Technical analysis of the hips squeezing action in rumba based on biomechanics

Yue Shang
Shandong Sport University, Jinan 10600, (CHINA)
E-mail: tiyuba@vip.qq.com

ABSTRACT

This study analyzes the body force of buttocks movement and the formation process of the inverted "8" tracks in rumba, and proposes a method to maintain the physical stability in the movement process. Besides, this article puts forward the technical essentials to improve the tenderness, grace and smooth of the hips' inverted "8" movement track. The analysis results demonstrate the scientificalness of the original technical points in rumba dance and lay a theoretical basis for the squeezing action of the hips.　　　　© 2013 Trade Science Inc. - INDIA

KEYWORDS

Biomechanics;
Rumba;
Focus;
Track.

INTRODUCTION

A "three-dimensional" teaching method, which is in favor of improving the overall quality of athletes, is highly advocated in the international dance sport community. Lucas, a world-class master of standard dancing, explains the motion and space feeling technology from the perspectives of human morphology, sports anatomy, aesthetics, biomechanics and dance principles, and summarizes the dance sport training methods from many aspects, including the analysis of the rumba. Then the Latin prince Slavic, international guru Tony and Hans's latke summarize the dance sport techniques as an integrated system scientifically.

Rumba is a highly expressive body rhythm dance, in which the fluency and rhythm of movement of the dancers' back muscles and hip action is of great importance to the dance as a whole. As beautiful soft hip action with speed rhythm fully embodies the sexy and romantic rumba characteristics, Katrina, an international master describes

in her teaching that particular attention should be paid to the hip action in the rumba. Rumba dances dance with the rhythm of the music and the buttocks will naturally draw a motion trajectory of the inverted "8" under the effect of body weight extruding.

In summary, sports dance teaching method has been developed rapidly and the direction and theory developed is in place, but there is no relative research on targeted theoretical analysis. This article conducts detailed analysis of the hips squeezing action in rumba based on the biomechanical principle and tries to demonstrate the technical rationality and put forward rationalization proposal.

MOTION MODEL OF HUMAN RIGID MODEL

The determination of human center-of-gravity position

As can be seen from Figure 1, the human body is

FULL PAPER

decomposed into 14 rigid segments[14]. The relative position of centroid of each segment is thought to be unchangeable, and then calculate the relative position of all centroid according to "definite proportion and division point" method:

$$\begin{cases} x_{\updownarrow} = (1-n)x_{\uparrow} + \lambda x_{\downarrow} \\ y_{\updownarrow} = (1-n)y_{\uparrow} + \lambda y_{\downarrow} \end{cases} \tag{1}$$
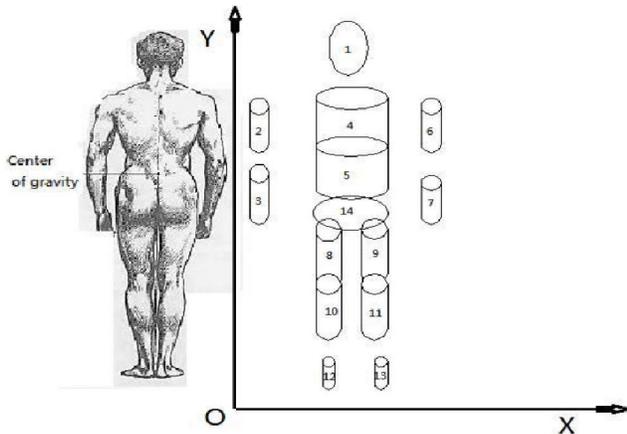

Figure 1 : The structure model of dancers' rigid segments

In formula (1): λ means the position proportion of centroid of each human body segment, $(x_{\uparrow}, y_{\uparrow})$, $(x_{\downarrow}, y_{\downarrow})$ respectively stands for the coordinates of the midpoints of top and bottom joints of each human body segment and $(x_{\updownarrow}, y_{\updownarrow})$ denotes the cancroid's coordinates of each human body segment[13].

The joint force point of gravity of all human body

segments is called the body centroid. According to the rigid model in formula (1), we decompose human body into several segments. The body centroid position changes with different posture when dancers move. The body centroid position is determined by moment synthesis principle, as shown in formula (2).

$$\left(X_G = \frac{\sum_{i=1}^{14} G_{xi} \times x_{i\updownarrow}}{\sum_{i=1}^{14} G_{xi}}, Y_G = \frac{\sum_{i=1}^{14} G_{y_i} \times y_{i\updownarrow}}{\sum_{i=1}^{14} G_{y_i}} \right) \tag{2}$$

In formula (2): (X_G, Y_G) stands for coordinates of the dancers' body centroid;

$(x_{i\updownarrow}, y_{i\updownarrow})(i = 1,2,3,\cdots,14)$ stands for coordinates of each segment's centroid;

$$\left(\frac{G_{x_i}}{\sum_{i=1}^{14} G_{x_i}}, \frac{G_{y_i}}{\sum_{i=1}^{14} G_{y_i}} \right)$$

stands for the relative quality of each segment in the coordinate direction[2].

The definite proportion and definite point and relative quality percentage of human body segments' centroid for China Youth is shown in TABLE 1.

By equation (1) (2) and TABLE 1, we can calculate the location of rumba dancer's body centroid in given posture.

TABLE 1 : The definite proportion and definite point and relative quality percentage of human body segments' centroid for China Youth

Young male			Young women		
Human body segments	definite proportion and definite point	relative quality	Human body segments	definite proportion and definite point	relative quality
Hand	50%	0.64%	Hand	50%	0.49%
Forearm	41.87%	1.30%	Forearm	42.72%	1.18%
The upper arm	48.6%	2.61%	The upper arm	46.91%	2.62%
Foot	44%	1.50%	Foot	44%	1.38%
A lower leg	40.91%	4.00%	A lower leg	40.63%	4.55%
Thigh	47.71%	14.00%	Thigh	45.87%	14.28%
Upper torso	53.73%	17.00%	Upper torso	54.26%	16.53%
Lower torso	40.54%	25.60%	Lower torso	47.36%	25.87%
Trunk	44%	42.70%	Trunk	44%	42.70%
Head	50%	9.30%	Head	50%	8.60%

Discussion of human body stability

The stability of human body in the movement process

is related to the effective support area of human body and ground. At the same time, it is relevant with the

minimum angle between body centroid and supporting point edge[5]. We call effective support surface as stable surface, call the minimum angle between body centroid and supporting point edge as stable angle. Both stable surface and stable angle are shown in Figure 2 blow.

The surface surrounded by body supporting points is called stable surface. When the body has no external force and the body centroid projection locates outside of stable surface, the body will be inclined. The value of $\triangle ABC$ is stable surface in Figure 2. The minimum angle between body centroid and supporting surface edge is called stable angle, its value determines the stability when body is unstressed. Parameter $\alpha = \min\{\alpha_1, \alpha_2, \alpha_3\}$ is stable angle in Figure 2.
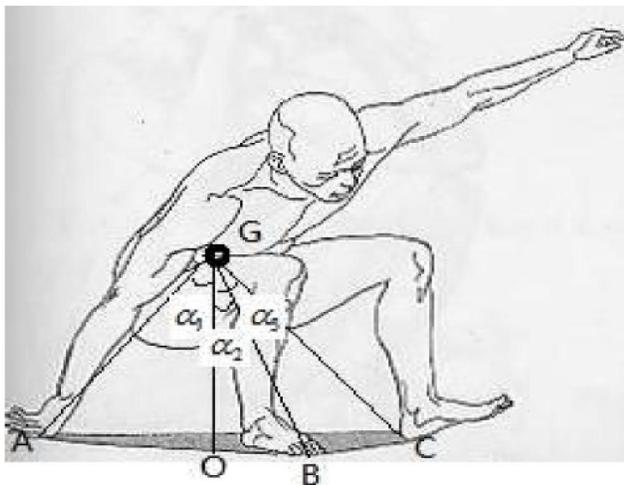

Figure 2 : Schematic diagram of stable surface and stable angle

In moving process, the body segments of rumba dancers produce various types of acceleration. Its embodied form is due to the not uniform movement. In this process, some overturning moment often appears which changes the stability of the body. The stability factor of human body is regarded as K, which is the ratio of overturning moment and stability moment[9].

The calculation methods of tipping moment, stable moment and stable coefficient are shown in formula (3):

$$\begin{cases} M_{turn} = F \times r \\[2mm] M_{steady} = G \times \dfrac{|GO|}{\cos\alpha} \\[2mm] K = \dfrac{M_{steady}}{M_{turn}} \end{cases} \quad (3)$$

In formula (3), M_{turn}, M_{steady} denote the tipping moment and the stability moment respectively; F represents the aggregate external force; G represents the gravity the body suffers; $|GO|$ represents the distance from the body centroid to the ground. When $K \leq 1$, human body is relatively stable, otherwise it is unstable[17].

During the body motion process, one should increase the stable angle and stable surface in condition of not affecting movement. When body moves, it can judge the tipping moment's direction and make timely adjustment to the stable angle and stable surface, thus the body can complete the movements stably and smoothly.

HIPS MOVEMENT TECHNICAL ANALYSIS

Buttocks squeezing action takes place when the exerting force of human head, coccyx and foot is in a straight line. At this time, the coccyx at the intersection shifts to one side because of the squeezing. Simultaneously the hips swing along an arc[4]. When one side of the hip moves upward, it constitutes the squeezing with the same side shoulder. Then move cyclically in the rumba step dance, the hip will form an inverted "8" trajectory, as shown in Figure 3.
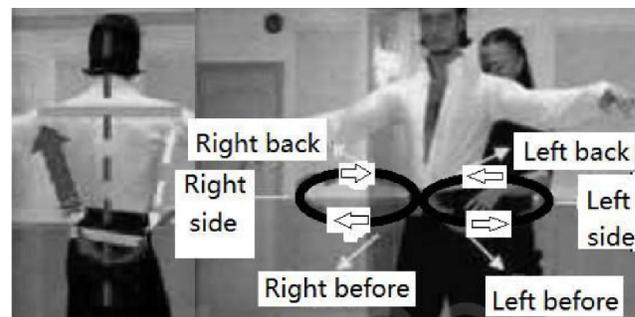

Figure 3 : Hips squeezing of inverted "8" schematic diagram

Hips rotation technical analysis

In the rumba smooth step-by-step movement process with the music rhythm, hips will surround rotate from front to back, from left to right because of the extrusion. It is shown in Figure 3.

In dancing process, buttocks trajectory looks as the inverted "8" from side view shown in Figure 4 below.

In dance walking process, do not bother to pursue

FULL PAPER

inverted "8" trajectory but only need to master the body centroid shift process. If the body centroid shifts correctly, it will naturally drive the hip to rotate in accordance with the established track.
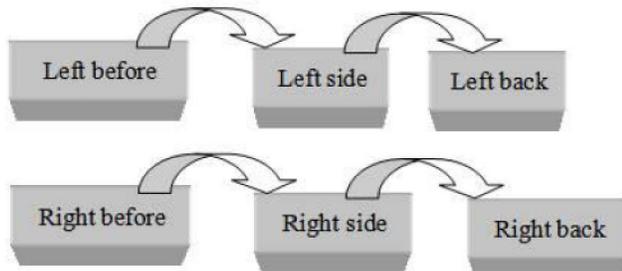

Figure 4 : Side view of the hip trajectory

The body centroid extrusion process is the key. When the hips complete inverted "8" movement, it will change the bodies original stability and cause it unstable.

Hips swinging technical analysis

Hips swinging mean that the rumba dancers' hips swing along an arc from high to low just like a pendulum. From an artistic point of view, hips swinging are the manifestation of rumba beauty. If superposition swings action in hips swinging process, it can make the dances more featured[3].

The hips can complete swing movement simultaneously during the rotation action, which can the motion range of hips increase, and forms the state where one side of the buttocks raised upwardly while the other side sinks relatively. The diagonal form will change constantly in moving process, and form a three-dimensional inverted "8" movement which is more aesthetically pleasing, as shown in Figure 5 below:
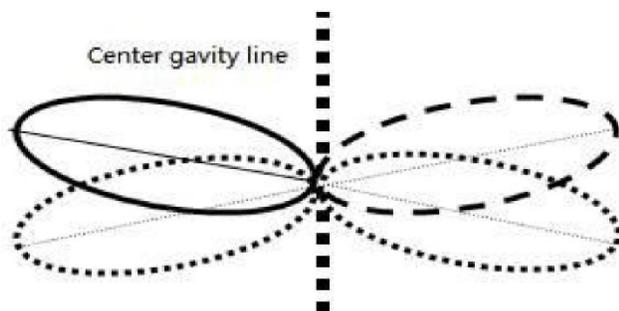

Figure 5 : The Σ movement diagram of rotation and swing

Hips squeezing technical analysis

Hips squeezing action is the personalized characteristic in rumba dancing, which determines the dance quality. "Squeeze" in physics means the elastic force process caused by relative pressure when two objects contact. Hip squeeze in rumba dance is to maintain the relatively stationary between shoulders and upper part of the body as much as possible. When the body gravity conducted to the ground through the main foot, compress back muscles to move up the hip, thus the hips and relative fixed shoulders form into "squeeze", as shown in Figure 6.

Figure 6 : Hip squeezing schematic diagram

RATIONALIZATION PROPOSALS

When the hips move in track of inverted "8", don't twist hips to pursuit trajectory, but rather naturally squeeze your buttocks in body squeezing methods.

Rumba dancers should maintain good control of the scapula in a parallel line in the buttocks moving process. Because in this process, hips are of oblique state and keep in line with scapula, reaching a confrontation state between scapula and hips.

Rumba dance needs more hips and abdominal exercise. Dancers should strength their power training of hip deep little muscle group and midsection muscle.

When doing buttocks extrusion, it often applies static pressure. So in training process dancers should pay attention to the physical flexibility training.

In rumba dancing process, pay attention to the stability of the body; increase the stable surface and stable angle if the action allows.

To sum up, during the dancing process, it requires not only the training of strength, speed and skills but also the improving of the theoretical knowledge learning. Only with theory to guide practice and practice to revise theory, can it make the rumba technique better in syndrome differentiation.

CONCLUSIONS

Rumba is a double dance, which needs tacit

FULL PAPER

understanding between the dancer and the partner. In the premise of mastering experience and technique, learn to use natural science technology to analyze the reasonableness of the action.

In rumba dancer movement process, the body stable condition is related to stable surface and stable angle. Use the dancer postural to adjust impact factors and make the dancing process more smoothly.

Buttocks squeezing action can help the hips rotate in accordance with the inverted "8" track.

Try to keep the balance of shoulders and make it confront with hip's oblique state. And then keep periodic rule extrusion to the hip.

Rumba dancers also need more effort on strength and muscle flexibility training, which is helpful to enhance movement harmony.

This paper uses biomechanical principles to analyze rumba hips squeezing, which restores this technical movement truly and confirms the rationality of experience and training.

REFERENCES

[1] Bing Zhang, Yan Feng; The Special Quality Evaluation of the Triple Jump and the Differential Equation Model of Long Jump Mechanics Based on Gray Correlation Analysis. International Journal of Applied Mathematics and Statistics, **40(10)**, 136-143 **(2013)**.

[2] Haibin Liu; Sports biomechanics Research System Based on Three-dimension PE Value. Journal of Jilin Institute of Physical Education, **2**, 74-75 **(2004)**.

[3] Hanting Niu; The rotation and rhythm skills of dance training. Art Panorama, 5 **(2007)**.

[4] Huanbin Zhao; The Current Situation of Sport Biomechanics and Its Developing Directions in China.Journal of Hebei Normal University(Natural Science Edition, 3 **(2001)**.

[5] Jiangang Qiu; The Study on the Characteristics of Competitive Areobics. Journal of Chengdu Physical Education Institute, **3**, 64-66 **(2003)**.

[6] Jianshe Li; Thought and Review of Theory and Methodology Research of Sports Biomechanics in Germany. China Sport Science and Technology, **35(1)**, **(1999)**.

[7] Jingguang Qian; The Biomechanics Principle of Walking and Analysis on Gaits. Journal of Nanjing Institute of Physical Education, **5(4)**, **(2006)**.

[8] Liang Xu; A Probe into the Migration and Disturbance for Exercise Skills. Journal of Hubei Sports Science, **20(3)**, 69-70 **(2001)**.

[9] Li Zhou; Current State and Analysis of Sports Biomechanics Study in China. Journal of Shanghai Physical Education Institute, **1**, 23-26 **(1997)**.

[10] Maijiu Tian; Sports Training. Beijing: People's Sports Press, 59-63 **(2000)**.

[11] Pengping Zhu, Xiaomei Wang; Classic Ballet Training System applied to Aerobics training. Journal of Chengdu Physical Education Institute, **1**, 54-56 **(2004)**.

[12] Shouhua Xi; Rumba technique method and graphical analysis. Beijing: People's Sports Press, **(2011)**.

[13] Sihong Zhou; The 21 Century Sport Biomechanics Review And Prospects. Journal of Physical Education Institute of Shanxi Teachers University, **1**, 73-77 **(2000)**.

[14] Xiling Deng; Factors that influence the performance of aerobics. Journal of Shanghai Physical Education Institute, **1**, 52-53 **(2001)**.

[15] Xirang Yang; Practical sports skill learning. Beijing: Higher Education Press, 75-76 **(2004)**.

[16] Xiuyuan Zheng; Modern sports biomechanics. Beijing: National Defense Industry Press., 2-4 **(2002)**.

[17] Zhong He, Zhilin Xu; Technical characteristics and special strength training of artsport. Journal of Wuhan Institute of Physical Education., **41(8)**, **(2007)**.