Relationship Between Psychological Color Recognition and Timbre Changes in Pipa Performance Education Based on Intelligent CAD Tutoring Systems

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Abstract. Among the traditional musical instruments of the Chinese nation, Pipa is unique. The timbre of Pipa's performance mainly covers two aspects of pronunciation, namely, natural timbre and changing timbre. The pipa is a representative of classical musical instruments, with beautiful timbre and crisp melody. Because the player is different, the effect is also different. Among the traditional musical instruments of the Chinese nation, the pipa is unique. The timbre played by the pipa mainly covers two aspects of the pronunciation state, namely natural timbre and changing timbre. The material, structure, vibration, and pronunciation of the instrument itself directly determine the natural timbre. In the process of teaching pipa playing, we should not only pay attention to teaching students relevant playing skills but also important for the recognition of the performer's psychological color and fully display the timbre changes so as to express emotions, resonate with the audience, and play an important role in enhancing the artistic expression of the pipa. In terms of psychological color and timbre change in Pipa performance teaching, there is an inevitable connection between them. This paper makes an in-depth study on the relationship between the recognition of psychological color and the change of timbre in the process of Pipa performance teaching. The change of timbre is based on the recognition of psychological color in Pipa performance teaching. In practical application, the timbre change should be carried out according to the different psychological color expressions so as to avoid confusion about the timbre effect caused by aimless change; simulation experiments are carried out for the constructed analysis model.

Keywords: Pipa performance; Psychological color; Timbre change; CAD Tutoring Systems
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1 INTRODUCTION

Pipa has a long history of more than 2000 years in Chinese music performance. It is not only a national instrument but also a plucked instrument. Pipa originated early. Pipa and Pipa originally represented two different playing techniques. In the long development process, as a playing instrument, it was widely used in the court and folk, and the accumulated playing methods were relatively rich [1]. Through the practice, innovation, and exploration of Pipa performance by artists of all ages, a relatively complete and rich performance mode has gradually formed. Pipa is the representative of classical instruments, with beautiful timbre and crisp melody. Because different performers have different effects [2]. Among the traditional musical instruments of the Chinese nation, Pipa is unique. The timbre of Pipa's performance mainly covers two aspects of pronunciation, namely, natural timbre and changing timbre. The material, structure, vibration mode, and pronunciation of the instrument directly determine the natural timbre [3]. Natural timbre also requires players to adopt correct playing methods so as to play a beautiful main timbre that is loose, mellow, bright, and transparent. This timbre interprets the original, neutral, and unmodified sound characteristics well. The variety of timbre changes is an important manifestation of Pipa performance, but it is also a major difficulty that players need to pay attention to [4]. The main reason for this is that in Pipa performance, if the performer cannot effectively control the string passing speed of the right fingertip, the force of touching the string, the angle of the nail, the difference of the force generating part of the hand and the sound pressing of the left hand, then the timbre change will be disturbed and affected, resulting in poor music effect, and it is difficult to show the emotion and artistic conception of the music work incisively and vividly [5]. It is very necessary to strengthen the control of timbre changes in the process of pipa playing.

In the teaching process of pipa playing, the plucking technique is applied. This kind of instrument has a unique application value. Modern Pipa players are used to plucking the strings with their right hands during the performance, highlighting the flexible and elegant artistic characteristics of plucking music [6]. When using the plucking technique, players must pay attention to maintaining the standardization and integrity of technical actions, grasp the core technical means and the basic rules of Pipa pronunciation, control the objective factors that affect the change of the timbre of plucking, highlight the variability and rhythm of timbre, express the rich artistic emotion and ideological connotation of music, and reduce the difficulty for scholars to understand the theme of Pipa music. In Pipa teaching, teachers should pay attention to teaching students relevant performance skills [7].

Hands are an important factor affecting the performance level of pipa. The amplitude, strength, and speed of the performer's hands in the performance process have a direct impact on the timbre and sound quality of the pipa. Only by fully displaying the timbre changes can we express emotions, resonate with the audience, and play an important role in strengthening the artistic expression of Pipa [8]. In terms of psychological color and timbre change in Pipa performance teaching, there is an inevitable connection between them. In order to promote the effective development of Pipa teaching and further enhance the teaching effect in Pipa performance, it is necessary for relevant personnel to pay attention to the cultivation of students' emotional performance and give full play to the relationship between psychological color recognition and timbre change, so as to coordinate the emotion shown by psychological color with timbre change and enhance the effect of Pipa performance [9]. Based on this, this paper studies the relationship between psychological color recognition and timbre change in the teaching process of Pipa performance, focuses on the analysis of timbre change law and application value in Pipa performance, and studies the different emotions of Pipa performance due to different psychological colors. By constructing note feature subsets, this paper optimizes the analysis objective function and puts forward a model for analyzing the relationship between the two. Compared with other models, this model has a certain theoretical level and practical value.

This paper discusses the relationship between psychological color recognition and timbre change in the teaching process of Pipa performance and analyzes the model it constructs. The work and innovations of this paper mainly include:

(1) The innovation in topic selection combines the relationship between psychological color recognition and timbre change in Pipa performance teaching, enriching the traditional Pipa performance teaching theoretical system. The relationship between psychological color recognition

and timbre change Through the empirical analysis of the two, it promotes the development of Pipa performance teaching.

(2) This paper proposes an optimization analysis algorithm for the note feature subset, analyzes music notes, takes the similarity matrix under the note standard distance as the music note similarity matrix, gives the note feature selection standard according to the music note similarity matrix, and takes this standard as the optimization objective function of the music note feature subset. Phase space reconstruction is also used for note recognition, which has good robustness.

2 RELATED WORK

Kleczkowski, P. made a physiological analysis of the skill of fingers. From the aspects of physiological conditions, physiological characteristics, and sports, this paper makes a more in-depth study and explains the importance of decomposition exercise. It can be seen that different physiological conditions and physiological characteristics also have an important impact on the presentation of timbre [10]. Murray and others believe that "Pipa performance is actually a functional movement of the human body, and explains the importance of the nervous system coordinating various tissues of the body." The presentation and expression of Pipa timbre also involve the scientific application of technology [11]. Bilbao and others combined pedagogy, psychology, and other aspects and connected with the actual situation, comprehensively analyzing the formation of timbre in the training process of pinkie skills. It can be seen that psychological changes also play an important role in the presentation and expression of Pipa timbre [12]. Hamadicharef B and others believe that the change of timbre is inseparable from sharp hearing. A good performer not only has solid basic skills but also has keen recognition and can correspond the inner timbre feeling with the external technical action. "The hearing of musicians, like the vision of painters, is not an ordinary physiological organ of the human body in the general sense, but a part of the soul and thought." The player's hearing is not only the response to objective sound but also the response to inner sound [13]. Miwa t et al. Put forward the view that the lack of changing timbre is not fully competent for the expression of all musical styles and interests. For the plucking technique, which is widely used in Pipa performance, if we do not pay attention to improving the ability to refute the timbre, it will weaken the musical expression of Pipa's performance. Therefore, this requires that players not only have a certain degree of proficiency in performance techniques but also need to grasp a variety of technical means and performance methods in order to meet the requirements of music for multi-level changes in timbre [14]. Wang Tianming and others believe that the music mood changes subtly, the timbre changes richly, and the playing techniques are diverse. Different scenes can be outlined in different paragraphs. The psychological characteristics of playing different paragraphs are also a problem worthy of in-depth study. The psychological changes of "quiet" can play a soothing Pipa sound, and the psychological changes of "noisy" may play happy music; the music changes brought by emotion are obvious to all [15]. Hamadicharef B and others, based on the relevant theory of music acoustics, only analyzed the acoustic spectrum of the change of timbre caused by the "change of plucking direction," more rationally verified the relevant theory, had a deeper understanding of it, and put forward the view that technology serves timbre and timbre serves music [16].

3 METHODOLOGY

3.1 Psychological Color Recognition in Pipa Performance Teaching

In Pipa teaching, teachers should not only transfer basic skills and knowledge to students but also pay attention to the identification of students' psychological color. Through the identification of psychological color, their emotions are integrated into Pipa's teaching to fully express their emotions, which helps to form a psychological resonance with the audience and plays an irreplaceable important role in the inheritance of Pipa art [17]. When performing pipa, in addition to the performance of technical skills, it is also necessary to put pronunciation and timbre in an important position. When performing, the sound of the Pipa is obtained through the vibration of elastomer, and other parts of the Pipa produce moving music. Secondly, the pipa will be excited after passing through its own string, and the effective chord length will be transmitted to the whole panel of the pipa through vibration. The sound beam, sound column, and other parts of the pipa will resonate with the whole shell of the Pipa and its resonance box so that the sound can be obtained, and thus, the Sanskrit sound column will also be generated. Pipa performance can serve music, and music serves human emotions. Therefore, teachers should assist students in fully showing their emotions during Pipa performance, which is particularly important for students' psychological color recognition. In student training, teachers should make necessary adaptations of small music for students to practice, which can enhance the melody and rhythm of music works and realize the organic integration of artistry and color, which is helpful to stimulate students' psychological color performance. First of all, teachers build a bridge between music and language and use a more intuitive way to effectively transmit the psychological color recognition performance in music to students so as to realize the cultivation of music's psychological color recognition performance. In the recognition and expression of music's psychological color, the light jumping music melody is the expression of joy psychological color; The slow and low melody is the expression of sad psychological color [18]. Therefore, in the process of Pipa teaching, teachers should guide students to understand the psychological color of music expression, which is helpful in enhancing students' understanding of music Pipa performance and plays an important role in enhancing the effectiveness of Pipa teaching and effectively transferring emotions. The practical teaching process of Pipa performance is shown in Figure 1.

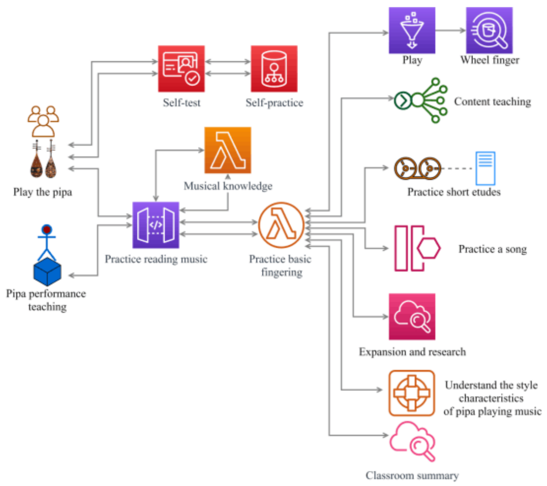

Figure 1: Practical teaching process.

In the practical teaching of Pipa performance, the training of Pipa basic skills is relatively boring, and the training time needs to be ensured, resulting in little effect on Pipa teaching [19]. In the training of basic skills, teachers should strengthen the training of students' psychological color recognition performance so that students can integrate their own psychological color performance in Pipa practice and performance so as to alleviate the boring feeling of Pipa teaching. Secondly, on the basis of basic skill training, teachers should strengthen targeted training for students. In this stage, students' skill training can be correctly guided through practice tracks. In this way, students can not only feel the rhythm of music but also strengthen the cultivation of music's emotion, which is also helpful for the improvement of psychological color recognition. In the targeted training, teachers must start with the empty string sound, train students in the training of auditory and psychological color recognition, and integrate it into the technical training as a basic skill [20].

3.2 The Relationship Between Psychological Color Recognition and Timbre Change in Pipa Performance Teaching

Psychological color recognition performance runs through all the time and plays an important role in cultivating students' psychological color performance of Pipa performance and adopting effective performance technology. In Pipa's teaching practice, teachers should pay attention to the full expression of psychological color in students' skill training. In Pipa teaching, as the organizer of teaching activities, it is necessary for teachers to assist students and actively enhance their psychological performance perception. The timbre change and psychological color expression in Pipa's performance should be realized through imagination. The expressive function of timbre changes in the process of Pipa's performance is to comprehensively express the artistic, creative thinking activities of psychological color with sound. The effect of timbre change directly determines whether the performance of music works is in place and whether the expressiveness of music works can be improved. In order to reflect the emotion and artistic conception expressed in the music works incisively and vividly, it is necessary for the performer to master the factors affecting the timbre change of the pipa and then strengthen the control over it so as to enhance the expressiveness of Pipa performance. According to the different characteristics of different students, teachers need to choose a reasonable way to cultivate students' psychological color expression and stimulate students' imagination, guiding students to transmit psychological color expression information, which is conducive to the artistic inheritance of Pipa's teaching.

When performing pipa, in addition to the performance of technical skills, it is also necessary to put pronunciation and timbre in an important position. When performing, the sound of the Pipa is obtained through the vibration of elastomer, and other parts of the Pipa produce moving music. Secondly, the pipa will be excited after passing through its own string, and the effective chord length will be transmitted to the whole panel of the pipa through vibration. The sound beam, sound column, and other parts of the pipa will resonate with the whole shell of the Pipa and its resonance box so that the sound can be obtained, and thus, the Sanskrit sound column will also be generated. When playing the pipa, its "natural frequency" needs to be adjusted. Explore its timbre, and in the sound, timbre has a certain particularity. There are differences in the structure, materials, and conditions of the vibration system, which leads to different effects on the performance of pipa. Generally speaking, sound is divided into musical sound and noise. Musical sound is a series of regular vibrations. There are more harmonious overtones on a pitch, but noise is in the opposite state with musical sound. A Pipa contains rich timbre, and a single timbre is far from meeting the needs of different music. When we create a piece of music for the second time, we usually first understand the content of the work to be expressed so as to consider what timbre structure should be adopted in general. From a technical point of view, the performance of Pipa's psychological color depends on the adjustment of rhythm and timbre. The skill and ability of the performer are of great significance for Pipa's repertoire performance. Performers integrate their own psychological color expression. The phenomena of "synesthesia" and "synesthesia" in psychology tell us that people can often cause another feeling through one feeling. Because the timbre change characteristics of Pipa's performance are significant, its performance function is strong. As long as the timbre is changed appropriately, different musical effects can be achieved.

3.3 Constructing Note Feature Subset and Optimizing Analysis Objective Function

For the analysis of pipa playing teaching, the relationship between psychological color recognition and timbre change needs further research. According to the music note similarity matrix, the note feature selection criteria are given, which can be used as the optimization objective function of the music note feature subset. Chaotic time series is the projection of the trajectory of chaotic motion in high-dimensional phase space on one-dimensional space. In the process of this projection, the trajectory of chaotic motion will be distorted. In the process of extracting nonlinear characteristic parameters of music signals, the phase space reconstruction method using delay embedding is the basis of nonlinear time series processing. Its principle is to reconstruct the attractor of the system in phase space from a one-dimensional time series so as to analyze the dynamic characteristics of the system by using the reconstructed attractor. In the process of phase space reconstruction of music signals, delay time and embedding dimension are two crucial parameters. Therefore, in order to extract nonlinear features that can reflect the essence of the signal, it is very critical to select appropriate parameter values. The process of directly using phase space reconstruction for note recognition is shown in Figure 2.

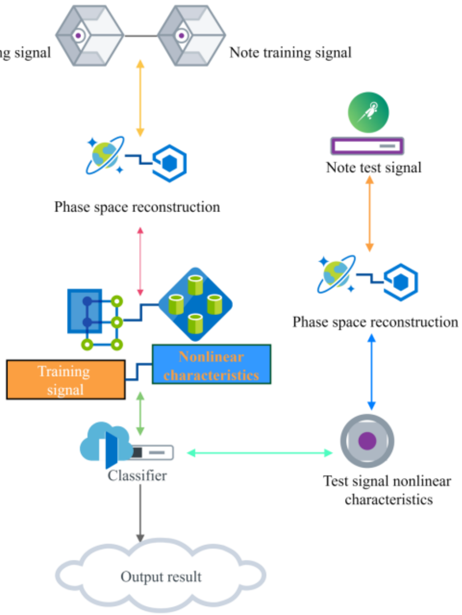

Figure 2: Note recognition process using phase space reconstruction.

Analyze music notes, take the similarity matrix under the standard distance of notes as the music note similarity matrix of DTW distance, give the note feature selection standard according to the music note similarity matrix, and take this standard as the optimization objective function of the feature subset of music notes. The specific process is as follows: Suppose C and F represent two music note data respectively, both of which are Q dimensional vectors, $C\ z\ = c_m\ 1, c_m\ 2, ..., c_m\ K$, $F\ n\ = f_n\ 1, f_n\ 2, ... f_n\ K$, T represents the weighted Euclidean distance, T_{TFW} represents the distance of TFW of two music note data and q represents the weight value, then:

$$T_{TFW} = F, \ C \ = \min \sum_{n_1=1, m_1=1}^{N} T\left[n_1, m_1\right] \tag{1}$$

For any music note sample, it is composed of a finite number of multivariate eigenvectors with the same dimension, and the eigenvector space is expressed by the following formula:

$$\aleph = \ x_1, x_2, L, \ x_k \ \in R^k \tag{2}$$

x represents other musical notes, and the vector formed by the group spacing from all note samples of L category to other note categories is called the threshold vector. Select any two music symbol data, and use:

$$T\left[n_1, m_1\right] = \sum_{K=1}^{K} q^2 \; t_1 \; k \; - r_1 \; k \;^2 \tag{3}$$

The distance of symmetrical TFW is:

$$T_{TFW} = \min \; T_{TFW} \; F, W \; , T_{TFW} \; W, T \tag{4}$$

Figure 3 shows two kinds of linear separable cases in two dimensions.

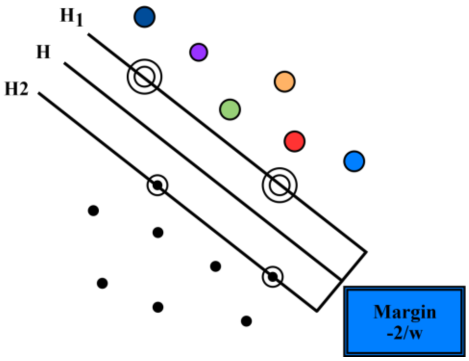

Figure 3: Schematic diagram of optimal classification surface.

Solid points and hollow points in the figure represent two types of training samples respectively. H is the classification line that separates the two types without errors, H_1 and H_2 are the points closest to the classification line and the straight lines parallel to the classification line in each type of sample, and the distance between H_1 and H_2 is called the classification gap or classification gap of the two types. For linear separable sample set a_i, b_i , the general form of linear discriminant function in w dimensional space is $l \; a \; = d \cdot a + b$, and the classification surface equation is:

$$d \cdot a + b = 0 \tag{5}$$

Normalize the discriminant function so that the range of the two types of samples is $\left| l \; a \right| \geq 1$. Even for the samples closest to the classification surface, the maximum classification interval is equivalent to $\frac{2}{\|w\|}$. The classification line is required to classify all samples correctly, that is, it is required to meet:

$$b_i \left[\; d \cdot a_i \; + m \right] - 1 \geq 0, \qquad i = 1, 2, \ldots, n \tag{6}$$

In these two kinds of samples, the point closest to the classification plane and parallel to the hyperplane of the optimal classification plane. The training samples on H_1, H_2 are those samples that make the equal sign in Formula 1, which are called support vectors. Because they support the optimal classification surface, the optimal classification surface problem can be expressed as a constrained problem, that is, finding the minimum value of the function under the constraint of equation 1. For this purpose, the following Lagrange function is defined:

$$L(w,b,\alpha) = \frac{2}{\|w\|} - \sum_{i=1}^{n} \alpha_i \left(b_i (w_i \cdot \alpha_i + b) - 1 \right) \tag{7}$$

Among them, $\alpha_i > 0$ is the Lagrange coefficient, which boils down to finding the minimum value of the function for w,b . The problem can be transformed into a simple dual problem by calculating the partial differential of w and d respectively and making them 0. The constraints are as follows:

$$\sum_{i=1}^{n} b_i \alpha_i = 0, \quad \alpha_i \geq 0, \quad i = 1,2,\ldots,n \tag{8}$$

The maximum value of the function is:

$$H(\alpha) = \sum_{i=1}^{n} b_i - \frac{2}{\|w\|} \sum_{i,j=1}^{n} \alpha_i \alpha_j b_i b_j (a_i \cdot b_j) \tag{9}$$

If α_i^* is the optimal solution, then:

$$w^* = \frac{1}{2} - \sum_{i,j=1}^{m} \alpha_i^* b_i \cdot a_i \tag{10}$$

Based on the obtained objective function, select the larger one from the expected value of music note classification accuracy obtained from multiple populations as the quality evaluation value of multi-group classification, and then classify music notes according to the evaluation value and complete the recognition on the basis of classification. For psychological color recognition, the change degree of timbre can be calculated by optimizing the analysis objective function of the note feature subset. The population classification accuracy of all notes and the recognition with feature weight are based on note recognition.

4 RESULT ANALYSIS AND DISCUSSION

In the actual performance of pipa, there is no invariable pattern in the actual application of psychological color expression and timbre change. Players need to follow the law between psychological color performance and timbre change and find the best pronunciation method according to different musical requirements. In this experiment, we will directly use the phase space reconstruction of note signals to identify the experiment and use the method introduced in the previous section to determine the phase space reconstruction parameters. In the scale recognition experiment, the delay time and embedding dimension are determined to be 4 and 8, respectively. In the experiment of note type recognition, 600 samples are taken for each note signal, of which 400 samples are used as training signals for the construction of classifiers, and 200 samples are used as test signals for the recognition experiment. The phase space of each sample is reconstructed according to the determined fixed delay time and embedding dimension. The nonlinear characteristics of the training signal are used for classifier construction, and the nonlinear characteristics of the test signal are used for recognition experiments. In addition, when constructing the classifier, it is also necessary to determine the type of kernel function and penalty factor. The recognition results are shown in Table 1.

	Number of training signals	*Number of test signals*	*Correctly identify the number*	*Running time*

Do	400	200	148	74%
Re	400	200	182	91%
Mi	400	200	162	81%
Fa	400	200	164	82%
So	400	200	154	77%
La	400	200	122	61%
Si	400	200	146	73%
Total	2800	1400	1086	77.75%

Table 1: Recognition results of major scales.

From the recognition results of the above major scales, we can see that the recognition accuracy of different kinds of notes is different. Among them, some have high recognition accuracy, while some have relatively low recognition accuracy. For example, the recognition accuracy of different test samples is also unstable. The original signal is decomposed into sub-signals containing several characteristic parameters, and then the nonlinear features of each sub-signal are extracted for the construction of a classifier and recognition experiment. For several other kinds of note signals, the embedding dimension determined by the pseudo nearest neighbor method is also used to determine the delay time and embedding dimension, and the best parameter value is selected by observing its phase space reconstruction trajectory. The statistics of delay time and the embedding dimension of each major scale are shown in Table 2.

Parameter	*Do*	*Re*	*Mi*	*Fa*	*So*	*La*	*Si*
Delay time	4	6	3	2	4	6	5
Embedded dimension	7	8	9	8	7	9	8

Table 2: Statistics of delay time and the embedding dimension of each major scale.

Through the different delay times and embedding dimensions corresponding to each major scale, it can be seen that when selecting the parameters of phase space reconstruction, different note signals need to use different delay times and embedding dimensions to extract the nonlinear characteristics of the signal better. Because in the process of practical application, the note signals that need to be identified are unknown kinds of notes, it is necessary to adopt a unified delay time and embedding dimension to reconstruct the phase space. The spectrum analysis software of the sample in this experiment is matlabmusic_ analyzer。 A total of 40 tones of samples were recorded (10 for each type, a total of four groups); The sample is mono; The audio sampling size is 24 bits; The sampling rate is 48Khz; The bit speed is 1152kbps; Each sample analyzed is the aftersound range of 500ms after the peak. For these 40 samples, each group selects four samples with similar peak decibel values for internal comparison, analyzes whether the spectral characteristics of samples in each group are consistent, and then selects a sample in each group for detailed comparative analysis. The basis for selecting samples is that the peak volume is close. The peak value of samples is determined by the analysis software Nuendo. The peak difference of samples is 0.00db~0.02db. Make a detailed spectrum analysis of the samples and get the data. The results are shown in Figure 4. Take four samples with similar peak decibel values for internal comparison. According to the spectrum diagram, the samples obtained in the same direction of plucking have similar spectral characteristics, and the fluctuations of harmonic energy are basically the same.

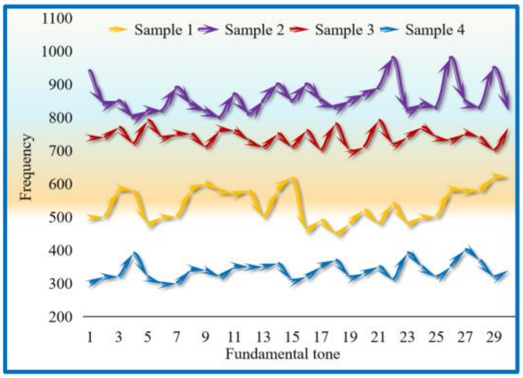

Figure 4: Summary diagram of harmonic frequency spectrum.

When a note with high energy appears, the starting point of the note can be detected by various methods similar to the mute area. However, because the difference between notes and sounds is that the whole music is coherent, we mainly investigate when the weaker notes are covered by the stronger notes. For the study of timbre changes, we select a piece of music with an obvious note cover for comparison. The comparison of short-term average amplitude change is shown in Figure 5.

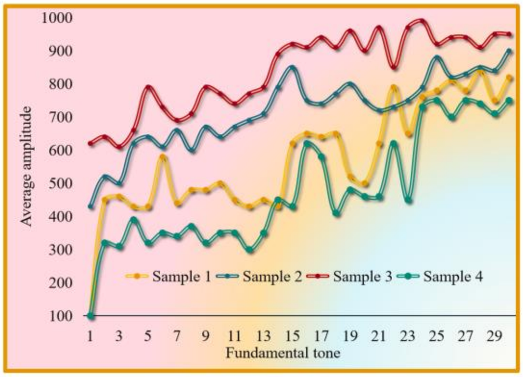

Figure 5: Comparison of short-term average amplitude change.

From the above figure, we can see that the results are relatively close, and the reason for the different values is also related to the location of FFT calculation data. Because in the continuous process of a note, the results of the two harmonic structures obtained by sampling at two different times are similar but not identical. The next step is to consider the effectiveness of this method in the practical application environment, so a Pipa song from a Pipa teaching set is selected for the experiment. The song is 1 minute and 40 seconds long. First, there are a few points that meet the above two conditions. There are only two or three qualified points in many notes. Check the notes with more records. The comparison of note results is shown in Figure 6.

From the results, we can see that the consistency of harmonic structure is not very good, and it is difficult to use it to determine the frequency overlap of a note. The results of the short-term average zero crossing rate are shown in Figure 7. As can be seen from Figure 7, the results of the short-term average zero crossing rate are relatively messy. Notes with high energy are prone to fluctuations after the highest point, resulting in misjudgment, and notes covered by strong tones cannot be well judged.

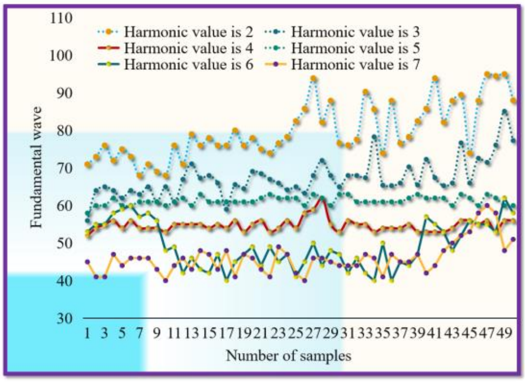

Figure 6: Variation results of fundamental waves with different harmonic values.

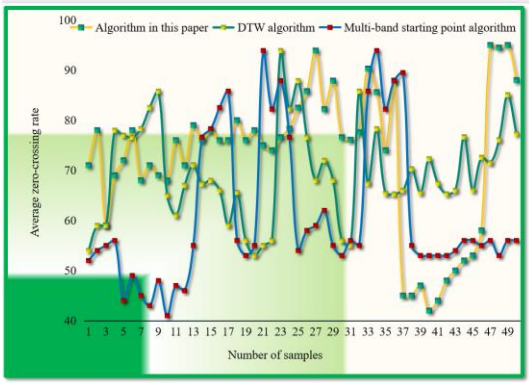

Figure 7: Results of short-term average zero crossing rate.

The algorithm based on this paper is the simplest, and its missed judgment and short-term average energy will be less than short-term average energy. The accuracy of note detection is analyzed and compared with three algorithms, and the results are shown in Figure 8.

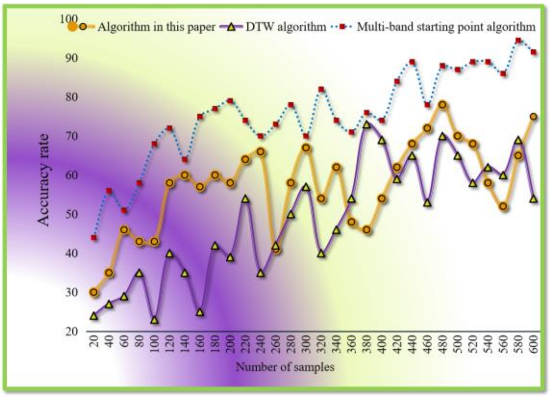

Figure 8: Comparison of note detection accuracy under different algorithms.

It can be seen from Figure 8 that the results of the algorithm based on this paper are the best among these methods, which can better distinguish those weak notes. The highest accuracy of note detection can reach 94.6%. In the process of Pipa performance, the mastery of various timbres and psychological color recognition are key and important. Analyzing the changes in timbres can enrich the musical effect of the Pipa and improve the shaping power of the musical images. As one of the means of musical expression in heavy play, timbre change needs to be based on the expression of psychological color to establish the combination of the individual and the music. Experimental results show that the accuracy of note detection under this algorithm is 94.6%, and the maximum short-term average zero crossing rate is 95.2%. It shows that based on this algorithm, we can better recognize the timbre changes in Pipa audio, which is conducive to observing the performance of psychological color recognition and getting the consistency between the performance of psychological color recognition and timbre changes.

5 CONCLUSIONS

High-level Pipa performance requires players to have superb performance skills and musical literacy. In the process of Pipa's performance, there is a close relationship between the mastery of various timbres and the expression of psychological color. The expression of psychological color must be finally reflected through the sound effect, and the change of timbre in the process of performers' performance is mainly based on the expression of psychological color. In the process of Pipa performance, the timbre change is easily affected by psychological color factors, resulting in the timbre played by the performer failing to achieve the expected musical effect and resulting in poor performance of musical works. In order to change this situation, players should pay attention to strengthening the control of the timbre change of Pipa performance, that is, the effective control of timbre change and psychological color, so as to achieve twice the result with half the effort. Starting from the requirements of music, the performer should recognize the importance of identifying psychological color and timbre changes. Only through rich and colorful timbre changes can we more vividly depict the artistic conception of music and accurately depict the musical image. Through the analysis of the relationship between timbre changes and psychological color recognition, this paper constructs the optimization analysis objective function of the note feature subset and analyzes the influence of psychological color recognition and its changes to timbre. Experimental results show that the accuracy of note detection under this algorithm is 94.6%, and the maximum short-term average zero crossing rate is 95.2%.

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