# BioTechnology

*An Indian Journal*

# Analysis and research on application and formula of harmony and melody in college music teaching

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## ABSTRACT

In college music teaching, the understanding and mastering of harmony and melody is an important part of the music teaching. From the point of the development of music, student can learn the relation between harmony and music, and necessary connection between melody and harmony that is a foundation of the development of college music teaching. As an essential part of musical creation, harmony can influence the overall creative inspiration. From the musical creation, we can find that harmony in the end of the music can determine the nature of the music. So the search and algorithm of harmony is significant. This thesis is based on the necessary connection between melody and harmony in college music teaching, and emphasizes on the collecting algorithm in harmony teaching and to reflect the application of harmony and melody in college music teaching.

## KEYWORDS

College music; Harmony melody; Collecting algorithm; Internal relation.

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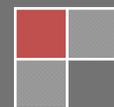
## INTRODUCTION

The nature of college music teaching is to let student more clearly understand the development and the important parts of music through the education and from this point to deepen the musical theory. College music teaching combines the related theories and continuously improves students' cognitive process of music. And the goal of the sublimation form theory to artistic conception can be achieved. The internal relation between harmony and melody is delicate that melody is the important way of musical expression while the harmony is the soul of music and both depend on each other and assimilate each other. Harmony offers a solid foundation for musical creation and is the primary method of the expression of main idea of music.

This thesis combines the collecting algorithm to study how student judge the graceful harmony, and discuss their necessary relation and make application of harmony and melody in college music teaching clear. Meanwhile the corresponding formula is combined to research the melody's collecting algorithm so that the goal of the thesis is specific, distinct and reasonable.

## THE DESCRIPTION OF MELODY'S COLLECTING ALGORITHM

### The principle of the algorithm

Like the particle swarm optimization is from predation of birds, the harmony searching (HS) comes from the musical creation. In musical creation, musicians repeatedly tune the pitch of each instrument to gain a graceful harmony. And the harmony searching just imitates this process, TABLE 1 shows the comparison between the musical play and optimization.

**TABLE 1 : Optimization and the play**

| analogical element | optimization procedure | implementation procedure |
|---|---|---|
| high-point | global optimum | graceful harmony |
| be evaluated | objective function | aesthetic standard |
| be evaluated | variate | pitch of instrument |
| element of procedure | every iteration | every practice |

In the college music teaching, the musical performance of student means each student can emit a tone. In this way they can form an effective vector quantity by the common guide. If the harmony is comparatively fine, every student will record it and it will be considered as an effective contrastive foundation. Because tones of each instrument correspond to decision variable $X_i (i = 1, 2, \dots, n)$, and they have one-to-one correspondence with solution vector. In this way the aesthetic evaluation function can be expressed in $f(x^j)$. While in the mathematics, if you want the esthetic evaluation of the graceful harmony, you first should find the optimal solution of the objective function. In the college harmony teaching, this search algorithm can be divided into several parts which can find its optimizing elements. Firstly, determine the size of the Harmony Memory (HM), and distinguish the Harmony Memory Consideration Rate (HMCR) and estimate the Pitch Adjustment Rate (PAR). All of these are the simplest principle of searching harmony for students. While in the teaching process of college music harmony search algorithm, first is to ask student to recognize the feasible solution in the HM which is decided by the size of the HM. And distinguishing the Harmony Memory Consideration Rate is the process of the cognition of feasible solution. And the PAR decides the disturbance of the feasible solution.

### The procedure of algorithm

Step1 Setting the basic parameter of the harmony search. (1) Number of variable NVAR; (2) Range of variable ;(3) number of harmony in HM HMS; (4) Harmony Memory Consideration Rate HMCR ; (5) Pitch Adjustment Rate PAR;(6) Maximum iterations NI.

Step2 Initialize HM.

Step3 Produce a new solution. Every time a new solution can be created by three mechanisms: (1) keep the component of HM ;(2) random creation. (3) Fine adjust the component from (1) (2).

Step4 Update the HM. If the new solution is better than the worst one in the HM, it will replace the worst one and get a new HM.

Step5 Judge the ending condition is satisfied or not. If it is satisfied the ending condition, stop the iteration and get the optimal solution; if not, repeat Sept3,   Step4.

**The improvement of parameter**

Since the wide spread of harmony searching algorithm, it has been applied in the engineering problem, in which there are so many differences between it and its practical environment. In this way, the procedure of algorithm needs a large of adjustment. And extensive scholars implement corresponding improvement and revolution which set three parameters for harmony searching and improve its pertinence.

In 2007, Mahdavi M and others carried out effective research on the HIS algorithm and in the application of harmony searching algorithm three elements were fixed. And in the practical application of idea did not have the permanent effects. In the preliminary work of optimizing, lesser PAR and bigger BW were needed and with the increase of the iterations, the bigger PAR and lesser BW were needed. So Mahdavi M proposed the IHS algorithm based on the dynamic PAR and BW. The parameters were applied as following:

$$PAR = PAR_{min} + \frac{(PAR_{max} - PAR_{min})gn}{NI}$$

$$BW = BW_{max} \exp(\frac{gn}{NI} \ln \frac{BW_{min}}{BW_{max}})$$

                                                                                                                     **(1)**

Adjusting step size was improved and the expression of PAR and BW is:

$$PAR = \begin{cases} PAR_{min} + \dfrac{PAR_{max} - PAR_{min}}{\frac{2}{3}NI} \times gn & if\ gn \leq \frac{2}{3}NI \\ PAR_{max} & if\ \frac{2}{3}NI \leq gn \leq NI \end{cases}$$

$$PAR = \frac{PAR_{max} - PAR_{min}}{\frac{\pi}{2}} \arctan gn + PAR_{min}$$

$$PAR = \frac{PAR_{min} - PAR_{max}}{\frac{2}{3}NI \times NI} \times gn \times gn + \frac{2(PAR_{max} - PAR_{min})}{\frac{2}{3}NI} \times gn + PAR_{min}$$

$$BW = BW_{max} - \frac{BW_{max} - BW_{min}}{NI} \times gn$$

$$BW = (BW_{max} - BW_{min}) \times e^{-gn} + BW_{min}$$

$$BW = \begin{cases} BW_{max} - \dfrac{BW_{max} - BW_{min}}{\frac{3}{4}NI} \times gn & if\ gn \leq \frac{3}{4}NI \\ BW_{min} & if\ \frac{3}{4}NI \leq gn \leq NI \end{cases}$$

                                                                                                                     **(2)**

In the formula above, $PAR_{max}$ refers to the upper bound of the rate in adjusting harmony pitch while $PAR_{min}$ refers to the lower bound. $BW_{max}$ means the upper bound of the rate in adjusting step size of pitch while $BW_{min}$ means the opposite concept. gn refers to the total number of iteration and NI means the biggest one in the total number of iteration. As for this, experts and scholars successfully summarized the formula so that the harmony particle swarm search algorithm was created. And the

effective application of dynamic PAR and pitch step size adjustment rate updated as well as enlarged the HM. The specific adjusting formula is seen below:

$$PAR_i = \begin{cases} 1, & E_i / E_{i-1} \geq 1 \ or \ E_{i-1} = 0 \\ E_i / E_{i-1}, & E_i / E_{i-1} < 1 \end{cases}$$

**(3)**

$E_i$ is the difference between the maximum and minimum of the function value of variable in 1$^{st}$ HM, and $E_0 = 1$;

$$BW(i) = d1*(HM(i,\max) - HM(i,\min)) + d2*(x^i_{upper} - x^i_{lower})/gn$$

**(4)**

We can see from the formula above that gn refers to the iteration in the current harmony pitch and X$_i$ standing for the upper bound has the opposite meaning. HM (i,max) has the meaning of maximum of X$_i$ in HM. While HM (i,min) indicates the minimum of X$_i$ in HM. d1and d2 is shown as the basic constant. When the iterations of the harmony pitch changes considerably, the left part can play an adjusting and optimizing role; when the algorithm becomes partial optimum, the right part will play an adjusting and optimizing role.

## THE RELATION BETWEEN MELODY AND HARMONY

In the creation of counterpoint, the relation between melody and harmony is comparatively obvious and here too many introductions are not necessary. And the feelings of them are similar to each other. Specifically, the configuration procedure of harmony needs melody being a foundation and the nature of melody contains the nature of harmony. So the relation between harmony and melody is delicate. In the music, the musical thought is often expressed by melody and harmony has an auxiliary function so that it can become full. They are linked together and depend on each other. This is what is called harmony and melody.

### Melody comes from broken chord

Harmony and melody contain the nature of harmony and it means that each pitch and basic pitch in melody is broken by chore. That is to say that harmony simultaneously plays triad, seventh chord and ninth chord and other high pile form rising chord forming crosswise melody. Figure 1 shows the example:



**Figure 1 : The melody of haydn (bear)**

### Melody is created according to effect of harmony

Every creation of the melody is an important way for the musician to express his/her creation intention. The character of music is all expressed by the melody and harmony. So every musician creates his/her according to his/ her characters. In this way, the graceful music owns creativity. But the next music should consider the effect of harmony so that the creation can have the artistry and is worth appreciating. Figure 2 shows the example:

**Figure 2 : The melody of charles camille saint-saens (hen and cock and the sound of hen)**

## The process of melody is influenced by harmony

During the college music teaching, the melody has certain diversity. According to the trend, melody can be divided into ascending, descending and standard. The creation depends on the internal logic and meanwhile three trends can be skillfully integrated into music. In this process, three kinds of melody also are influenced by harmony taken Figure 3 for example:



**Figure 3 : The melody of mozart**

We can see that the radical and the plunge are influenced by the harmony. In this music, the environment is full of preparatory but also offers a feeling of radical. From this point, we can see the function of harmony in melody. While in another point, it creates some obstacles to the smoothness of melody, taken Figure 4 for example:



**Figure 4 : The melody of le nozze di figaro**

In this music,  we can see how harmony in F major belonging to seventh chord influence the smoothness in ascending and make it stay: Non-essential tone of harmony appears only once, while the essential tone "C" appears at least twice, "E" appears seventh time. Here harmony inhibits the smoothness in melody. On the other side, harmony provides melody a proper and natural pivot. So melody always tries to go back to the certain point of harmony, which is melody comes from one point and keeps it as a pivot. Of course, only key note and subordinate note can become this pivot.

## THE DEVELOPMENT AND SIGNIFICANCE OF MELODY AND HARMONY

There is a close relation between melody and harmony which they depend on each other and influence each other. So they can supplement each other. As for the significance of melody of music, melody's function is large, but the success of music is always determined by harmony. From this thesis, we can clearly find that both of them are very important. And in the college music teaching, the application of harmony search algorithm is a foundation of music.

And during the process, there are differences between eastern and western development of constructions of harmony system. The development of Chinese music is not profound as western music. Chinese folk music influences the inheritance and development of Chinese folk culture. The main line of melody is clear that is the resource of wonderful creation. To some extent the music lacking of melody prevents the development of the creation of modern instruments.

Bernard Shaw, a great musician said, "If you have an apple and I have a same one, we can exchange but the result is not changed. But if we exchange the idea, the result is different." From above words, we can see that different people have different understanding of culture. And this is just the true meaning of inheritance and development of modern music. As early as 20th century, the Chinese musicians explored the musical style and improved vocal music from different point folk. In this way, melody and harmony of folk music are combined perfectly and create a special music. For instance, New Women of Nie Shou-xin is added sixth chord in the end. And in the creation Hunan Flower-drum of Xi Qi-ming, minor second is integrated with sixth chord which shows the character of northern music. Luo Zhong-rong's Crossing the river to pick up the lotus and Lu Shi-lin's Red-crowned crane family are different in approach but equally satisfactory in result which combine the western twelve tone technique and make the chord special. As for the folk music, Ba and Story of Chuanjiang river of Guo-Jing-wen hide the stress in the melody and sublimate the features of folk music. While in the Shaanxi folk music the music of porter, there are only four pitch and there less of three interval determining the Gong and Jiao which is a typical case of tonal moving. From above introduction, it is not difficult to find that the integration of harmony and melody is necessary to the development of folk music. And in the college music teaching, the application of harmony search algorithm is the foundation of improving students' accuracy of using harmony which positively affects the controlling of melody.

Melody and harmony are basic elements which affect each other. Now and in the future, they are the core of music. Only when they coordinate and supplement each other, can the goal of creating perfect music is achieved.

## CONCLUSION

The contents above are the specific research process of analysis and research on application and formula of harmony and melody in college music teaching. The thesis is emphasis on the search algorithm of harmony and enabling students judge the graceful harmony. And in this way it can give a favor to teaching. Besides, the thesis also analyses the internal relation between harmony and melody and explain the function of melody in musical creation, and also highlights the interaction between them. Through the related formula and rational formula, this thesis is further studied and the solid foundation of theory and data is provided to the thesis and college music teaching.

## ACKNOWLEDGEMENT

## REFERENCES

[1] Kuznetsov[Rusia], Peng Cheng(Translate), Xiang Ming(Check); The Harmony and its Development of Scriabin, Journal of The Central Conservatory of Music, **2**, 5-17 (**2014**).
[2] Ma Xue-Wen; Research on the Pure Fifth Recombined Harmony in JinXiang's Chamber Music Cool Moon, Chinese Music, **1**, 148-154 (**2014**).
[3] Li Hai-Feng, Sun Jia-Yin; A Music Cognition based Music Melody Detection Approach, Sinal Process, **26(10)**, 1456-1465 (**2010**).
[4] Peng Cheng; The Moscow School of Harmony and its Inheritance Relationship, Musicology in China, **2**, 119-124 (**2014**).
[5] Tian Ye; Construction of Feeling in the Melody-Primary Exploration of Organic and Dynamy of Feeling Teaching Function, JiaoXiang-Journal of Xi-An Conservatory of Music, **1**, 92-95 (**2010**).
[6] Qu Xue-Xuan; Considering: High Pitch Technique and Aesthetic Sound of Chinese Folk Singer, Chinese Music, **1**, 208-209 (**2014**).
[7] He Yuan; Narration and Feeling of Out of Africa and its Musical Melody, Movie Literature, **7**, 136-137 (**2014**).