



# Research on Emotional Conditioning Based on Chinese National Pentatonic Modes

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**Abstract.** The music with pentatonic modes has been utilized for emotional conditioning since antiquity. Recently, the theoretical research on exploring pentatonic mode by using emerging technologies represented by databases has been further deepened. Nevertheless, the vast majority of current applied research is limited to clinical assistance. Against this background, building a web platform for emotional conditioning through database technology, as a beneficial attempt to promote the creative development and innovative transformation of traditional culture contributes to enhancing the awareness of five-element music among the public and helps to enhance the self-confidence and soft power of national culture, thus realizing cultural renaissance.

**Keywords:** Five-element Music, Emotional Conditioning.

## 1 Introduction

Chinese national pentatonic mode marks a unique musical cultural system in the world, which is based on the pentatonic scale encompassing Gong, Shang, Jue, Zhi, and Yu arranged in pure pentatonic intervals<sup>[1]</sup>. The academic circles, however, are controversial about the approach to determine the pentatonic mode, with no consensus being reached. While the introduction of computer technology has inspired the research of computer-based mode judgment, most of these studies are limited to the discussion of databases, rarely involving applied research and investigation.

It is imperative, therefore, to deeply analyze the characteristics of the interval structure of traditional national modes, and put forward a brand-new judgment method based on improving and updating the judgment method of five-element musical modes. Meanwhile, the decision tree model should also be utilized reasonably to build a five-element database by judging tracks. More specifically, on the one hand, it is helpful to provide valuable inspiration for academic research on musical mode judgment. On the other hand, it is undoubtedly of rich practical significance and cultural connotation to innovate the mode of communication, explore applied research, and realize the practical application of relevant technologies.

## 2 National Pentatonic Modes and Emotional Conditioning

### 2.1 Basic Principles and Research Status of Emotional Conditioning through Music with Pentatonic Modes

Huangdi *Neijing* defines the corresponding relationship among five zang organs and seven emotions as well as five minds, especially the pairing of five notes and five zang organs. Consequently, the five notes affect people's emotions and other psychological activities by affecting the five zang organs. Utilizing the law characterized by the "generation-inhibition in five elements", the five notes can regulate emotions by conditioning the five zang organs of individuals. In other words, the treatment of various diseases can be further implemented based on different volumes, tones, melodies, rhythms, emotional reactions, and corresponding five zang organs<sup>[2]</sup>. In this foundation, the emotional conditioning through five-element music came into being naturally.

### 2.2 Determination Criteria of National Pentatonic Modes

Given the diversity and complexity of the classification criteria of the pentatonic mode as well as the difficulty in the unified correspondence between the pentatonic mode and the five elements and five zang organs, we will focus on the five-tone mode. Regarding the classification criteria, we take the Western music theory as the basis, supplemented by the Gong-Jue relationship method for determination. To be specific, it is imperative to make a basic judgment about whether it belongs to the Chinese traditional pentatonic mode or the Western major and minor modes. The most concise and practical method for making this determination is by auditory judgment through singing the music score. Music is an art based on the auditory sense.

Through the singing of the music score, we can further employ our auditory sense to determine whether it's the Western major and minor modes or the Chinese pentatonic mode<sup>[3]</sup>. Apart from auditory judgment, we can also utilize the organizational structure of musical scores and melodies for determination.

In contrast, Chinese traditional pentatonic modes generally exhibit a melodic pattern characterized by a three-note sequence with major thirds connecting to minor seconds in the score, with the adjacent pitch levels maintaining major seconds or major and minor thirds relationships in cases of no dissonant intervals, as illustrated in Fig. 1.



Fig. 1. Example 1

Once the Chinese pentatonic modes are determined, it's essential to further define their musical mode structure. Selection of the tonic sol-fa system is helpful to determine the name of the tonic in the context of Chinese traditional music modes based on the pentatonic modes, in which "do," "re," "mi," "sol," and "la" correspond to the traditional

pentatonic scale degrees, Gong, Shang, Jue, Zhi, and Yu, respectively., as illustrated in Fig .2.

Of these, the Gong note can be utilized to determine the key signature. In other terms, the Gong note, as the initial "do", can be employed to deduce the name of the tonic, thereby determining the name of the mode. Arranging the scales from the tonic, the scale degrees of the national pentatonic mode (i.e., Gong, Shang, Jue, Zhi, and Yu) can be further determined based on the interval structure.

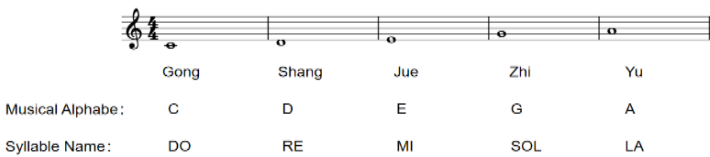


Fig. 2. Example 2

The mode structure can be determined according to the interval relationship, while the Gong note can be determined according to the Gong-Jue relationship (i.e., the interval relationship of the major third), thus determining the key signature. Conceptually, the Gong-Jue major third refers to the Gong-Jue notes, with its interval position remaining fixed. Within the pentatonic scale encompassing three major seconds, two minor thirds, four perfect fourths, perfect fifths, and two major seconds, it is the sole interval with a major third, which is called the Gong-Jue major third<sup>[4]</sup>. In addition, the mode can be determined based on the musical scale structure. Overall, the musical scale arrangement structure of pentatonic mode includes the following five types, each of which presents its musical scale structure (i.e., the interval relationship between adjacent notes). This marks an important feature of the pentatonic mode. With the musical scales being arranged from low to high from the tonic of the track, the mode of the track can be determined according to the corresponding musical scale structure. On these grounds, the ultimate mode of the track can be confirmed according to the key signature determined by Gong note, as well as the tonic.

As such, the Gong-Jue major third serves as an important judgment tool to determine the mode. In the case of clef in B-flat major, as explained in Fig. 3 bB and D jointly form a major third relationship. Accordingly, this melody takes bB as the Gong note.



Fig. 3. Example 3

By the same token, as illustrated in Fig. 4 the major third between bE and G is the sole major third within the music score. Given its utilization of bE as the Gong note, its mode name is C Yu mode.



Fig. 4. Example 4

### 3 Database Construction

#### 3.1 Design Background and Research Status of National Pentatonic Mode Database

Music database construction can be roughly divided into two types, one of which is the traditional database of libraries and audio archives for collecting, storing, classifying, and retrieving music data, whereas the other is the music database for processing a myriad of digital music by employing computer technologies (i.e., music retrieval technologies)<sup>[5]</sup>.

The pentatonic mode database system developed in this research is composed of two parts: portal subsystem and background management subsystem. To be specific, for one thing, the portal subsystem is not only a man-machine interface between the five-element music resource display system and users but also a window to show users the services of the system. Moreover, whilst providing users with an entrance to retrieve music resource data comprehensively, the portal subsystem is also convenient for better displaying music resources. For another, the background management subsystem primarily provides a host of functions such as resource classification management, log management, advanced retrieval configuration, user management, resource entry management, and similar thesaurus configuration<sup>[6]</sup>, as illustrated in Figure 5.

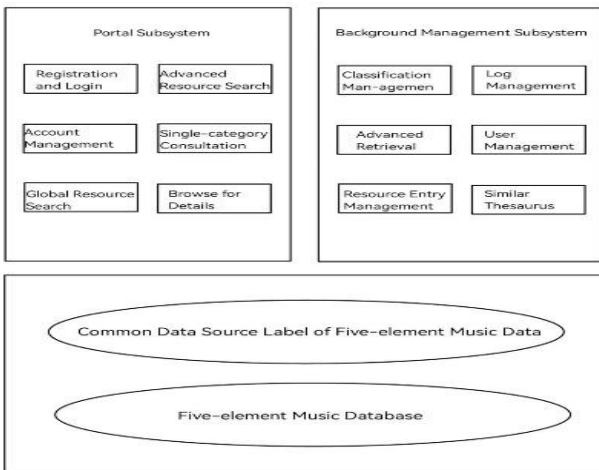


Fig. 5. Five-element Music Database

## 3.2 Algorithm Design

### 3.2.1 Determination of National Pentatonic Modes Based on Machine Learning.

Taking pitch as the feature, the decision tree algorithm divides the music samples into diverse subsets by constructing a tree structure, thus facilitating the determination of the five-element musical modes. Within the tree structure of the decision tree, each internal node represents a pitch threshold, with samples included in the left subtree or the right subtree according to the pitch<sup>[6-7]</sup>. The above-mentioned process will continue consistently to the leaf node, which contains a decision of five-element musical modes. Hence, the proposed algorithm can traverse the whole decision tree by providing a pitch as input, ultimately determining which type of pentatonic mode the music sample belongs to. Through the determination of the five-element musical mode, it can further establish a pentatonic mode database based on the category.

The construction process of the decision tree involves the selection of the optimal features as well as the division of data sets into subsets until the stopping conditions (i.e., reaching the maximum depth or the minimum number of samples) are satisfied. To determine the optimal features and division points, the decision tree algorithm leverages different division criteria, such as information gain or Gini impurity. Such criteria contribute to the selection of features that distinguish varying categories to the greatest extent<sup>[8]</sup>. Once the decision tree is constructed, it can be employed to classify new data, and traverse the tree from the root node to the leaf node according to the eigenvalue, ultimately determining the category of data points.

Detailed steps are presented as follows:

*Step 1: Data Preparation.*

*Step 2: Definition of Division Rules.*

*Step 3: Selection of Optimal Features and Division Points.*

*Step 4: Recursive Construction of Decision Tree.*

*Step 5: Prediction.*

### 3.2.2 Determination of Pentatonic Mode Based on Last-note Solmization Method.

The principle of this algorithm can be summarized as inferring the musical mode of a tune based on the pitch (i.e., syllable names) of the last note of music. Various musical modes are associated with the syllable names of different notes. For instance, Gong mode corresponds to C (do), with Shang mode corresponding to D (re), Jue mode corresponding to E (mi), Zhi mode corresponding to G (sol), and Yu mode corresponding to A (la). In this connection, the algorithm can check the syllable name of the last note and compare it with the note mappings of these modes to determine the mode of the tune. This method is helpful in establishing a comprehensive understanding of the basic tonality of music, facilitating further music analysis. To achieve this function, the MIDI

music file needs to be parsed to extract the pitch of the last note. Furthermore, by comparing it with the note mapping of each mode, the mode to which the tune belongs can be ultimately output.

Detailed steps are presented as follows:

*Step 1: Processing Music in MIDI Format.*

*Step 2: Extracting the Last-note Pitch.*

*Step 3: Determining the Syllable Name of the Last-note Pitch.*

*Step 4: Determining the Mode of the Input Track.*

### 3.3 Experimental Results

**Table 1.** Comparison of Experimental Results

|   | Manual determination | Machine learning method | Last-note solmization method |
|---|----------------------|-------------------------|------------------------------|
| <i>Partridges Flying</i>                | Jue mode             | Jue mode                | Jue mode                     |
| <i>General's Command</i>                | Zhi mode             | Shang mode              | Shang mode                   |
| <i>August Roses Blooming Everywhere</i> | Gong mode            | Gong mode               | Gong mode                    |
| <i>Fishing Boat In the Evening</i>      | Gong mode            | Gong mode               | Gong mode                    |
| <i>Running Horse</i>                    | Yu mode              | Yu mode                 | Yu mode                      |
| <i>Combating Typhoon</i>                | Zhi mode             | Zhi mode                | Zhi mode                     |

By comparing the experimental results shown in Table 1. of the two algorithms, the decision strategy based on the last-note solmization method performs well in terms of the accuracy of tune mode, which further verifies the high accuracy of the proposed algorithm. Furthermore, it proves conclusively that the theoretical standard of the five-element music classification formulated in this research has been scientifically and reasonably considered, thus ensuring the effectiveness and credibility of this classification system.

## 4 Conclusions

To sum up, based on the characteristics of the interval structure of traditional national pentatonic modes, this research puts forward a novel determination method by improving and updating the determination method for the five-element musical modes, thereby offering valuable inspiration to academic research on the determination of musical modes. Meanwhile, this research establishes a five-element music database after utilizing the decision tree model to determine the tracks. On these grounds, this research

intends to construct a platform for the public to employ the five-element music to implement self-emotional conditioning, with a view to providing feasible references for clinical treatment based on user feedback.

From the social and individual perspectives, on the other hand, this research suggests leveraging five-element music to regulate personal emotions. On the same note, the pivotal role of music therapy in emotional conditioning should be highly valued, thus cultivating the individual's good and healthy social mentality as well as adequately exploring the contemporary values of traditional culture.

## References

1. Ren W. X., Che M. J., & Wang Z. W., et al. CNPM Database: A Chinese National Pentatonic Mode Database for Computational Musicology [J]. *Journal of Fudan University: Natural Science*, 2022,61(05):555-563. DOI: 10.15943/j.cnki.fdxh-jns.20221017.008.
2. Du. J. Construction of Syndrome Differentiation Music Scheme in Assisted Reproduction Technology by Chinese Medicine Meridian Flowing Five Elements Music Theory[J]. *Chinese Community Doctors*,2022,38(35): 75-77+80.
3. Zhao L. M. A Concise Method to Differentiate Music Modes[J]. *New Curriculum Learning (Middle)*, 2015(02): 58-59.
4. Cao T., & Zhang J. Design of Zhang Zhongqiao Music Database[J]. *Inner Mongolia Science Technology & Economy*, 2021(22):82-83+141.
5. Zhao D. L. Discrimination of Traditional Music Modes from the Perspective of the Utilization of the Gong-Jue Relationship[J]. *Home Drama*, 2015(11): 56+58.
6. TEMPERLEY D. What'skeyforkey? TheKrumhansl -Schmucklerkey-findingalgorithmreconsidered[J]. *MusicPerception*,1999,17(1):65-100.
7. PAUWSS.Musicalkeyextractionfromaudio[C]//InternationalConferenceonMusicInformationRetrieval.Barcelona, Spain: ISMIR,2004:1-4.
8. KORZENIOWSKIFWIDMER G. End-to-endmusicalkeyestimationusingaconvolutionalneuralnetwork[C]//201725thEuropeanSignalProcessingConference. Kos, Greece: IEEE, 2017:966-970.

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