

The Advantages of Using Computer Programs and Artificial Intelligence in The Creation of Film Music

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Abstract - The subject under study is the process of creating music for modern films by means of computer programs and artificial intelligence systems. The study aims to systematize the types of soundtracks, analyze the modern practice and determine the contemporary trends in film music creation, reveal the advantages of using computer programs, and compare the functionality and potential of the programs CHANT, AIVA, and MorpheuS introduced at the beginning of the 21st century in terms of their use in the creation of film music. The scientific novelty of the study lies in the analysis of the technology of

film music production by means of computer programs and artificial intelligence and the identification of factors that optimize the music-making process. The results of the study can be of use to composers working in the field of film and television, musicologists, music educators, film directors, producers, and figures in the socio-cultural sphere.

Index Terms – arrangement, artificial intelligence, composition, computer program, film music, music generator, soundtrack.

INTRODUCTION

Cinema is an art form that is unsurpassed in its degree of expression because of its synthetic nature. Filmmakers draw the viewer's attention not only to the plot or acting but also to the music that enhances the emotional perception of events, deepens the meaning or comments on the action, dynamizes it or reduces the tension, encourages the viewer's interpretation of the characters, characterizes the era in which the events unfold, facilitates empathy with the characters, and reveals the meaning that remains "behind the scenes".

Film music, or soundtrack, not only accompanies the visuals intensifying their impact on the viewer but is also becoming one of the autonomous directions in music creation. The artistic value of film music is increasing along with the growing importance of cinema art in the life of modern people, the intensifying competition in the film industry, and the growing requirements to the authors of films. The technologies of film music creation are also improving: today, computer programs and artificial intelligence help film composers select precise means of expression and create an impressive musical image.

The figurativeness of musical thinking and extensive knowledge of musical genres combined with the modern opportunities for sound synthesis are the characteristics of today's professional film composer. Of importance are also the proportional mastery of the orchestral palette (the instrumentation of contemporary popular and ethnic music) and the capabilities of computer sound synthesis. For example, the use of music in *Gravity* (directed by A. Cuarón, 2013) and *Arrival* (directed by D. Villeneuve, 2016) follows this path. In both films, the sound synthesis is largely intertwined with the musical accompaniment and constitutes the films' unique sonic characteristics.

METHODS

The study deploys a complex research method combining culturological, historical, and theoretical approaches to the studied material and a comparative analysis of computer program algorithms. The culturological approach is associated with soundtrack types systematization and the allocation of the place occupied by film music in contemporary culture and the influence of the demands of the public and the financial factor on its nature. The historical approach relates to the analysis of contemporary practice and the identification of current trends in film music creation, as well as the search for the reasons and conditions for the introduction of computer technology resorted to by contemporary film composers. The theoretical approach is driven by the need to identify the advantages of using computer programs and artificial intelligence in the film music industry. A comparative analysis of computer program algorithms is conducted to evaluate the functionality and potential of CHANT, AIVA, and MorpheuS programs in terms of their use in the creation of film music.

LITERATURE REVIEW

The process of creating film music with the help of computer programs and artificial intelligence is largely understudied. Researchers are concerned with the issues of the aesthetics, theory, and history of film music, the technology of its creation by traditional method – picking melodies on an instrument or recording notes [1]-[5]. An important contribution to the study of the problem is made by M.V. Pereverzeva who explored the perspectives of using artificial intelligence in music composition [6] and the specifics of Hollywood film music [7] and the use of computer technologies in music composition [8]. According to R.

Dannenber, technology is what defines the modern approach to creating film music [9]. N. Lin considers the objective factors of the use of computer technologies in film music to be “the high speed of development of modern science and technology and the emergence of different trends in music creation in general” [10]. Changes in the creative process with the use of artificial intelligence are indicated by A.F. Kudryashov and O.I. Elkhova [11], A.V. Pushkaryev [12], and C. Dobrian [13], the ethical problem is considered by N. Bostrom and E. Yudkowsky [14]. The algorithms of artificial intelligence in the creation of music are discussed in detail in the works of D. Herremans [15], [16] and M. Toro, M. Desainte-Catherine, C. Rueda [17].

RESULTS

The modern soundtrack has several varieties, including OST, Score, Promo Score, Expanded Score, Music Inspired By The Film, and others.

OST (an acronym for “Original Sound Track”) refers not only to the original author’s music written specifically for the film but also the popular independently living songs played in the film. Songs by different artists typically prevail in this genre over instrumental compositions which, in some cases, may be completely absent from a film (a prime example is Quentin Tarantino’s films).

- Score – the music specially written by the composer for the film, usually instrumental compositions without vocals;
- Promo Score – an album with original author’s music published in small numbers for promotion among film companies;
- Academy Promo Score – an album of original composer music that is sent for evaluation as a potential Oscar nominee in the Best Film Music category;
- Expanded Score – original music for a film usually distributed as a bootleg (an audio recording made without the permission of the rights holders). In most cases, such a publication is created by extracting the audio track from the DVD media and then editing it. The Expanded Score differs from the original album in the amount of material;
- Complete Score – all of the original author’s music played in the film. Composed in much the same way as the Expanded Score. Since the Expanded Score and the Complete Score are compiled from music cut from the film’s soundtrack, they may contain noises and dialogues;
- Temp Score – music selected by the director or editor as a temporary soundtrack for the film (in the early stages of editing). Temp Score is not written specifically for the film but is compiled from the existing recordings that match the mood and style of the music the director would like to hear in the final version of the original soundtrack.,
- Rejected Score – music written by the composer for the film but for some reason rejected by the director or the film company and not used in the film;
- Music Inspired By The Film – albums with music or songs “inspired” by a movie. The same name is often given to the “rejected” composers’ soundtracks when they are published [18].

A composer is typically involved in filmmaking at the last stage of production at a point when all the video material has been shot and edited, the actors have voiced their characters, and the sound engineer has added the necessary sound effects [1]. By this time, the time limit for the film production is mostly exhausted, and then comes the time for the composer to show their creative and professional capabilities. In the world of big cinema, it takes one to two months to compose and record music for a film [2]. Under such conditions, a composer physically needs assistants for orchestration, arranging, copying, and other processes. What is undeniable is the fact that the process of film music composition itself is organized with a high degree of professionalism.

Thanks to computers, the direct process of composing film music takes much less time compared to the traditional process of preparing, analyzing, sampling, mixing, creating “stems” (individual tracks of audio produced by an instrument group), and making changes to the musical material at the request of the director or music editor. If we add to that the need to search for musicians for a studio recording, rent the studio itself, process the resulting recording, mixing, and “mastering” (preparing the audio file depending on the subsequent playback device), a modern film composer is only left with then 10% of the effort to be spent on composing itself [19].

This situation is due to the fact that the modern world of cinema shows a trend of maximizing the concentration of the music creation process in a single pair of hands, “in the box”. This is associated with the substantial progress in the development of computer technology. Only 10 years ago, recording and processing high-quality sound were only possible in a professional studio using a mixing table and analog devices for the reverb, equalization, compression, etc. In a mere decade, analog devices have “moved” into the category of digital, and now by purchasing a specialized computer program, a user gets all the capabilities of a professional digital studio with a maximum set of sound processing tools [20].

For a film composer, this entails a need to combine the professional skillset of a sound engineer, a sound director, a producer, amusic editor, and a qualified program user “in one box”. Instructions on the desired character of the music and the duration of the music are more and more commonly sent to the composer via e-mail. Comments on the composed musical material are provided similarly. The entire film is at the composer’s complete disposal with an opportunity for frame-by-frame analysis which allows for maximum coherence between the screen action and the soundtrack.

The “Music Generator”, “eJay”, “Acid”, “Band-in-a-Box”, and “The Jammer” music arranging programs have standard user operations and functions including banks of voices, timbres, and patterns and allow one to master the simplest techniques of arranging and performing music on a synthesizer [8]. Working in “Music Generator”, “eJay”, “Acid”, and other music composition programs involves selecting and combining ready-made musical phrases from a rich collection of elements used in different sound layers. These phrases can be combined vertically and horizontally, like series in a dodecaphonic composition. Similar “mechanisms” for composing pieces from pre-made fragments

were invented in earlier times as well, but thanks to digital technology, the user is freed from the need to perform simple operations and concentrates solely on creative activities.

Computer programs that allow to quickly arrange music contain blanks in the form of chord patterns and models of typical forms (period, blues square, simple 2 and 3-part). A user can select a genre, style, and structure for the chord sequences that automatically accompany the solo melody played on the keyboard and then add new voices, vary the rhythm, harmonicity, and timbres of the sound texture, and add rhythmic figures between the verses, as well as the typical intro, conclusion, and coda patterns.

Medium- and low-budget film projects are aided by sound sample libraries. Currently, there are about ten high-quality paid sound libraries that contain hundreds of samples of the timbres of string, wind, plucked, percussion, and other musical instruments. Moreover, the existing computer programs provide the opportunity to create custom sound samples and use them along with other available samples in the score.

Let us proceed to examine the details of the process of composing music using the CHANT computer program created for compositional practice on the example of simple musical material. The program was implemented using the FORMES system developed by C. Rohde and P. Conte at the IRCAM Institute. CHANT can be connected with sound synthesis and data processing in the program on the FPS-100 matrix processor. All sound samples are synthesized by means of the waveform function of the FOF synthesis technique and a bank of time-varying filters.

The filters are controlled in the same way as the formants controlled in the CHANT program, that is, by specifying the center frequency, bandwidth, and amplitudes. This allows using CHANT not only for synthesis but also for filtering and processing the sound while composing. Any external source can be used, but filters with a noise sound source are the most interesting.

Work in the program begins with solving the issues related to the organization of the sound material. Otherwise, the composer operating with musical elements will get lost in an endless network of algorithms. The creation of original sounds opens up great possibilities for the composer, and the processing of synthetic material takes less time compared to acoustic sounds. A user creates the primary models for musical situations to their liking. The essence of the program is the opportunity to control various musical parameters considering the peculiarities of the chosen style. CHANT allows for simultaneous implementation of two different situations :

- gradual interpolation between the set parameters;
- abrupt transitions between different musical characteristics.

Programs primarily comprise pre-made patterns that present values for the selected parameter and are displayed in a list. Aside from them, it is possible to use different time values to define the general contours of the composition. A commonly used method is the circular technique of repeating chords that form the patterns with each sound making a glissando to the sound of a new chord. A composer's goal is to create a layered network of constantly changing but controlled elements of the musical composition. By these means, various

parameters are controlled from both inside and outside the sound patterns. A typical choice is a constantly changing but purposeful process derived from combining various matrices of all sorts of parameters.

It is easier to operate with larger units without losing sight of the micro-level situation. This allows controlling the musical parameters and focusing on a variety of form principles. The rhythmic part of the program adopted as a basis for processing other sound parameters is also varied. The essence here lies in creating certain conditions under which the same rhythmic pattern can be repeated with a smooth change of tempo and at different speeds to create interpolations between groups of different lengths. A composer can realize almost any musical idea which would not be difficult for a computer but is impossible when composing music for acoustic instruments.

As for timbre, it is possible to select some parameters for the matrix band and control others with the usual time functions and barriers depending on the needs and nuance. One of the composer's tasks with respect to timbre is to develop a precise timbre change in each tone. This kind of pointillistic texture can be combined with interpolations of broader lines found within other timbre factors or parameters. Let us apply the matrix stretching technique, where the spectral contours are changed by stretching and compressing the formant frequencies. Here, each particle of the pattern has a formant structure that differs from the preceding one.

DISCUSSION

The advantage of the CHANT program is the ease with which it is possible to transform the physical model of a voice or the sound of a musical instrument and obtain abstract sound objects that are far afield from the original. For example, one can combine breath and voice as the material with a very vivid, bell-like sounding. The sound fading time or resonance is variable and can last a long time [20]. The matrix provides infinite possibilities for timbre control. This way of obtaining sound, a "discovery" made by independent parameters, as in the case of a physical structure, is far from traditional musical material [8]. For example, it is possible to create sounds in which different timbral elements coexist independently, while two different durations are combined within the same sound. The result is a sound where the stretch matrix controls the formants adapting to the durations prescribed by the rhythmic matrix.

However, even greater opportunities for creating film music are offered by artificial intelligence, which is currently utilized in digital sound processing, composition, and performance of musical works. For this purpose, several computer programs with artificial intelligence have been developed to imitate the processes of human mental and creative activity. The sequence of these processes is fixed in the algorithm of operations of artificial intelligence which allows the program to carry out creative functions [9].

Artificial intelligence is now in possession of the "interactive composition technology" that implies a computer composing a piece in response to a live human performance of music [13]. The latest generation of player computer programs

allows creating scores interactively with the partial participation of the composer or performer. The algorithms of multimedia intelligent systems include the principles of organization of temporal and pitch objects (sounds, computer graphics, animation, video), their quantitative relations, and interactive interrelations.

The AIVA program (the Artificial Intelligence Virtual Artist) created in 2016 in Luxembourg creates soundtracks for any mass media in a variety of styles and emotional colorations [6]. The styles uploaded into the database are signified as “modern film music”, “electronic”, “pop music”, “ambient” (electronic music based on modulations of sound timbre and characterized by an atmospheric, enveloping sound), “rock music”, “fantasy”, “jazz”, “shanty” (songs of British sailors), “20th-century film music”, “tango”, and “Chinese”. The algorithms of AIVA are based on the architecture of deep self-learning artificial intelligence. AIVA was used to create a rock song called “On the Edge”, as well as the song “Tainted Love” featuring pop singer Taryn Southern as a part of her work on her 2018 album “I AM AI”. However, the program was originally designed to generate music from the classical-romantic tradition, and many AIVA tracks, such as the “Genesis” Symphonic Fantasy in A Minor, Op. 21, are on listeners’ playlists today as examples of academic music.

Thanks to this composition, AIVA was recognized as a “virtual composer” whose works are registered by the SACEM International Copyright Society [8]. AIVA can compose emotional soundtracks for movies, video games, commercials, and any other type of entertainment content. AIVA has studied the art of composing music having “read” a large collection of musical scores written by composers (Mozart, Beethoven, Bach, etc.) and created a mathematical model representing what music is. This model is used to compose contemporary film music.

The MorpheuS automatic music generator was developed at Queen Mary University of London with the financial support of the M. Curie Foundation (2017). This intelligent system is based on the optimization technology and the algorithm for finding variables in the dataset (selecting the best possible variant) used to create new pieces in a given tone, size, and instrumentation by transforming the original samples [15]. The creators emphasize that the AI independently creates music that has a certain structure and emotional coloration [6]. The optimization technology integrates the processes of selection of thematic material and the principles of composing from “sample” pieces to generate a logically built structure with repetition and development of themes found in traditional music. The pieces composed by MorpheuS have been performed in concerts at Stanford and London.

The goal of the software engineers was to create a program that would cooperate with the authors rather than replace human abilities. MorpheuS works in the following fashion:

- determines the stylistic features of the music played by the musician;
- accompanies the musician when they play;
- attempts to improvise based on the material played by the musician.

K. Saariaho indicates that computer programs allow the composer to realize the idea and find original sounds corresponding to the required character of a particular film scene [20]. C. Dobrian emphasizes that the algorithms of modern artificial intelligence programs still have many defects and processes that require improving the operation of the computer [13]. M.V. Pereverzeva notes that artificial intelligence is so far unable to completely replace a composer in making music, although it substantially simplifies many creative processes and reduces the time spent by an author on designing and developing the material, selecting timbres, and varying the melodic and rhythmic patterns [6]. D. Herremans and colleagues see the prospects for the use of computer music systems in expanding the functionality of programs [16]. M. Toro believes that the advantages of utilizing artificial intelligence in making music can be associated with improvements in the program algorithms [17].

With a computer, the process of creating music is simplified and yet becomes increasingly sophisticated as the artistic level and technologies of filmmaking constantly improve. Many directors think through the character of the music as early as at the scriptwriting stage. Already during the editing of the footage, the director typically knows exactly which scene should be emphasized by musical accompaniment and how the offscreen musical theme should sound [7]. The film is often edited to a mentally heard piece of music, or the scene is edited to a selected example of the desired music [5].

Of critical importance is a film composer’s skillful handling of the sound elements that make up the arsenal of expressive means of a sound film. The inability to find the right combination and ratio can not only ruin the end result but destroy the idea and the depth of the film. However, computer programs can detect such flaws, if not correct it, at the pre-composition stage when the user selects timbres and parameters of the future composition. In the American film industry, the composer creates music for specific episodes according to the timings in which the musical accompaniment must be arranged precisely, so creating a soundtrack through a computer program is most optimal and efficient. In addition, the banks of timbres and styles in computer programs are so vast that no composer can encompass that much information in their memory and imagine the sound of as many instruments and their combinations as a computer can demonstrate. For example, Andrei Tarkovsky needed an avant-garde film composer for his film “Stalker”, he was not interested in sensuality, melodicism, and the principles of symphonic development, he demanded a special sound solution from the composer. That is why Eduard Artemiev turned to electronic music and computer programs when looking for the nature of the soundtrack he needed for the director.

The process of music composition typically includes improvisation with a musical instrument and the selection of melody intonations, chords, and timbres, however, a computer program reduces the time of the “selection” of parameters and allows to listen to a few dozen versions of the sound of the fragment in a short period of time. Moreover, artificial intelligence is capable of generating music in specific styles using the composer’s “blanks”, which means that the composer can figure out how the same theme will sound arranged in different styles.

CONCLUSION

The present study systematizes the varieties of modern soundtracks, identifies the specifics of the work of film composers and the process of creating film music, substantiates the need to use computer programs and artificial intelligence in composing soundtracks, as well as identifies the prospects for the use of computer technology in music composition. The comparison of the functionality and

potential of computer programs and systems with artificial intelligence shows a clear preference of such programs as CHANT, AIVA, and MorpheuS as they provide for the entirety of the composition process from the selection of material to the recording and, given that the algorithms of their work are further improved, can assist a composer in creating music of a high artistic level that remains as original as the idea of a film director.

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