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Computer-Aided Design AND APPLICATIONS

Computer-Aided Modeling of Music Rhythm in Visual Teaching

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Abstract. Rhythm and melody are two fundamental elements of music, and computer-aided modelling of them can not only help people better understand music but also be an effective method of music visualization teaching. This article combines the research results of computer-aided modelling of music rhythm and melody both domestically and internationally and introduces a computer-aided modelling method for music rhythm and melody based on graphical programming technology. Based on computer-aided modelling of music rhythm and melody, the idea of combining computer technology with music teaching is proposed. By establishing a visual rhythm and melody model, students can have a more intuitive and vivid understanding of the application of different musical rhythms and melodies in different melody structures, thereby deepening their understanding of music. Through experiments and practice, it has been proven that this intelligent model can effectively solve the shortcomings of computer-aided modelling of rhythm and melody in traditional teaching. It can be applied to visual music teaching through certain conditions, and the model can be introduced into classroom teaching through computer technology, enabling students to master the ability to analyze and express rhythm and melody, thereby improving classroom teaching efficiency.

Keywords: Music Rhythm and Melody; Computer Assisted Modeling; Visual Teaching; Graphical Programming Algorithms
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1 INTRODUCTION

The rhythm and melody of music are two fundamental elements, the soul of music, and an important means of expressing the theme of music. Due to the traditional music teaching model, rhythm and melody are often taught through teacher demonstrations or explanations, with students passively imitating. The traditional teaching model is that teachers guide students to imitate performance by demonstrating different rhythms and melodies, but this teaching model does not involve students in music practice, thus failing to understand the connotation and essence of music truly. For students, due to a lack of hands-on participation in practice, they often lack emotional understanding of the rhythm and melody of music, which leads to difficulties in learning. The subtle connection between vision and hearing was first proposed by scientists from ancient Greece. They believe that auditory and visual sensations correspond to rationality and sensibility respectively, and the combination of the two can provide more information for people to understand and feel the world. In modern society, while continuing the audio-visual concepts of history, new technologies and theories are also combined and put into practice, achieving progress in multi-level research and multiple application fields. In modern society, the development of visual culture has been accelerating, and the forms of expression in the visual industry have become increasingly diversified with the rapid advancement of the image age. The current visual industry, supported by new digital media technologies and communication media, has transformed from a single static visual form in the past to a diverse and more easily disseminated form of expression. Therefore, it can be confirmed that the flourishing development of visual culture has promoted the progress of more visual-related industries, among which the field of visualization is also clearly poised for development. Based on the development of visual culture, visualization technology has been widely applied in various fields and professions, including music visualization. Music has traditionally been assumed to belong to auditory art, but nowadays, through visual means, abstract aesthetic experiences are combined and evolved with vision to create new forms of display [1]. The development of the post-industrial era has raised a new way of cultural production. Artistic works have not only been created in a single medium but can be designed and presented in different media. Visual art and music art are two typical media, and the advancement of digital technology has promoted the cross-border integration between the two. Researchers have attempted to achieve visual translation of music acoustic information and emotional experience through various mapping design methods. Chen [2] uses interdisciplinary and experimental design research methods to explore the relationship between music and vision and extracts the basis for music to visual transformation in music visualization design. Summarized and analyzed the extraction and analysis methods of music and visual elements in the music visualization mapping mode. A mapping pattern framework that can be reused in music visualization design is proposed by combining information visualization methods, and two types of mapping patterns are divided based on this framework. Guided by design aesthetics and using experimental design research methods, demonstrate and evaluate the impact of two mapping modes on the utility of music visualization. Feng [3] discussed the concept of music visualization and conducted research to support the theory. Most scholars start by exploring the relationship between auditory art and visual art and explore the connection between music art and visual art from their own disciplinary fields. It combines knowledge related to music theory and analyzes and sorts out the corresponding relationship between the two in music visualization cases through theories such as physics and psychology. This type of article usually corresponds to the theoretical basis of the constituent elements and structural features between music information and visual information, explaining the rationality of music visualization formation. Although it provides some theoretical support for music visualization to a certain extent. However, the abstract nature of music and visual information itself makes the correspondence based on theory somewhat subjective and lacks persuasiveness. Franceschini et al. [4] conducted a simple exploration and research on the new art form of music visualization under digital media art. Start the prelude to music visualization research by briefly elaborating on artistic synesthesia. Elaborate on how to visually present music content using new digital media methods through the analysis of physical project cases. At the same time, the current situation of music visualization exploration at home and abroad was also introduced. Its focus is on the visual communication methods and related technical support of digital visualization music, in order to extend the new media aesthetic style it creates. Huang [5] conducted research on the method of obtaining music models in music visualization mapping, mainly focusing on the extraction and analysis of music data models. This type of literature starts with music information, and most of them demonstrate through experimental methods that a certain extraction and analysis method of music information or that certain music information is more worthy of extraction in specific application fields. Many scholars regard accurately expressing emotions in music visualization as the highest goal. This type of research literature mostly starts with several emotional models and combines psychology and physics content as well as music theory knowledge to analyze a large number of music works. Digital technology is the foundation of music visualization mapping, and most of this type of literature analyzes specific mapping techniques in the form of experiments. Many mathematicians will combine practice to try to replace or expand and improve their own visualization techniques. In summary, research on music visualization mapping patterns is more extensive in foreign countries than in China. These studies provide methodological references for the design practice of music visualization, thereby promoting better mutual promotion between theoretical research and practice. Li [6] proposed a mapping pattern framework that can be reused in music visualization design and summarized the specific steps and methods of the mapping pattern framework. In the basic framework, there are two types of mapping patterns: logical mapping patterns and expressive mapping patterns, and their respective characteristics are summarized. Finally, through experimental methods, the impact of the two mapping modes on the functional and aesthetic effects of music visualization is demonstrated and evaluated. Summarize the advantages and applicable application scenarios of the two mapping modes. It takes the mapping basis, important elements, construction methods, construction process, and application effects of music visualization mapping mode as research clues, from the perspective of design aesthetics. Prove the specific advantages and applicable fields of the two mapping modes through experiments. This provides a reusable implementation method for music-to-visual conversion and also provides reference evaluation results for determining appropriate mapping types in music visualization design. As a carrier of information exchange and emotional expression, music integrates into the context of human social and cultural development through its own development. From the perspective of the historical chain of music development, the visual expression of music is not a completely new artistic topic, as music already has a visual aesthetic meaning in its origin. "The selection of harmony in sound and the preparation of great music" is truly a primitive description of the mirror of great music that conforms to audiovisual perception. As mentioned earlier, there is an inseparable "synesthesia" relationship between music and vision. With the increasing richness of human artistic expression, visual and kinesthetic elements in music have gradually been extracted, forming independent art categories such as singing and dancing, and music has gradually become a purely auditory aesthetic category. Although independent art genres have gradually emerged in the long river of history, human efforts to restore the original spirit and aesthetics of music and art in the visual dimension have not stopped [7]. Lukács and Honbolygó [8] evaluated the transfer effect of music education in primary schools on language proficiency development. Studied the relationship between specific music auditory skills, phonological awareness, and reading among multiple second-grade children. These children either attended intensive music courses or regular courses. The results indicate that there is no significant difference between music classes and regular classes, indicating that one year of Kodali classroom music education is insufficient to improve music and language abilities. Although there is no significant relationship between reading and musical abilities, there is a special connection between the accuracy of phonemic deficits and tonal memory. These findings suggest that processing melodies and speech sequences may require similar cognitive mechanisms. Therefore, we assume that there may be task dependency mechanisms in melody and speech perception, which may be the reason for inconsistent findings in music transfer literature.

Therefore, this article proposes a computer-aided modelling method for music rhythm and melody based on graphical programming technology and applies it to visual music teaching using computer technology. This method can effectively solve the shortcomings of computer-aided modelling of rhythm and melody in traditional teaching, and also provide a new approach to visualized music teaching.

2 CURRENT RESEARCH STATUS

The study of music visualization mapping patterns is an interdisciplinary topic, which includes content from multiple disciplines such as design aesthetics, music acoustics, computer science, and psychology. The most primitive material for music visualization comes from the extraction of music data, which needs to be analyzed, extracted, and integrated from a professional perspective to ultimately form the relevant data required for music models in music visualization. This includes knowledge related to music acoustics and computer science. In order to obtain higher-level music information, in the process of music visualization, it is not only necessary to extract acoustic features such as frequency, phase, loudness, amplitude, etc. but also to obtain and summarize music structure and even music emotions. This part inevitably requires the support of psychology, physics, and music theory knowledge. The establishment of visual models in corresponding music visualization ultimately relies on visual presentation, which includes the process of art design and related content of graphic imaging. Therefore, it is necessary to fundamentally master the relevant theoretical knowledge of these disciplines in order to deeply study and explore the entire mapping process of music visualization. Müller's [9] educational guide analysis on music processing basics teaching through FMP laptops. Integrate and analyze it, and propose corresponding music visualization solutions for different application fields.

Pan [10] analyzed the educational reform of university music courses based on cloud classroom-assisted technology of graphic drawing. Currently, painting and music often interact and influence each other. Music and painting share a common property, which is that they both ultimately react to the sensory nerves of the human brain, creating a space for imagination in people's thinking during the process of listening to music and appreciating artworks. Excellent painting works can bring people beautiful enjoyment. The colours, brightness, and lines of the picture are like the rhythm and melody of music. Seeing beautiful pictures is like hearing the high mountains, flowing water, or passionate melodies. And excellent music works are also beautiful paintings. This painting uses notes as brushes and melodies as colours to depict a painting of music in our hearts. Pei and Wang [11] analyzed the changes in concepts and practices of visual art and music art through CAD and sorted out the close relationship between music and vision. Then, based on the visual and auditory cues, the early research and practice of music visualization were sorted out, and the creative ideas and technical methods of music visualization design under different historical backgrounds were summarized and summarized. Secondly, conduct separate studies on the musical and visual elements involved in the process of music to visual transformation. Divide music elements into levels and types, and analyze the characteristics of music information at different levels, summarize the corresponding acquisition methods. The study of visual elements is guided by information visualization methods and introduces the theory of visual variables. And divide the visual variables into static visual variables and dynamic visual variables for research, laying the foundation for the construction of the mapping pattern framework.

With the development of visual technology and the increasing demand for popular visual culture in the context of modern consumption, digital visual art based on modern computer graphics technology has emerged and rapidly developed. Nowadays, visual culture has gradually become one of the prominent characteristics representing modern social culture. The arrival of the image era has also led to the continuous evolution of visual culture styles. We are transitioning from traditional static and purely image-based individuals to a large-scale digital visual cultural industry derived from new technologies, media, industrialization, and other means. The new cultural industry of music visualization is the most typical example, and it can also be said that it is the further result of the visual industry's promotion of the form of the music industry. As is well known, music belongs to the category of auditory art in the traditional aesthetic system, and with the intervention of visual technology, this traditional auditory art has evolved into a new type of art that combines auditory and visual elements [12]. The process of music visualization involves many practical operations and different types of technologies, and there are also various mapping types and methods for different users and purposes. Meanwhile, music visualization has broad application value in various fields such as data display, artistic creation, healthcare, and education. In the era of mature visual technology, the public demands a more comfortable operating process, a smoother interaction experience, and a more immersive user experience. Silva [13] refers to mature research examples abroad and provides a necessary methodology for designing music visualization mapping patterns by sorting and analyzing a large number of mapping pattern cases based on relevant theoretical knowledge.

With the advancement of technology, various new digital media technologies have emerged in large numbers, and the advent of the new media era provides a good opportunity for music visualization. Since 2009, with the deepening development of visual culture and the advancement of visual industry systems such as stereoscopic imaging technology and spectacle imaging technology, stereoscopic imaging technology has gradually matured, and the visual expression ability of virtual images has also been maximized. This provides us with good technical support and a basic guarantee for reconstructing visual forms of music art through the aesthetic power of technology, in order to better express the connotation of music. The era of big data and the development of media have also created a more powerful social and cultural environment for the visualization of music and art. Simply put, digital music visualization is the process of expressing music art through visual art with the support of digital media technology, thereby forming a new form of artistic aesthetics and developing a new visual industry format in the media era [14]. Zhang [15] developed a visual training simulator with a real-time audio correction function using Python programming language and a reference audio file classification library. Based on melody perception and playback level, the learning rhythm increases from the minimum value. The required results are influenced by the number of repetitions. The simulator, designed with real-time visualization options, allows for the estimation of results and errors. The proposed methodology has certain practical value and can serve as a reference for music teaching in preschool education institutions and other music disciplines in music colleges. Further research will focus on using virtual reality methods to improve this technology.

3 CONSTRUCTION AND OPTIMIZATION OF MUSIC RHYTHM AND MELODY

3.1 The Overall Architecture

Computer-assisted modelling of music rhythm and melody is a new method of music modelling that utilizes computer technology to analyze and process music rhythm and melody. This approach can fully leverage the advantages of computers, combining music rhythms and melodies, thereby better-helping learners understand and analyze music. Therefore, it has strong practical significance in music teaching. Based on this, this study constructs a highly intelligent computer-aided music feature analysis model based on the characteristics of music rhythm and melody. The model mainly includes three parts: multi-dimensional analysis of music rhythm and melody, feature extraction of music rhythm and melody, and completion of visual model construction. The overall architecture is shown in Figure 1.

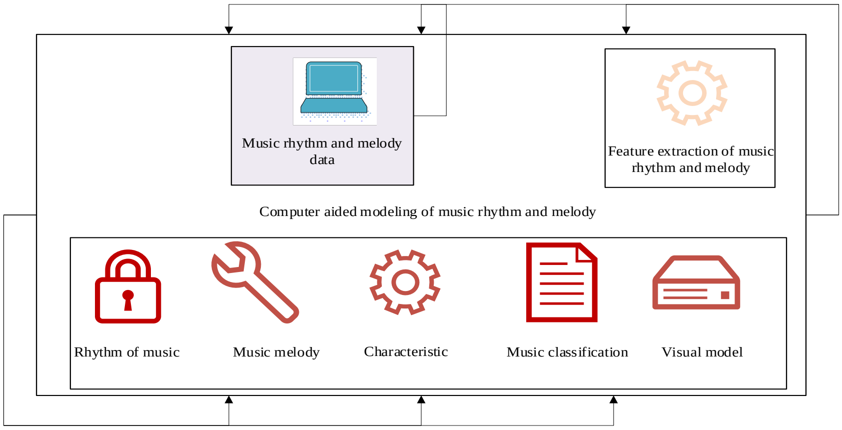

Figure 1: The overall architecture of a computer-aided model based on music rhythm and melody.

Firstly, a multidimensional analysis of music rhythm and melody. This study mainly analyzes the rhythm and melody of music to understand the characteristics of rhythm, rhythm, melody, etc., in music and uses computer technology to process and analyze them in order to obtain a relatively complete set of music feature data. Computer technology can be used to visualize the rhythm and melody of music and present them through charts and other forms in order to better assist learners in understanding music. After analysis, processing, and visualization, computer technology is used to model and analyze it, in order to obtain more scientific music feature data. The corresponding formulas in this process are as follows:

$$Z(d) = \int ed_i + \ e + r \ d_{i+1} \tag{1}$$

$$X(d) = \int ed_{i-1} + rd_i + \ e + r \ d_{i+1} \tag{2}$$

After introducing the disturbance factor, it can be further concluded that:

$$C(d) = \int \left(\frac{ed_{i-1} + rmd_i + \ e + r \ d_{i+1}}{erm + e^2 + r^3} \right) \tag{3}$$

$$V(d) = \int \left(\frac{rd_{i-1} + emd_i + \ e - r \ d_{i+1}}{\sqrt{2erm + e^2 + r^3}} \right) \tag{4}$$

$$B(d) = \iint \frac{ed_{i-1} + ermd_i + \ e + 2r \ d_{i+1}}{e^2 m^2 + \sqrt{e^3 + r^3}} \tag{5}$$

The formula, $Z(d)$、$X(d)$、$C(d)$、$V(d)$、$B(d)$ represents the beat judgment function, rhythm judgment function, melody disturbance function, melody dimension analysis function, and feature extraction function in the auxiliary model, representing interior design data elements. d_i represents the melody standard value, e, m, r disturbance factor, and feature value, respectively.

Secondly, feature extraction and classification of music rhythm and melody. On the basis of music rhythm and melody, classify music rhythm and melody to better help learners understand and master music. In the classification process of music rhythm and melody, this study mainly used two classification methods: pentatonic and octatonic. In the process of dividing the fifth and eighth notes, a combination of fifth and eighth notes was used, with four notes grouped together, each group consisting of a measure, and divided into measures. Among the four tones, the first two belong to the basic level, and the last two belong to the higher level. On this basis, music rhythm and melody are divided into eight categories: fast, slow, medium, and fast. By analyzing and categorizing music rhythm and melody, learners can better understand the content of music.

Thirdly, based on teaching objectives, complete the construction of visual models. In this study, the visualization modelling of music rhythm and melody mainly refers to the visualization model of music rhythm and melody. In the process of visual modelling, this study used dynamic charts and visualized the rhythm and melody of music through charts. After visualization, computer technology is used to analyze and process it to obtain more scientific and comprehensive music feature data. The corresponding formulas in this process are as follows:

$$Z'(d) = \frac{\int ed_i + \ e + r \ d_{i+1}}{emr} \tag{6}$$

$$X'(d) = \frac{\int ed_{i-1} + rd_i + \ e + r \ d_{i+1}}{mr + er + em} \tag{7}$$

$$C'(d) = \frac{\int \left(\frac{ed_{i-1} + rmd_i + \ e + r \ d_{i+1}}{er + e^2 + r^3} \right)}{emr} \tag{8}$$

$$V'(d) = \frac{\int \left(\frac{rd_{i-1} + emd_i + \ e - r \ d_{i+1}}{\sqrt{2erm + e^2 + r^3}} \right)}{e + r + m} \tag{9}$$

$$B'(d)=\frac{\iint \frac{ed_{i-1}+ermd_i+\ e+2r\ d_{i+1}}{e^2m^2+\sqrt{e^3+r^3}}}{e+r+m} \tag{10}$$

The formula, $Z(d)$、$X(d)$、$C(d)$、$V(d)$、$B(d)$ represents the beat judgment function, rhythm judgment function, melody disturbance function, melody dimension analysis function, and feature extraction function in the auxiliary model, representing interior design data elements. d_i represents the melody standard value, e,m,r disturbance factor, and feature value, respectively.

In the visual modeling process of music rhythm and melody, there are mainly two stages: the first stage is to analyze, process, and visualize the music rhythm and melody and display them through visualization. The second stage is to analyze and process the rhythm and melody of the music and visualize them. After visualization, based on the learning situation of learners, computer technology is used to analyze and process them in order to obtain more scientific and comprehensive music feature data. During the visualization process, real-time monitoring of student learning can be carried out, and the learning status of students can be understood in a timely manner. Through this approach, it can better assist students in learning music knowledge.

3.2 Application of Graphical Programming Algorithms

The rapid development of computer technology has led to the widespread application of artificial intelligence in various fields, including music. As an interdisciplinary field in music, computer-aided modelling of music rhythm and melody is supported by computer technology. Applying graphical programming algorithms to computer-aided models based on music rhythm and melody can effectively solve the difficulties encountered by students in the process of learning music and enhance their interest in music learning. Before modelling the rhythm and melody of music, it is necessary to convert them into a graphical language and present them through computer technology. This study mainly uses graphical programming algorithms to analyze music rhythm and melody and visualizes them using computer technology. Throughout the entire process, this study mainly models music rhythm and melody and visualizes music rhythm and melody through the application of graphical programming algorithms.

Specifically, graphical programming algorithms can divide music rhythm and melody into different levels according to different needs and use graphical programming algorithms to achieve their visualization. Different musical rhythms and melodies also have different forms of expression. For example, in the same musical rhythm, different segments exhibit different musical effects. In this process, it is necessary to conduct a multi-dimensional feature analysis on the segments and classify them into rhythmic and melodic types. When analyzing different musical rhythms and melodies, it is also necessary to combine the relationship between music rhythms and melodies for analysis and classify them according to different needs. For example, rhythm type can be divided into two types based on its performance form: single beat and multi beat. The melody type can be divided into two types based on its performance form: upward and downward.

Secondly, for a comprehensive analysis of music rhythm and melody, it is also necessary to implement graphical programming algorithms. In this process, it is necessary to conduct a comprehensive analysis of music rhythm and melody, as well as decompose and combine them. In this process, it is mainly based on graph theory to decompose various different components of music rhythm and melody and transform them into a graphical language. On the other hand, when decomposing music rhythm and melody, it is necessary to comprehensively consider the relationships between various components and use graph theory to conduct a secondary analysis of them. Then, based on the different components of music rhythm and melody, the secondary decomposition is carried out. The experimental results are shown in Figure 2.

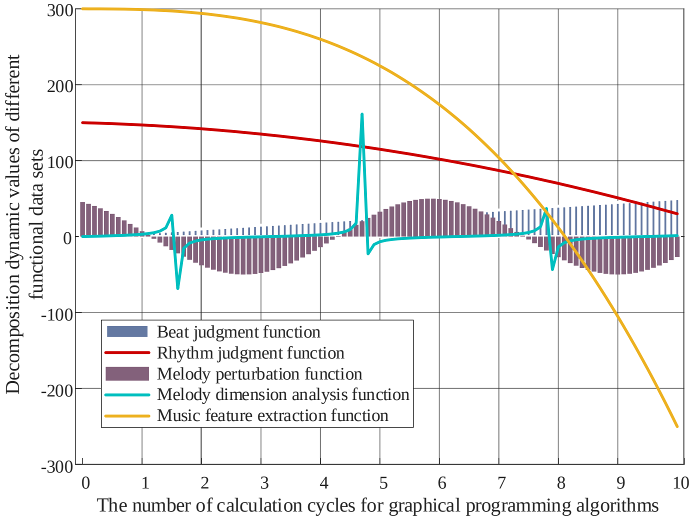

Figure 2: Simulation results of decomposition dynamic values of different function data sets under graphical programming algorithms.

Finally, by combining artificial intelligence technology and graphical programming algorithms, intelligent training is achieved to visualize the modelling process of music rhythm and melody. In this process, it is necessary to intelligently train various different musical rhythms and melodies, and use artificial intelligence technology to classify them, thereby achieving visual modelling of musical rhythms and melodies. For example, when classifying music rhythm and melody, they can be divided into single beat, multi beat, rising melody, falling melody, etc., based on their expressive forms. When intelligently training music rhythm and melody, it can be transformed into a graphical language according to different needs. In this process, artificial intelligence technology can be used to classify it. For example, visual modelling tasks can be divided into two categories: visual modelling of rhythmic music and melodic music. These two styles showcase the unique charm of music through different rhythm patterns and melodic lines, bringing people different musical experiences. They are visualized through high-energy and fast modelling, achieving intelligent classification and efficient utilization of multiple algorithms. Rhythmic music is mainly reflected through instrument performance, vocal singing, and other means. This music style can be expressed by the rhythm type, and by analyzing the rhythm type, the analysis of melodic music can be achieved. When analyzing rhythm patterns, they can be classified based on their performance form, music style, etc., in order to achieve analysis of music rhythm and melody. In addition, melodic music can be divided into ascending and descending melodies based on its performance form. By utilizing artificial intelligence technology, effective mining of its internal information can be achieved. The experimental results are shown in Figure 3.

From Figures 2 and 3, it can be seen that the combination of artificial intelligence technology and graphical programming algorithms can effectively improve the scientific modelling of music rhythm and melody. This is because graphical languages can fully demonstrate the characteristics of music rhythm and melody, and classify them based on this. At the same time, with the support of graphical languages, computer technology can also be used to train music rhythm and melody intelligently.

3.3 Optimization Process of Graphical Programming Algorithms

When constructing an initialized computer-aided model based on music rhythm and melody, this study found the following main problems: slow model running speed, unstable accuracy within a specific range, and insufficient convenience.

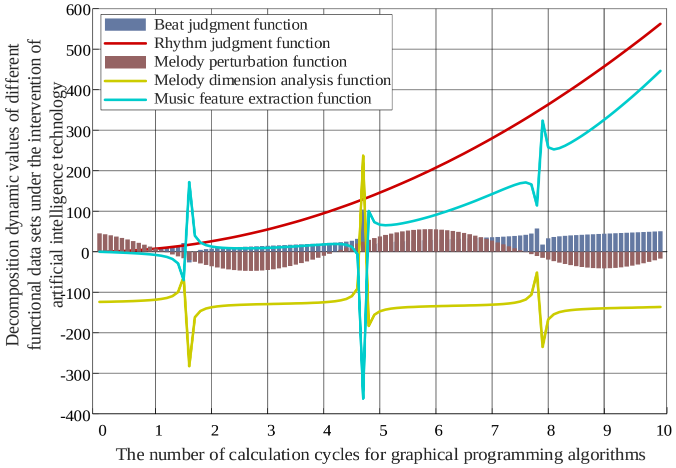

Figure 3: Simulation results of decomposition dynamic values of different functional data sets under the intervention of artificial intelligence technology.

Therefore, this study combines graphical programming algorithms and artificial intelligence recommendation theory to improve and optimize the computer-aided model based on music rhythm and melody. Specifically, improving the optimization process can be divided into two directions.

Firstly, based on graphical programming algorithms and artificial intelligence technology, optimize the operation rules of computer-aided models. In the traditional modelling process of music rhythm and melody, computer operation rules are mainly used. This modelling method has certain limitations and cannot meet people's actual needs for music rhythm and melody. For example, when modelling music of different rhythm types, it is necessary to conduct certain analyses and research on them. However, in traditional computer-aided models, there are certain problems in the modelling process due to the lack of corresponding operation rules. For example, when modelling different types of musical rhythms and melodies, if only processed through computer operation rules, it will lead to a lack of scientific modelling of music rhythms and melodies. In this case, graphical programming algorithms and artificial intelligence technology can effectively solve the above problems. In the actual operation process, this study integrates artificial intelligence recommendation theory into computer-aided modelling of music rhythm and melody. Through the analysis of music rhythm and melody, it is understood that different types of music have different characteristics of rhythm and melody. When classifying music rhythm and melody, full consideration was given to people's actual needs, and artificial intelligence recommendation theory was integrated into it, effectively improving the accuracy of computer-aided models. The experimental results are shown in Figure 4.

Secondly, based on graphical programming algorithms and artificial intelligence technology, optimize the cyclic judgment conditions of the output results of computer-aided models. In traditional computer-aided models of music rhythm and melody, the loop judgment condition is mainly based on the length of the music melody. That is, when the length of a certain melody reaches a certain standard, the melody will be judged as a rhythm type. The corresponding formula in this process is as follows:

$$Z''(d) = \frac{\int ed_i + \ e + r \ d_{i+1}}{\sqrt{e + m + r}} \tag{11}$$

$$X''(d) = \frac{\int ed_{i-1} + rd_i + \ e + r \ d_{i+1}}{\sqrt{mr + er + em}} \tag{12}$$

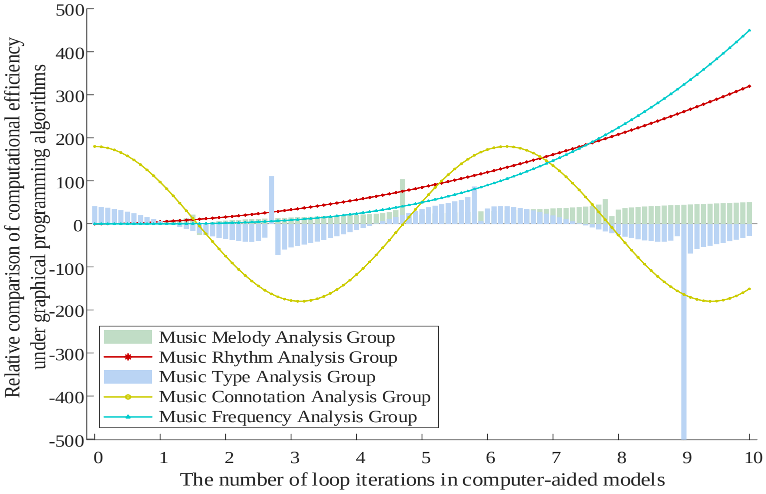

Figure 4: Optimization and iteration experimental analysis of computer-aided models for music rhythm and melody.

$$C''(d)=\frac{\int\left(\frac{ed_{i-1}+rmd_i+\ e+r\ \ d_{i+1}}{er+e^2+r^3}\right)}{\sqrt{e+m+r}} \tag{13}$$

$$V''(d)=\frac{\int\left(\frac{rd_{i-1}+emd_i+\ e-r\ \ d_{i+1}}{\sqrt{2erm+e^2+r^3}}\right)}{\sqrt{e+r+m}} \tag{14}$$

$$B''(d)=\frac{\iint\frac{ed_{i-1}+ermd_i+\ e+2r\ \ d_{i+1}}{e^2m^2+\sqrt{e^3+r^3}}}{\sqrt{e+r+m}} \tag{15}$$

The formula, $Z(d)$、$X(d)$、$C(d)$、$V(d)$、$B(d)$ represents the beat judgment function, rhythm judgment function, melody disturbance function, melody dimension analysis function, and feature extraction function in the auxiliary model, representing interior design data elements. d_i represents the melody standard value, e, m, r disturbance factor, and feature value, respectively.

However, in the actual operation process, due to differences in people's needs, some problems have arisen in the actual application process. For example, when the length of a melody reaches a certain standard, it is judged as a rhythm type; But when the length of a melody is less than a certain standard, it is judged as a melody length. In practical applications, due to the differences in people's requirements for music rhythm and melody, this phenomenon of inconsistent cyclic judgment conditions may occur in different situations. In this regard, this study combined artificial intelligence technology to optimize and change the criteria for determining the melody of different music types, achieving adaptive judgment conditions and effectively improving the accuracy of their output results.

Thirdly, the visualization setting conditions have been simplified. In traditional computer-aided models, the visualization setting conditions are mainly based on the length of the music melody. In this case, although it can improve the accuracy of its output results, it has certain limitations in practical application due to the complex visualization setting conditions. In order to effectively improve the accuracy of its output results, this study simplified the visualization setting conditions, that is, in the visualization setting conditions, the music rhythm and melody are analyzed as a whole. When visualizing the modelling of music rhythm and melody, it is necessary to first analyze their music rhythm and melody. Then, based on the characteristics of different types of music rhythm and melody, they are transformed into a graphical language and classified through graphical language. The experimental results are shown in Figure 5.

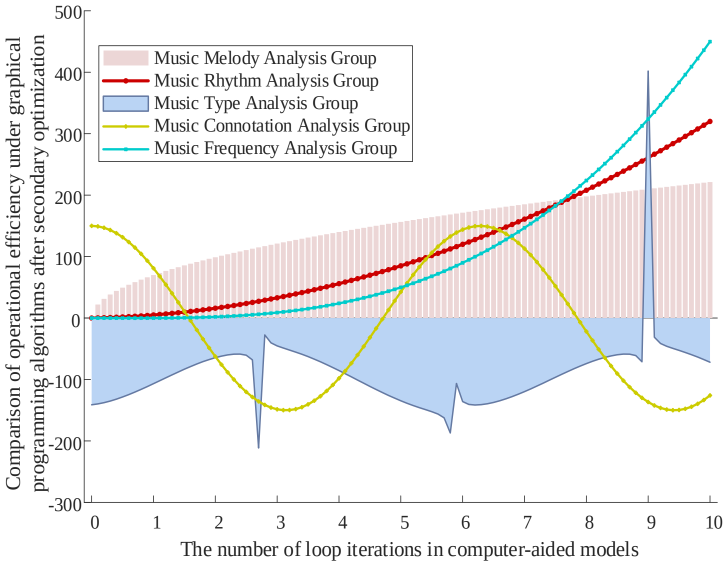

Figure 5: Analysis of the Optimization Iteration Experiment Effect of Computer Aided Models for Music Rhythm and Melody after Secondary Optimization.

From Figures 4 and 5, it can be seen that the optimized model can effectively improve the accuracy of the output results. Meanwhile, the model has a certain degree of convenience in practical applications. This is because after converting its visual language into a graphical language, you only need to select the corresponding graphical language and combine it with music rhythm and melody to classify it. In this case, it can not only improve the running speed of computer-aided models but also effectively reduce their running time, thus having certain advantages in practical applications.

In summary, in the computer-aided modelling process based on music rhythm and melody, this study integrates graphical programming algorithms and artificial intelligence recommendation theory into the computer-aided model. By optimizing it through graphical programming algorithms and artificial intelligence technology, the model can be effectively optimized and improved.

4 EXPERIMENTAL RESULTS AND ANALYSIS

4.1 Experimental Design

This study takes first-year students majoring in music in universities as experimental subjects and takes actual music works as case studies. Through computer technology, the model is introduced into classroom teaching, and teaching practice is carried out to explore the effectiveness of the model in actual classroom teaching. In the specific experimental process, this study conducted a detailed analysis of the computer-aided modelling process of music rhythm and melody and optimized it based on this. Firstly, the rhythm, melody, and other parts of the music were disassembled and transformed into a graphical language; Secondly, according to the learning situation of students, different visualization languages for training; Finally, an experimental test was conducted in the music classroom, and the experimental results are shown in Figure 6.

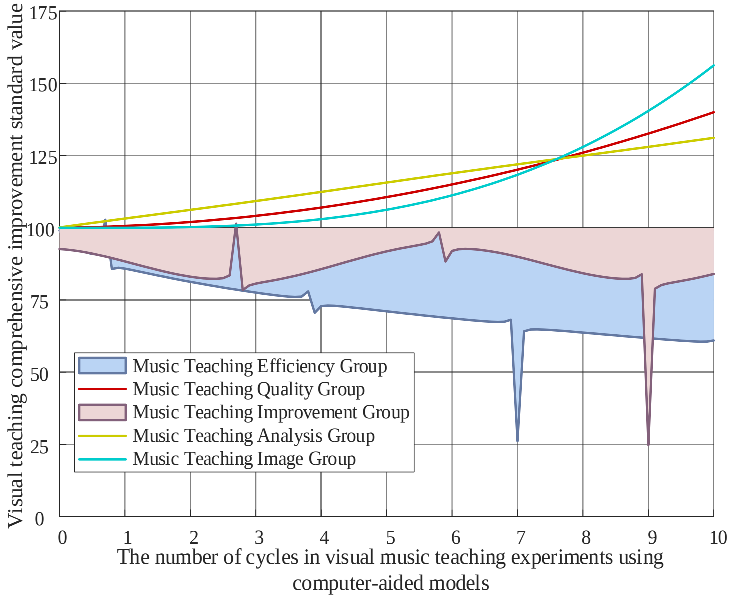

Figure 6: Experimental results of computer-aided models in visualized music teaching.

The experimental results in Figure 6 indicate that the computer-aided model can effectively solve the shortcomings of traditional computer-aided modelling of rhythm and melody in visual music teaching, and can improve classroom teaching efficiency. In actual music course teaching practice, through experimental observation and analysis of students, their understanding and acceptance of the model are relatively high, and classroom teaching efficiency is improved. This is because, during the experimental process, improvements were mainly made in three aspects: first, the rhythm and melody of the music were analyzed, and it was transformed into a visual language for large-scale operations. Secondly, the rhythm, melody, and other parts of the music were disassembled and transformed into a visual identification. Thirdly, using image language to extract features and information from various parts of the music, such as rhythm and melody.

4.2 Analysis of Experimental Results

In order to objectively evaluate and analyze the experimental results of this study, a common multidimensional system evaluation method was used, and multiple indicators were normalized. The analysis results are shown in Figure 7.

From the analysis results in Figure 7, it can be seen that the computer-aided modelling method for music rhythm and melody used in this study not only vividly and intuitively displays the process of students learning music knowledge compared to traditional modelling methods, but also provides more learning information for students, which is conducive to their understanding and mastery of music knowledge. This is because, through computer-aided modelling, students can more intuitively demonstrate the learning process of music knowledge, which will also have a significant impact on their learning effectiveness and help improve their mastery of music knowledge. study, they can clearly present the relationship between rhythm and melody in their minds, which helps them have a more comprehensive and clear understanding of music rhythm and melody.

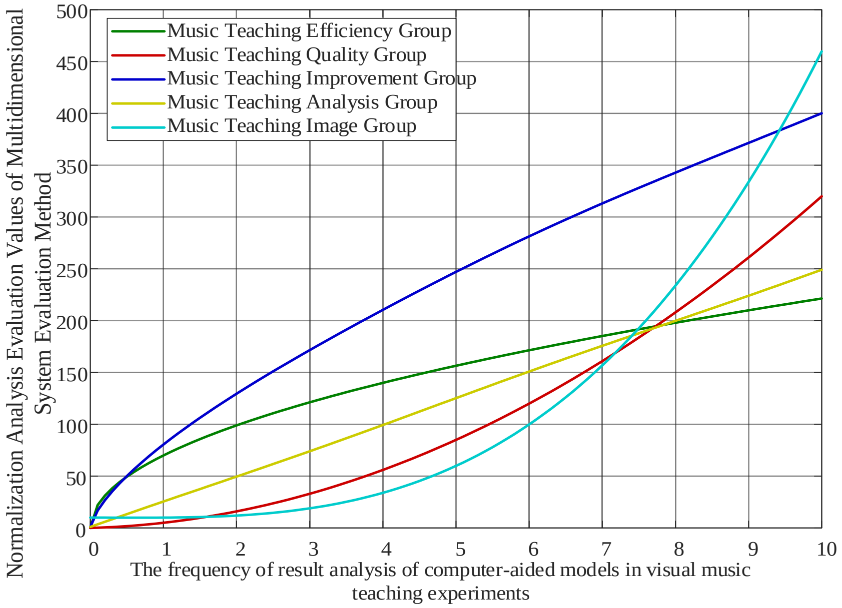

Figure 7: Experimental analysis and evaluation results of computer-aided models in visual music teaching.

On the other hand, when students see the music rhythm and melody modelling method used in this Meanwhile, due to the modelling method used in this study being able to present music knowledge more vividly and intuitively, students can learn music knowledge through computer-aided modelling methods, which helps them better understand and master music knowledge, and effectively improves the overall learning effect.

5 CONCLUSIONS

This article conducts computer-aided modelling of music rhythm and melody, proposes a computer-aided modelling method for music rhythm and melody based on graphical programming technology, and applies it to visual music teaching. An intelligent model based on computer-assisted modelling of music rhythm and melody is established, providing an effective method for people to understand music. In addition, this article applies the intelligent model to visual music teaching, which plays a certain role in helping students master the application of different music rhythms and melodies in different melody structures and deepen their understanding of music.

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