Research on the Design of Modern Music Creation System Under Data Technology

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Abstract. The innovative and diverse nature of modern musical composition has become an indisputable fact. With the rapid development of modern information technology, the corresponding computer music composition has also emerged, and the application of artificial intelligence in the field of music has become an emerging field of research, which poses a new challenge for music sociology. But while computer music poses challenges, it also presents many opportunities for musicians. This paper presents a study of modern music composition based on deep learning algorithms, analysing the trends and characteristics of this new approach, in the hope that such research will make technology work better for music.

Keywords: Deep learning algorithms · Modern music · Music composition

1 Introduction

With the development of science and technology, computers are playing an important role in music composition, and computer music composition has become a style of music. In terms of the current practice of composing computer music, there are two different conceptual tendencies: one is to use the computer as a tool to imitate or partially replace the traditional musical forms and acoustic characteristics with innovative ones. Most of the popular music and film scores are created under this concept. The other is to use the computer as a tool, but to break away from the traditional musical forms and acoustic characteristics, seeking new timbre design, acoustics and musical expression. The music created under this concept is often performed live in concert (with computers and electronic instruments on stage in real time), sometimes in conjunction with traditional acoustic instruments, but in a way that breaks away from traditional techniques to play new sounds. These two different conceptions of music, the former belonging to the category of popular or practical music and the latter belonging to the category of serious or experimental music.

Whatever the composer's conception, whether his music is popular or practical or serious or experimental, as long as he is composing on a computer, he must follow the technical procedures of computer music, and it is this specific technical procedure that

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distinguishes this composition from traditional composition in its approach (not only in its means) [1]. The computer has not only changed the technical means of music, but also the way in which it is composed, enriching the forms and increasing the scope of computer music composition. Computer music composition has obvious advantages for breaking through existing musical styles, and this is the focus of computer composition research. This paper presents a study of modern music composition based on deep learning algorithms, analysing the trends and characteristics of this new approach, in the hope that such research will make technology work better for music.

2 Deep Learning Algorithms

2.1 Overview of Deep Learning

Deep learning is the simulation of the biological brain by building deep, mesh-like computer models, which in some ways resemble bionics. It is an important branch of machine learning. The development of neural networks has experienced three high points. The first climax was in the 1940s. During this period, scholars introduced many new concepts that formed the prototype of deep learning, such as the concept of perceptual machines and adaptive linear units. A perceptual machine refers to a model that can learn model weights based on each category of input, while an adaptive linear unit can simply learn data patterns to predict new data, and its method of training weights is, with minor improvements, the stochastic gradient descent method that is very popular today. The second high point was from the 1980s to the 1990s. Some of the ideas developed during this time are very important to present-day deep learning, such as the backward conduction algorithm which began to be used successfully and which is still the dominant method in neural network training today. For the problem of temporal modelling, the Long Short Term Memory Network (LSTM) came to prominence [2]. A third high point began in 2006. During this time, deep learning techniques were not only perfected at a much faster pace, but began to be applied to real, widespread life, with breakthroughs in the structure and performance of convolutional and temporal neural networks, for example, which have beaten humans in the fields of computer vision, speech recognition and natural language processing. Even in areas of human intelligence that were previously beyond the reach of machines.

2.2 Deep Generative Models

A deep generative model is a deep network model that can learn the joint probability distribution of observed data samples and labels. It is generally a probabilistic graph-based model. A trained deep generative model is able to generate new data that matches the probability distribution of that sample. Labeled data is not necessary in some generative models (e.g. restricted Boltzmann machines, deep belief networks) which learn the probability distribution of observed data samples through their unique network structure and training methods. As such, it can be applied to both supervised and unsupervised learning. Some of the more representative models of deep generative models are Restricted Boltzmann Machines (RBM), Deep Belief Network (DBN), and Generative Adversarial

Network (GAN). The probability distributions of RBMs and DBNs are calculated based on the energy function of their own networks, and they both maximize the probability value of the data in the visible layer or the probability value of the input data of the network in the previous layer by maximizing the likelihood method. The approximate inference of DBNs is a top-down process of mutual feedback, as the human brain itself uses many top-down.

2.3 Models for Deep Learning and their Training

A restricted Boltzmann machine is a modification of the Boltzmann machine, which is a stochastic network with a slow training process due to the interconnections between the cells within its layers as shown in Fig. 1(a). 1986 Somlensky introduced a restricted Boltzmann machine, which contains one visible layer and one hidden layer, with no interconnections between the cells within the layers as shown in Fig. 1(b). This is shown in Fig. 1(b). This makes the use of RBMs for inference calculations very efficient.

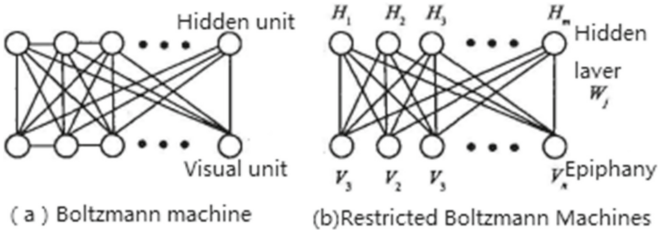

Fig. 1. Boltzmann machine and restricted Boltzmann machine

Suppose an RBM contains n visible units and M hidden units, we can use vectors v and h to represent the states of visible units and hidden units respectively, where v_i represents the state of the ith visible unit and h_j represents the state of the jth hidden unit. Then, for a given set of states v, h, the joint probability distribution of RBM as a system can be expressed by energy function:

$$\mathrm{E(v,h)} = -\sum_{\mathrm{i}=1}\sum_{j=1}^{m} W_{ij}v_i h_j - \sum_{i=1}^{m} v_i b_i - \sum_{j=1}^{m} h_j c_i \tag{1}$$

where w_{ij} and c_i are the parameters of RBM. Where w_{ij} is the connection strength between the visible unit i and the hidden unit j, b_i is the offset of the visible unit i, and c_j is the offset of the hidden unit j. The task of learning RBM is to get the values of these parameters to fit the given training data.

3 Elements of Musical Composition

3.1 The Relationship Between the Cultural Elements of Thematic Appeal and Musical Composition

Thematic appeal refers to the fact that every composer pours out his or her feelings through beautiful lyrics in the process of creating music, the purpose of which is to

express personal feelings. The motivation for thematic appeal stems from the writer's personal cultural literacy and need for culture. Of course, different regions and time periods, influenced by different cultural and historical contexts, will show different thematic demands. Firstly, in terms of different geographical areas, the thematic aspirations change with the region. During the Second World War Madusovsky's musical work 'Evening outside Moscow' was a song composed to commemorate the defence of Moscow. The words of the young man's heartfelt feelings of victory, budding love and pre-dawn farewell are cleverly blended with the beauty of nature. From different time periods, the thematic aspirations change over time. For example, most of the lyrics in our ancient times were intended to express love for the great, simple, and peaceful landscape. During the period when our country was invaded, red songs were widely popular in the country, and the words were all about the people's yearning for peace. And most of the thematic appeals of modern songs involve the need for love [3].

Musical composition refers to an expression and innovation of the culture of the region in which the music creator lives. So the thematic demands of each musical composition are different. As the creator is driven by the need for culture, the thematic appeal is also a product of culture. The relationship between thematic aspirations and musical compositions influences each other and complements each other. There are differences in the thematic aspirations of music creators and listeners due to the influence of cultural differences. This cultural difference stems from space and time.

3.2 The Relationship between the Cultural Element of Aural Experience and Musical Composition

Aural experience refers to the accumulation of the creator's experience of various instruments and songs in his or her life. In the process of accumulation, the composer needs to rely on his or her own musicianship to summarise what he or she has heard, that is, to remove the dross and absorb the essence. Music composers often need to travel to different regions to listen to and record music with a distinctive musical style for future compositions. These recordings can be of great use in later compositions. But if we, as ordinary people, were to listen to and record this music, we would only end up remembering the simple melodies.

One of the reasons why this article considers the aural experience as a cultural element that influences musical composition is because in musical composition, the aural experience, like the linguistic experience, is a concrete expression of the cultural and musical literacy of the creator. The second reason is that music itself is a cultural product of its time, and the most common way to improve one's cultural literacy is through listening, seeing, touching and other sensory actions to obtain information and to expand and accumulate it. As a result of the influence of different cultural backgrounds, different creators will have different musical listening experiences. The difference in listening experience leads to different compositions.

4 Modern Music Composition Based on Deep Learning Algorithms

4.1 Integration of the Compositional Process

In traditional music composition, it is mainly the composer who uses the score to encode the musical information, and the singer and performer decode it according to the composer's encoding, which is to restore the performance to its true effect. In this process, the score process is very important because it does not capture the entire process, so there may be gaps in the composer's encoding, and the singer and performer may add a lot of innovation or understanding to the decoding process, resulting in the actual song not being the same as the one presented by the composer.

Modern music composition based on deep learning algorithms does not have these differences, as the computer makes the coding process easier for the composer and provides a true and detailed record of the composer's information. At the same time, the computer reduces the difficulty of decoding for the singer and the performer, and the conversion is done by the computer. All the composer has to do is to perform his or her regular performance on the keys and this information is automatically encoded on the computer, which is what digital coding really is. The computer is capable of automatic decoding, a process in which the digital signal is converted into an analogue signal. When composing on a computer, the composer has to form a unified whole of conception, composition and performance, to be able to process the acoustics in time and to be able to arrange the best possible finished product with quality.

4.2 Integration of Aural and Visual Sensations

Once the computer has received the signals from the composer, it is able to convert the information into sound signals in time for the composer to perceive the song through headphones or speakers. The computer presents these sound signals in the sequencer software interface, displaying a wide range of graphics consistent with the sound, including MIDI event tables, multitrack graphics, scores, sound frequencies, time codes and other indicators, which make composing a dynamic process [4]. The composer can see the invisible music directly and compose it at the same time, by merging, copying, cutting, deleting, copying, etc., in the same way as word processing, without the need to anticipate the sound from memory as in traditional composition, but in a visual and aural experience.

4.3 Expanding the Possibilities of the Material

Traditional compositions are usually written and composed orally with expressiveness, range and timbre as the main focus. Computer-based songwriting breaks away from this mode of composition and allows the composer to imitate conventional instrumental timbres, use non-instrumental sound materials as inspiration, and create and invent compositional timbres. The composer can capture sounds from nature, from the chirping and roaring of animals, to the sound of wind and water, the sound of the sea and even industrial noises. Based on deep learning algorithms, the synthesizer is able to collect a wide variety of sound materials and create distorted sounds from a variety of simulated

sounds, breaking the limits of time and range. Anything a composer can think of can be created using a synthesiser. The composer can also use music from radio and television, VCD, CD, etc. to create his or her own musical material. The composer is able to find the most desirable sound effects through actual simulations, breaking the traditional songwriting model and increasing the infinite possibilities of music.

5 Conclusion

Computer music composition is an important component of songwriting and occupies a more important position. Modern music composition based on deep learning algorithms is an important way of creating music that breaks with the original compositional paradigm, increases the plasticity and infinitude of music, and makes music composition more flexible.

References

1. Tianxing, Z.: The development and teaching characteristics of computer music. Art Res. J. Harbin Normal Univ. **32**(01), 2251–2264 (2012)
2. Hongyuan, Z.: Research on automatic composition and arrangement based on deep learning. Master's thesis, University of Science and Technology of China, Hefei (2019)
3. Xiaomei, Q.: Research on the teaching characteristics and application of computer music, **16**(04), 887–899 (2012)
4. Pengyun, L.: "Flying beyond the boundary":A study of Liu Jian's interactive electronic music composition. J. Nanjing Arts College (Music and Performance Edition) March 2013