



Digital Protection of regional Guqin art and intelligent analysis of rhythm

Wei Zhou

Nanchang Normal University, Nanchang, Jiangxi, 330032, China

Email: 56269655@qq.com

Abstract. In the current era of rapid digital informatization of the Internet, new requirements have been put forward for the cross-border dissemination of guqin culture and art. The performance of guqin is a spatial movement, and this article will mainly introduce its specific content from multiple aspects such as notation, content retrieval, guqin string method, guqin music annotation, music style analysis, overtone and off tone, tonal algorithm synthesis, and phonemes for the digital protection of regional guqin art. After modeling based on the six commonly used tuning strings and rhythm analysis rules of the guqin, the pitch of the guqin was scientifically measured and data analysis was conducted. The problem of pitch control in digital guqin pitch was explored, and the commonly used pitch control of the guqin was used as a reference object to debug and classify the guqin pitch. Measurement using GMAS software. A rigorous and scientific quantification method was adopted, which has strong practical significance.

Keywords: Guqin; Digital protection; Spectrum quantization; K-means; Legal analysis

1 Guqin Introduction

Guqin is one of the oldest plucked instruments in China, with a history of over 3000 years. In November 2003, Guqin art was included in the second batch of world human oral and intangible heritage masterpieces. In May 2006, with the approval of the State Council, Guqin entered the first national Intangible cultural heritage list. In 2017, Jiangxi Guqin Art was listed as Jiangxi Provincial Intangible cultural heritage by the People's Government of Jiangxi Province and the Agency for Cultural Affairs of Jiangxi Province. In September 1977, the Voyager exploration spacecraft launched by the United States played a record called "Voice of Earth", which included representative works of art from around the world. One of them is Mr. Guan Pinghu, a famous guqin player, who plays the guqin music "Running Water" to represent Music of China. The earliest Guqin had only five strings, which combined the elements of gold, wood, water, fire, and earth; Gong, Shang, Jiao, Zheng, and Yu in the five external consonants. Later on, it became the current seven stringed guqin. In guqin, we can find many elements of traditional Chinese culture. From Figures 1 the guqin is mainly divided into three parts: the surface, the bottom, and the belly. The length of the qin is generally

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about three feet six inches five (approximately 120-125 centimeters), symbolizing 365 days in a year. The surface of the qin represents the circle of the sky, forming an arched shape, and the flat surface of the qin bottom symbolizes the place, hence the saying of "the circle of the sky and the place". The guqin has a total of thirteen emblem positions, symbolizing the twelve months of a year. The largest emblem position in the center of the qin represents the leap month. The guqin is an art form of traditional Chinese culture and a typical representative of traditional elegant art.[1]

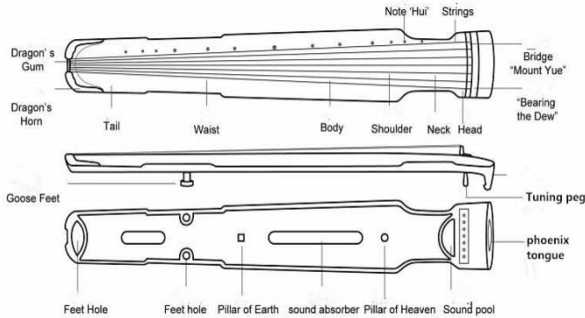


Fig. 1. Schematic Diagram of Guqin Structure.

The Guqin has a wide range of sounds, ranging from the large character group C to the small character group D, with over 200 overtones. From Figures 2 and 3 the development of guqin art has driven the development and transformation of computer music engineering information technology. From its unique written notation and subtractive notation, to quantitative pitch calculation models, in the rapidly developing digital information age, traditional art also faces greater challenges. The data research presented by guqin audio and video involves various interdisciplinary subjects in various text data experiments, However, the measurement and data analysis of the rhythm system in guqin have further advanced the research on the music format in its rhythm system. [2]

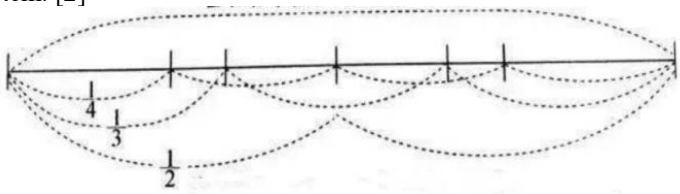


Fig. 2. vibrations - pitch and vibrations - overtones
 The sound produced by all string vibrations - pitch
 The sound produced by some string vibrations - overtones

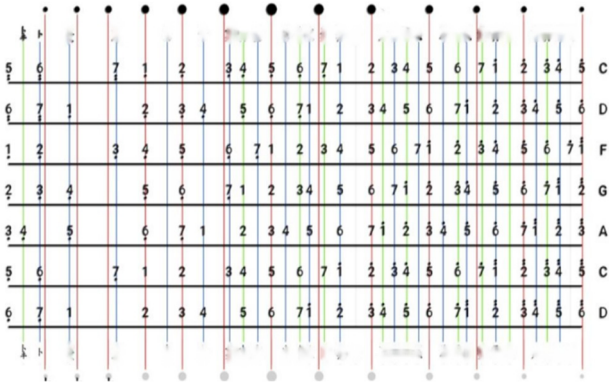


Fig. 3. Guqin tuning frequency and phoneme diagram.

2 Overview of Digital Protection of Regional Guqin Art

When protecting the traditional guqin music culture, most performers will perform the music, but there is not much research on its performance techniques and style characteristics, which leads to the inability to better preserve the complete characteristics of traditional guqin music. This also puts forward higher requirements for the protection and inheritance of traditional guqin music. The protection of digital guqin art involves interdisciplinary integration such as modern information technology. Under the impact of artificial intelligence and digital media technology, as well as the widespread dissemination of AR/VR, it undoubtedly poses greater challenges to the work of digital inheritance and protection.[3]

The traditional notation for guqin consists of two forms: written notation and subtracted notation. Written notation refers to the use of language and writing to record a complete qin piece, marking the strings and emblem of each note in the piece. The disadvantage of written notation is that there are too many characters. [4]Taking the existing "Jieshi Diao. Youlan" as an example, this ancient qin piece consists of over a thousand notes and is played for about ten minutes. If written notation is used to record the changes in strings, emblem positions, rhythm, and strength played by both hands, it is undoubtedly a cumbersome method. Compared to the written script, the subtracted character spectrum is simpler and clearer. The subtracted character spectrum mainly consists of four parts to form a font, representing the fingering of the left and right hands, the position of the strings, and the emblem of the qin. However, as far as the Pathogen transmission is concerned, the subtracted character spectrum cannot be quickly output by computer. [5]The current subtracted character spectrum of guqin is handwritten. It is difficult to recognize and explore the information of the music spectrum. Digital products such as computers cannot quickly recognize and process the music spectrum. How to use digital devices to quickly recognize and convert subtracted character spectra into popular staff and simplified spectra is also an important research field.. But precisely because of this, there is a broader research prospect for the digital coding, inheritance and protection of Guqin notation.[6]

3 Intelligent Analysis of Rhythm Modeling in Guqin Score

At present, the score of guqin adopts the technique of recording performance using subtractive notation, but the rhythm and strength symbols of the music are not marked on the score. From a physical perspective, music has four characteristics: pitch, value, intensity, and timbre. Rhythm is the pulse of music and one of the most important elements in music. Rhythm is an important factor in expressing the artistic characteristics of music. [7]This is also a deficiency in the notation method of guqin music score, where only the playing position and pitch are present, without the length of the rhythm, resulting in the inability to accurately mark the duration of the music. So in the current guqin score, in addition to subtracting the character score, each sentence will also be annotated with a notation or staff score, in order to better perform and disseminate music. But undoubtedly, these have brought certain challenges and difficulties to the digital information dissemination of Guqin art, making it difficult to quickly identify audio and music information.[8]

Corrected piano emblem		Waiting for calibration of the piano emblem	
Seven()	→	Five (ten)	Same sound
Seven()	→	Four(nine)	Same sound
Four(ten)	→	Six ()	Same sound
Six ()	→	Three(nine)	Same sound
Five ()	→	Two(nine)	Same sound
Four ()	→	One(nine)	Same sound

Fig. 4. The method of adjusting the strings of a guqin according to its pitch

Corrected piano emblem		Waiting for calibration of the piano emblem	
Seven(seven)	→	Four (five)	Same sound
Four(four)	→	Six(five)	Same sound
Six (seven)	→	Three (five)	Same sound
Seven(five)	→	Five(four)	Same sound
Five (seven)	→	Two(five)	Same sound
Four (seven)	→	One(five)	Same sound

Fig. 5. Guqin overtone correction string method

From Figures 4 and 5, it can be seen that there are two methods for correcting the pitch of guqin: the scattered string method and the overtone string method. From Figure 4, it can be seen that the pitch of the strings that have been corrected and are waiting to be corrected have scattered notes and pitch based calibration. Assuming that the pitch

frequencies of the first string to the seventh string are represented by L1~L7, respectively, the pitch of the following different notes can be obtained:

1) If the pitch of the seventh string is determined by the empty string, the sum of the same notes is added with the notes of the fifth string and the tenth emblem, and then the sum of the same notes is added with the notes of the fourth string and the ninth emblem;

$$L7=L5(10)=L4(9)$$

2) If the fourth string and the tenth emblem are used as the basis, then the sixth string empty string sound is combined with the same sound as before;

$$L4(10)=L6$$

3) If the pitch of the sixth string empty string is taken as the standard, then the pitch of the third string nine badges is combined with the same pitch as before;

$$L6=L3(9)$$

4) If the empty string sound of the fifth string is used as the standard, the second string and the ninth emblem of the qin are combined with the same sound as before;

$$L5=L2(9)$$

5) Finally, if the fourth string's empty string sound is used as the standard, the first string's ninth emblem's note should be combined with the same note as before;

$$L4=L1(9)$$

6) Experimental results: The difference in pitch accuracy of guqin mainly depends on the energy ratio between the fundamental frequencies of the guqin. The same single tone extraction to parameter (MFCC) is used as the audio feature parameter, and the K-Means algorithm is used to cluster the feature vectors. Each scattered or per tone is ultimately represented as a set of quantization numbers. The audio spectrum quantization and tuning method for guqin using this method is effective.[9] Quantized data can fully utilize the statistical encoding and recognition applications between various components. The evaluation indicators and methods of intonation are determined through data analysis and comparison. Under the standard data model, the seven strings of the guqin were tested separately, and the pitch was corrected by taking the average and standard deviation. The smaller the difference after comparison, the closer it is to the standard tone, and the better the pitch and timbre of the guqin.[10]

4 Conclusion

With the development and progress of social technology, the popularization of network digital informatization has emerged, and using objective methods to evaluate has become an inevitable trend in current society. This study provides a certain reference for the digital protection of guqin art in different regions. It intelligently analyzes the rhythm frequency and quantitative information in the text, and analyzes the numerical

calculation of the fundamental frequency of actual music.[11] The fluctuation of rhythm techniques is analyzed. Based on the basic principles of guqin sound effects, the article elaborates on the characteristics of guqin string spectrum acoustics. In the era of digital informatization, as one of the world's intangible heritage cultures, the art of guqin still needs to be solved and completed in terms of digital protection in regional inheritance. Through the normal calibration of guqin strings according to sound, scattered sound, and overtone, audio modeling is carried out, continuously spreading and improving the ways of inheriting digital new media, and combining digital media with traditional music protection, this is also an important direction in the field of music expression applications.[12]

Acknowledgement

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