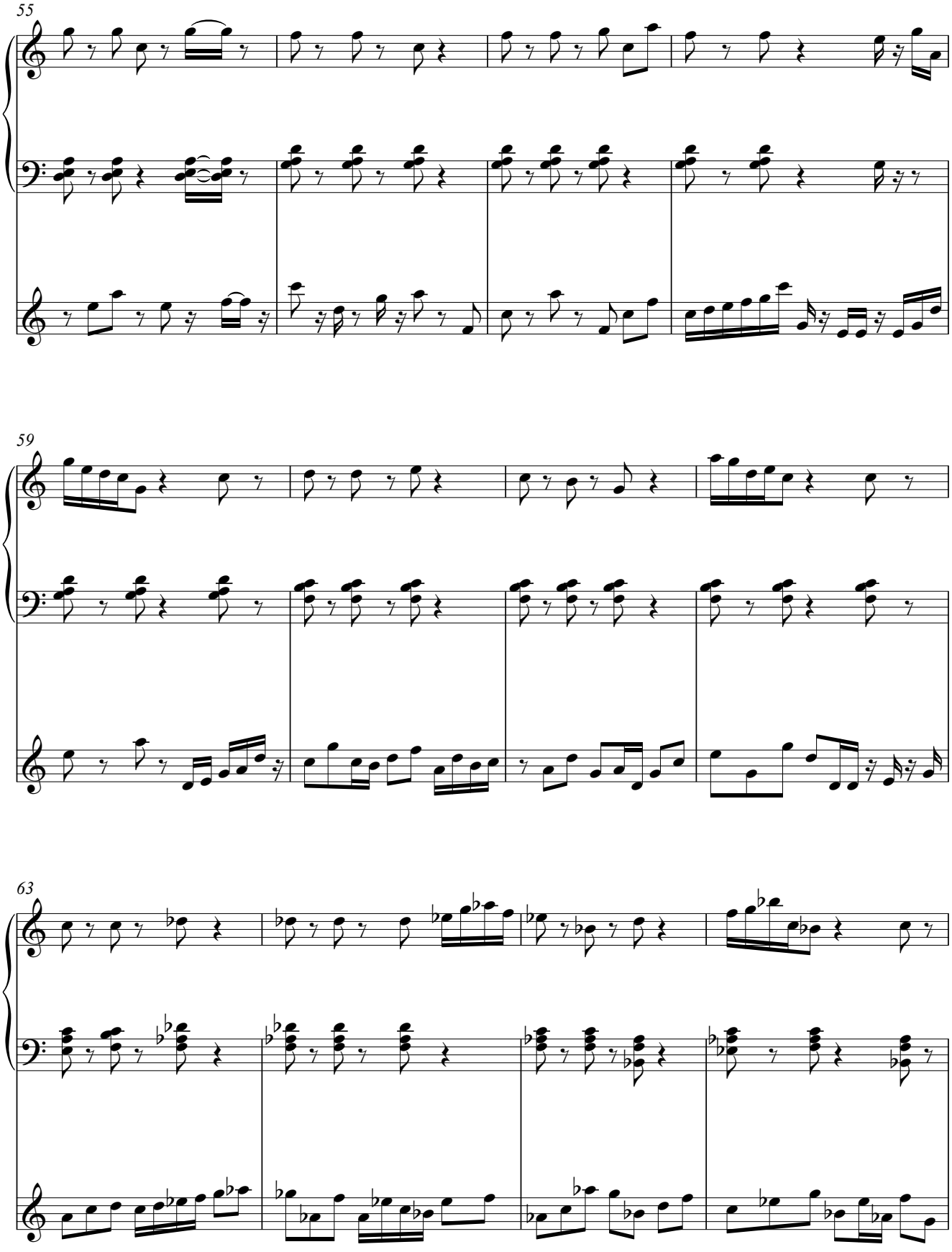
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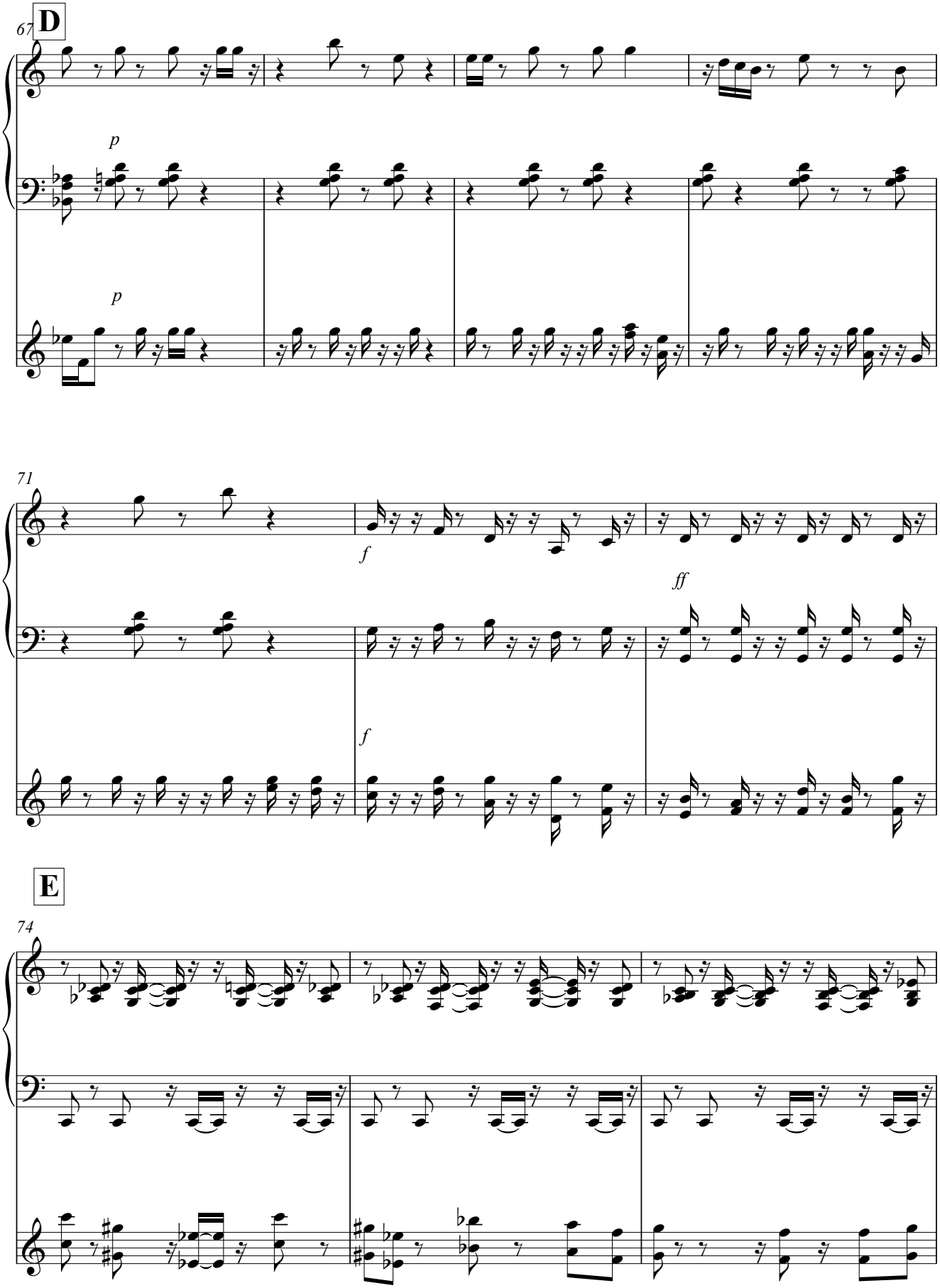
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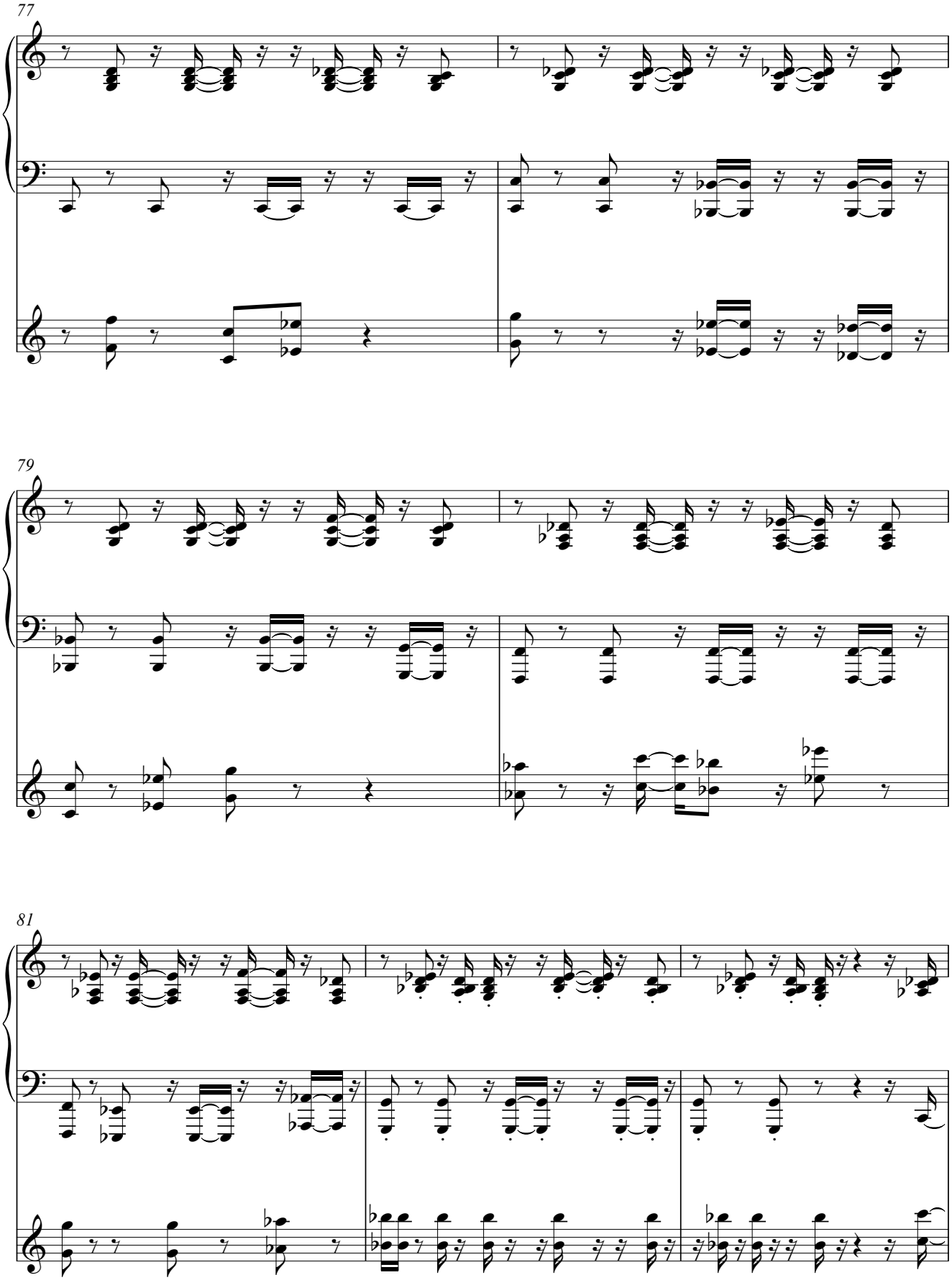
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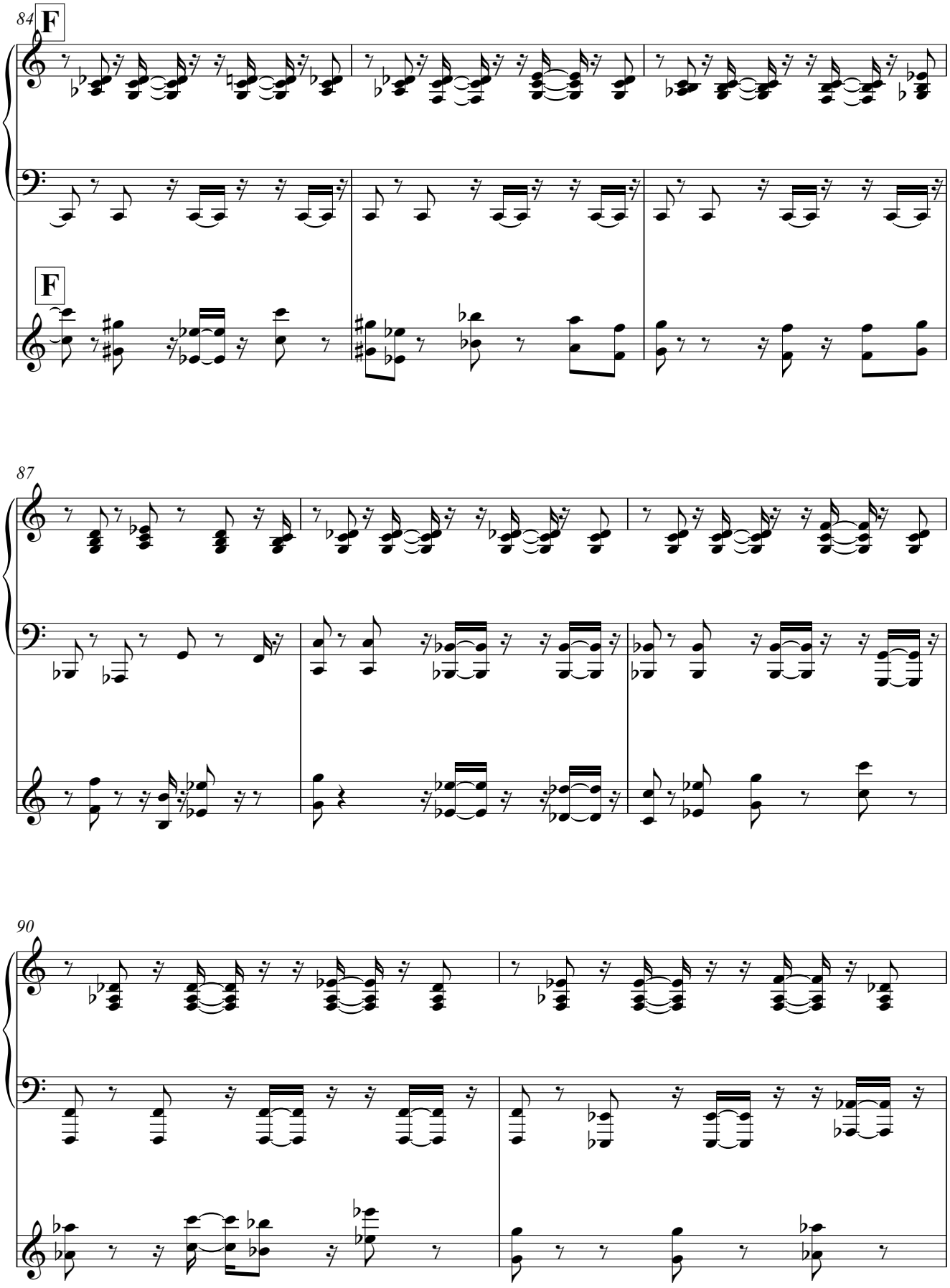
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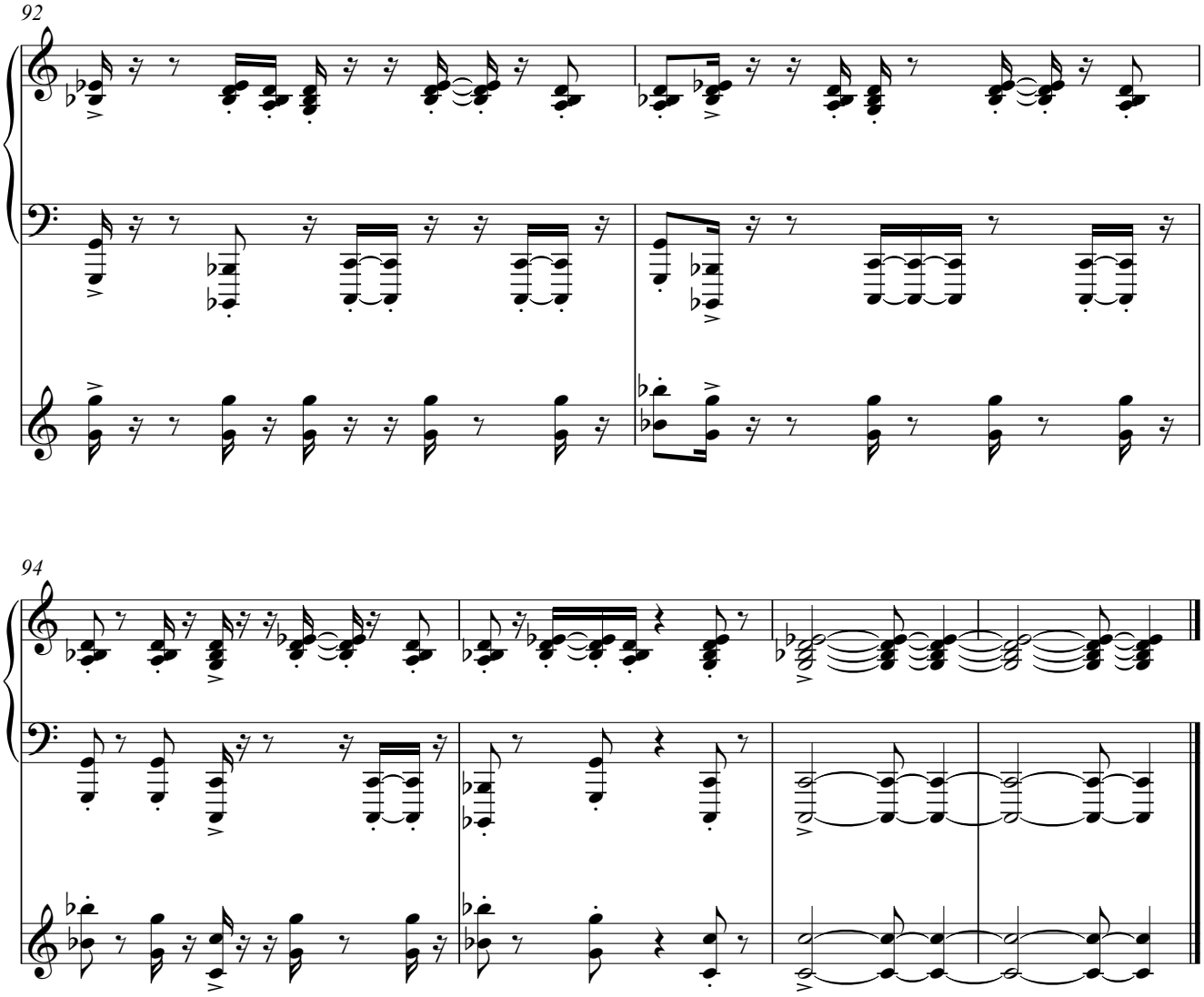
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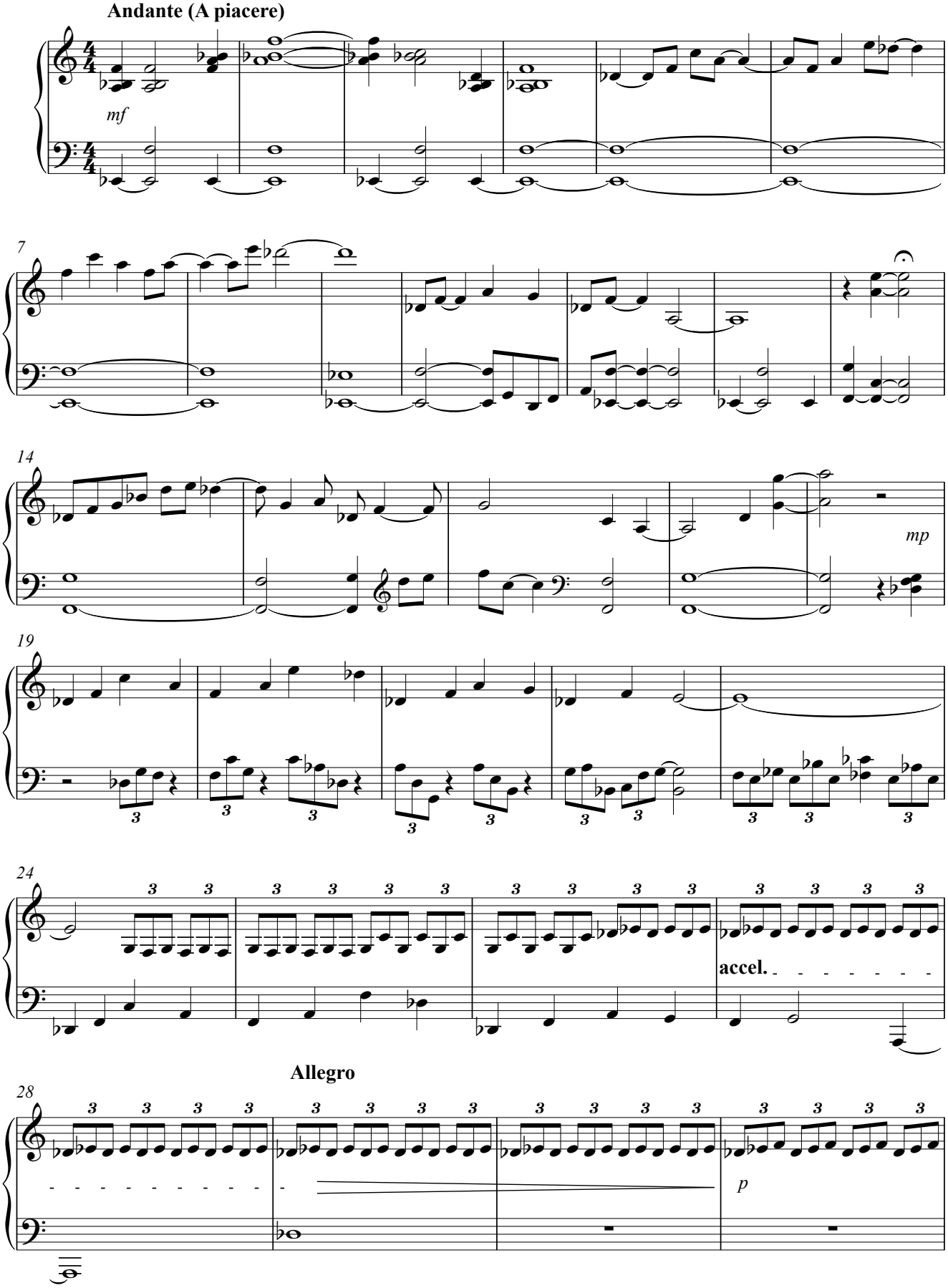
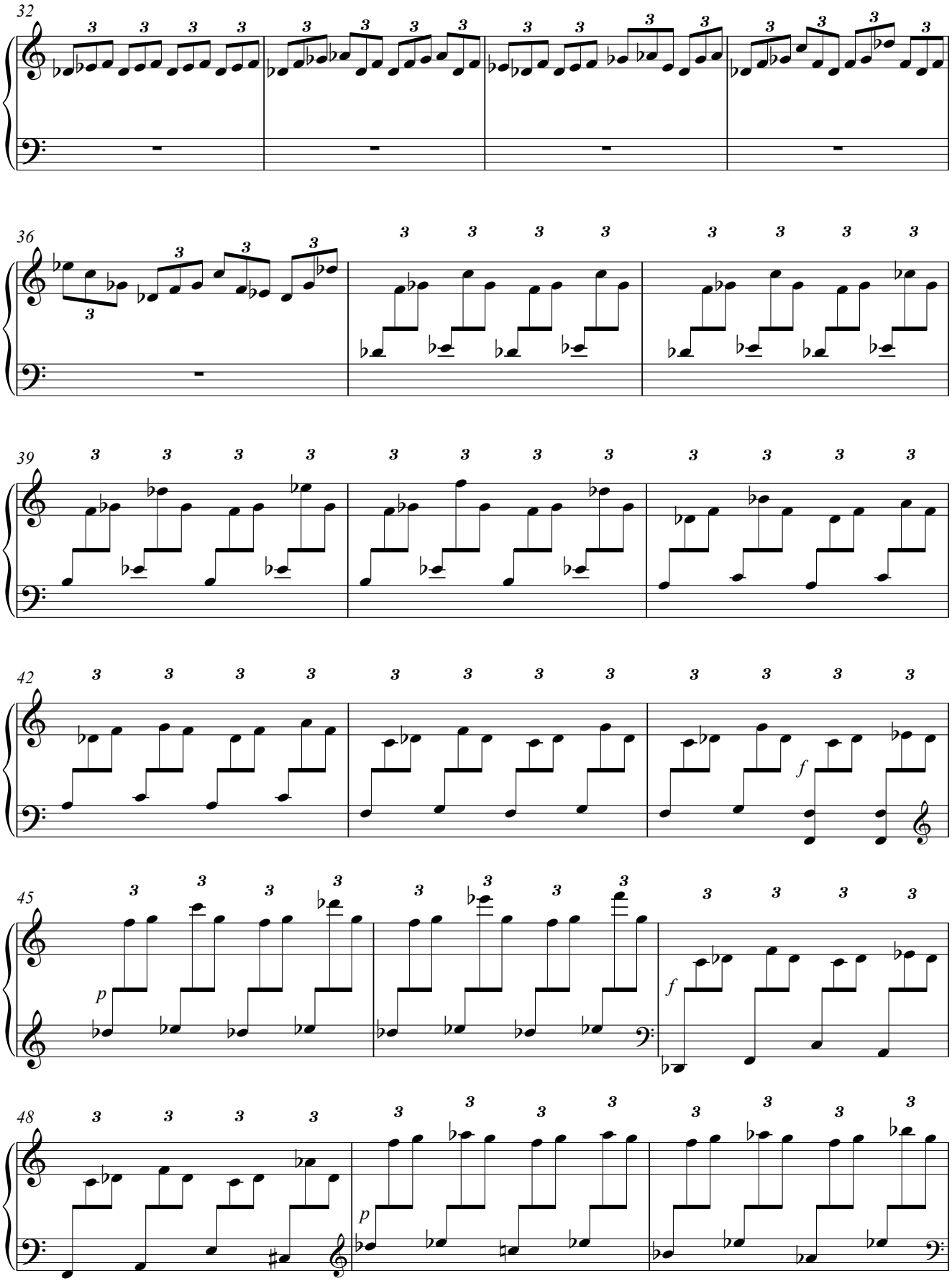
The Armadillo

Sebastian Seidel 04 2010

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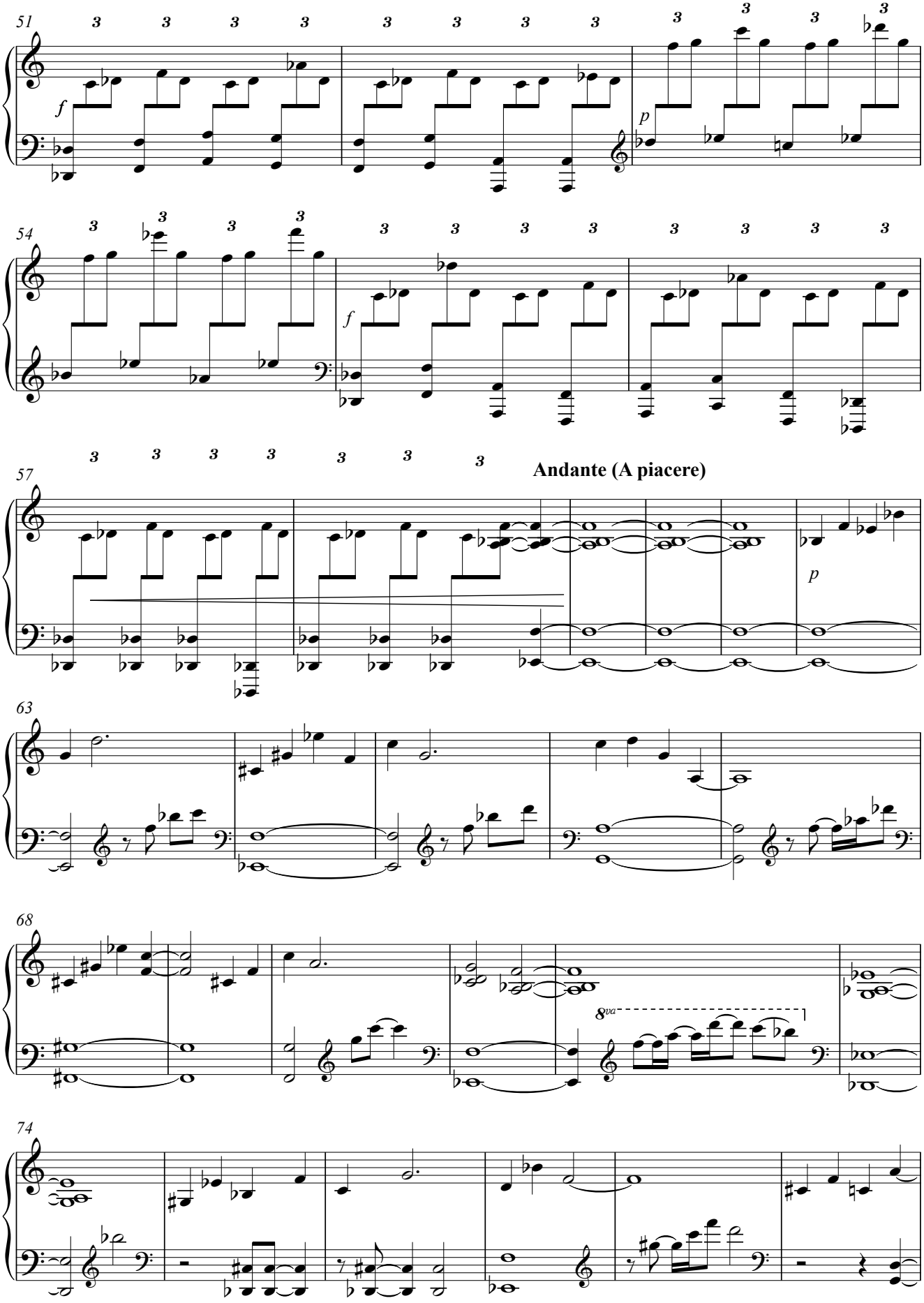
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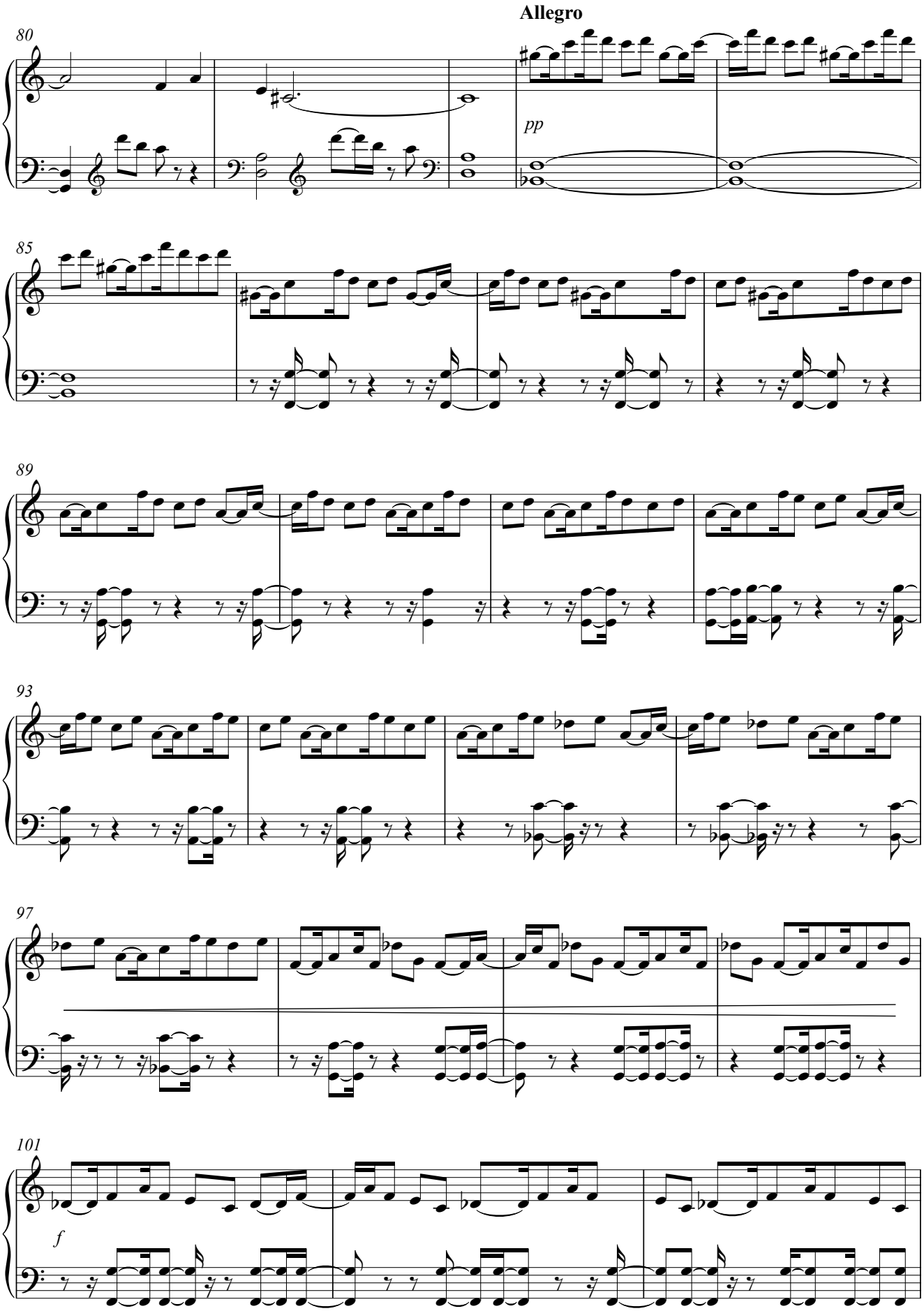
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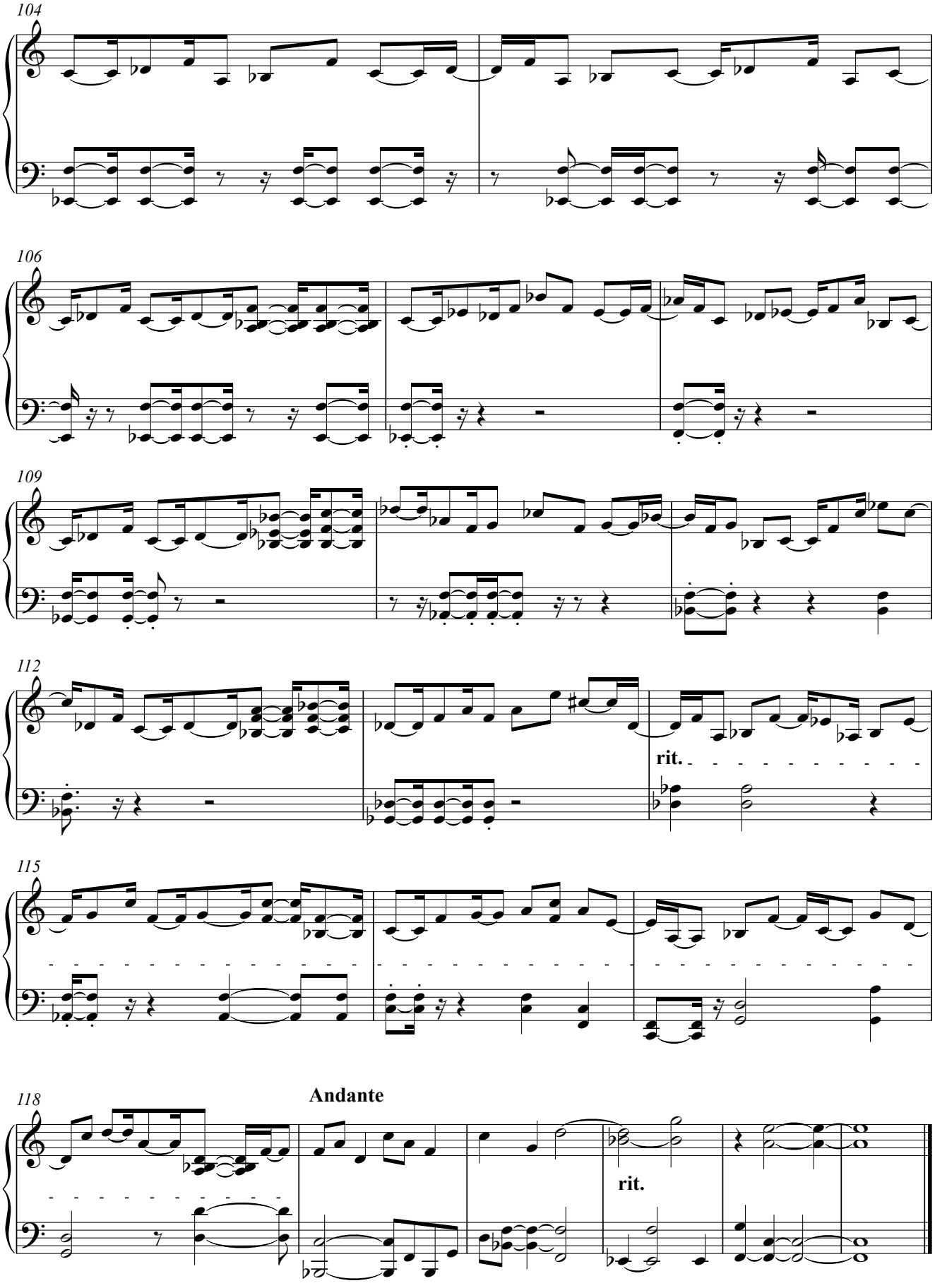
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Curriculum Vitae

Academic qualifications of the thesis author, Mr. SEIDEL, Sebastian Martin:

- Received qualifications assessment from the Hong Kong Council for Accreditation of Academic & Vocational Qualifications stating that below degree “meets the standard of a local Master Degree” (May 2011)
- Received the degree of *Diplom-Mediengestalter* from Bauhaus University Weimar, Germany (October 2004)

March 2014