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Rumba open point turn technical analysis based on human motion mechanics

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ABSTRACT

Rumba is a multi-point turn action sports project. In rumba point turn process; there are often some wide-angle rotating actions, which are of certain degree of difficulty for beginners, such as the turnover after the Latin cross step. How to solve these difficult movements becomes the focus of attentions of many coaches and athletes. This paper uses the theory of human motion mechanics to analysis the dynamics principle in the rumba open point turn process, respectively analysis the open point turn action technique in the six-step process for both men and women dancers. Then it studies the cause of body standing instability after rotation, gives improvement methods for the body destabilizing factors during or after the rotation, and provides a theoretical basis for rumba open point turn technical training.

KEYWORDS

Center of gravity shift;
Movement mechanics;
Moment of inertia;
Stable.

INTRODUCTION

Early rumba dance is transmitted by the African slaves to Cuba, which has 200 years of history in Cuba. The original Lombard is wild, improvisation, and fast-paced, while Ballroom dancing is slow and sexy which constitutes a sharp contrast. Rumba is a passionate dance compared the two together. Even so, the rumba is the slowest in the Latin dance. To master Rumba better can make it easier to accept and master other Latin dance.

There are many studies on dance sport rotation technique, for example: Haoran Xiong from Luoyang Normal University, in the biomechanics analysis of Ballroom Dancing rotation technique, he explained that the reaction force, the turning radius, the constantly shifting center of gravity and the rotation angle are the key factors that impact the Ballroom Dancing rotation; Another example: Zhong He and Zhilin Xu from the Department of Xiang fan College Sports, in the Dance Sport movement technique characteristics and special strength training, they analysis the characteristics affect sports dance movement technique, and formulate the index system to analysis sensitive training project. Although the above two has summarized and analyzed the sports dance technique and training, it is not specifically targeted, just generalities.

This paper uses the theory of human motion mechanics based on farmer's work to analysis the dynamics principle in the rumba open point turn process, re-

spectively analysis the open point turn action technique in the six-step process for men and women dancers. Then it studies the causes of body standing instability after dancer rotation, gives improvement methods for the body destabilizing factors during or after the rotation, which provides a theoretical basis for rumba open point turn technical training.

HUMAN POINT TURN MODEL

Centroid and weight distribution of human multi-body model

Xiao Hui from China standardization and information classification and coding Institute, in the study of Chinese adult centroid, explains that human body can be transformed into a rigid body model and use the model's kinematic relation to confirm the physical movement scientificalness.

The rigid model divides the human body into a number of elements, including the head, arms, legs and feet. When a dancer's position is determined, the centroid position of the body elements has also been identified. The various centroid positions of the body elements have a direct relationship with the various parts of the body mass distribution.

Percentage diagram for relative quality of various elements in the human body, shown as Figure 1 below:

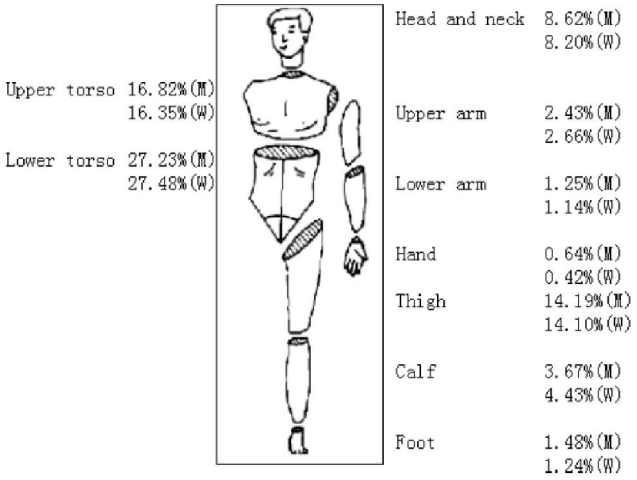

Figure 1 : Percentage diagram for relative quality of various elements in the human body

Centroid relative position of various elements, shown as Figure 2 below:

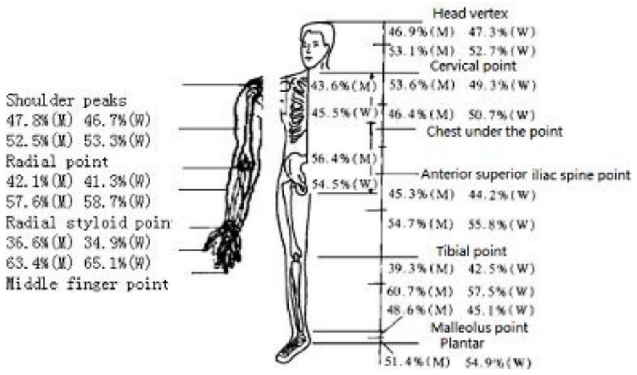

Figure 2 : Centroid relative position of various elements

Human body rotation principle

Open point turn action in rumba dance follows the rigid body turn kinetic law. Rigid body rotation kinematics occupies a very important position in human Kinesiology. The parameter variables include the time, the angular velocity, angular displacement, the angular acceleration and linear velocity. Objects various rotating formation is due to the impact of the non-equilibrium torque. Formula (1) shows the total torque expression:

$$\sum M = \sum_{i=1}^{n} M_i \qquad (1)$$

In the formula: $\sum M$ is the total torque vector of an object, M_i is a sub torque objects of an object; When objects around the entity axis, $\sum M$ is not equal to zero; When the body rotates around the joint axis, $\sum M$ is also not zero.

The particle quality is, the distance between the particle and the shaft is , the product of the distance and quality refer to rotational inertia. For the various elements of the human body, the rotational inertia has additive ability, as formula (2) shows:

$$I = m_1 r_1^2 + m_2 r_2^2 + m_3 r_3^2 + \cdots m_n r_n^2 = \sum m_i r_i^2 \qquad (2)$$

In the formula: I presents the total rotational inertia of the human body, $m_i r_i^2 (i = 1,2,3,\cdots,n)$ represent the rotational inertia of one human element. Parameters which affect body rotational inertia are the quality and distance, so the body can change the rotational inertia by changing the body posture or transform shaft.

According to the angular momentum theorem, it

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gives out formula (3):

$$\sum M\Delta t = I\omega_2 - I\omega_1 \Rightarrow \sum M = I \cdot \beta \quad (3)$$

In the formula: β represents the angular velocity change rate, i.e. the angular acceleration vector.

When body translational, somewhere in the body is constrained by the brake, the body will be rotated around the constraint points. The linear momentum before the rotation is partially converted into rotational moment of momentum. Since the expression of angular velocity is the ratio of line speed and the rotation radius, the larger the line speed, the greater the angular momentum, the smaller the rotation radius, the greater the angular momentum.

In formula (1), (2) and (3), the quality and the particle position can be determined according to the body posture and the relative position and relative mass of 2.1.

RUMBA OPEN POINT TURN ANALYSIS

In rumba point turn, there are often some wide-angle rotating actions, like the turnover after the Latin cross step. In this process, the dancers often the body center of gravity dance disharmony, the below is point turn analysis for male and female dancers under the cooperation mode.

Men's open point turns analysis

Men's open point turn action is divided into six steps with music beat movement.

The first step: In the music beats 2&, left foot step forward, end at his back position; the hip turn to right 25%, and angle should be well controlled between 25% -40% of the best. The first step shows in Figure 3 below:

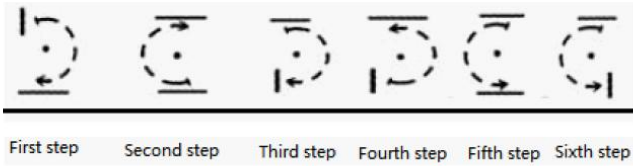

Figure 3 : Men's six-step hip trajectory figure

The second step: In the music beats 3&, body centroid line is transferred to the right foot center, at the same time the hip turns right 50% accompanied with beats 1-2 in 3&. The rotation angle of slightly greater than 50% is the best, because this can go to the next beat coordinately. Each step has slightly turnover to make action more smoothly. Hip trajectory is shown in Figure 3 Second step.

The third step: in the music beats 4 (1) & left foot goes next step, at the same time, hip rotates right about 25% in beats 2-3 of 4(1). Hip trajectory is shown in Figure 3Third step.

The fourth step: in the music beats 2&, the right foot steps forward, end when transported to his back position. At the same time, hip rotate left about 25% in beats 3-4 of 2&. The trajectory of the hip is shown in Figure3 Fourth step.

The fifth step: in the music beats 3&, body centroid line turns to the left foot center, while hip rotates left 50% in beats 4-5 of 3&. The hip trajectory moves as figure 3 Fifth step.

The sixth step: in the music beats 4 (1) & right foot goes next step, at the same time, hip rotates left about 25% in beats 5-6 of 4(1). Hip trajectory is shown in Figure 3 Sixth step.

In the rumba process, it must focus on both men and women's coordination, which is particularly important in the open point turn technique. Otherwise the poor coordination will cause the failure of the dance. The men in the dance process not only have to control the rhythm, but also should have good strength training. Because in men and women coordination dance, the men carry more weight and at the same time send signal to the women to realize better cooperation and harmonious rhythm.

Women's open point turns analysis

Women's open point turn action is divided into six steps with music beat movement too, and has the same step beats with men's.

The first step: In the music beats 2&, left foot step forward, end at his back position; the hip turn to right 25%, and angle should be well controlled between 25% -40% of the best. The first step shows in Figure 4 below:

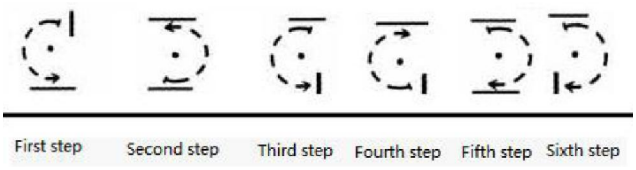

Figure 4 : Women's six-step hip trajectory figure

The second step: In the music beats 3&, body centroid line is transferred to the left foot center, at the same time the hip turns left 50% accompanied with beats 1-2 in 3&. The rotation angle of slightly greater than 50% is the best, because this can go to the next beat coordinately. Each step has slightly turnover to make action more smoothly. Hip trajectory is shown in Figure 4 Second step.

The third step: in the music beats 4 (1) & right foot goes next step, at the same time, hip rotates left about 25% in beats 2-3 of 4(1). Hip trajectory is shown in Figure 4 Third step.

The fourth step: in the music beats 2&, the left foot steps forward, end when transported to his back position. At the same time, hip rotate right about 25% in beats 3-4 of 2&. The trajectory of the hip is shown in Figure 4 Fourth step.

The fifth step: in the music beats 3&, body centroid line turns to the right foot center, while hip rotates right 50% in beats 4-5 of 3&. The hip trajectory moves as figure 4 Fifth step.

The sixth step: in the music beats 4 (1) & left foot goes next step, at the same time, hip rotates right about 25% in beats 5-6 of 4(1). Hip trajectory is shown in Figure 4 Sixth step.

Women should follow and accept the rule of men guiding in the dancing process. It is forbidden to play randomly, otherwise it makes men produce chaos awkward and cause uncoordinated dancing.

REASONABLE ANALYSIS OF THE OPEN POINT TURN

Rotational force point problem: helix turn needs pelvic rotation, while point turn belongs to turnover, which just needs upper body force accompanied by hip rotation and the master of rotation force;

The rotation direction problem: control the body to make the direction of body rotation slightly downwards, just like a downward spiral nail. This can make the center of gravity decline, stable angle increase and the rotation more robust. On the contrary, it can make the body centroid away from the ground and body offset. The methods to make the rotation direction downward is to apply a hydrostatic pressure at the fulcrum of the rotation process to maintain a balance, but the spatial extent of the action is not huge;

The rotation sequence and leading problem of the various human body elements during the rotation: before the point turn, arm should stay in the opposite direction of rotation. When rotating, the arm swings up and upper torso. Then the hip rotates under the driven of body trunk. Feet twist comes next. The head last shakes quickly and to the rotate position (relative latecomer) than any other body elements. The shakes can also display rumba dynamic. In the overall process, the arm is always in force, but finally reaches the rotational position. The arm plays a regulating rotating speed role during rotation process. when the arm is accelerated, the rotational accelerate correspondingly and when the arm is decelerated, the rotational decelerate correspondingly, which can better meet the music rhythm;

When the body rotational movement comes to the end, swing foot heel did not touch the ground and the fulcrum foot has turned to the specified location, first control swing foot heel to touch ground, and apply a static pressure to the soles of the feet to make it flat on the ground, and then swing leg inwards tightly to control the angle of rotation and body balance, lastly make fulcrum foot land on the ground accompanied with the rhythm;

Inner thigh muscles' contract and relax occurs in the footwork and step-by-step transfer interacted with each other. Inner thighs tighten process is actually a process of human force, caused by human static pressure applied to the thigh, which is the assurance to control rotating action quality. The four factors step-by-step trajectory of the dancers, step-by-step speed, step-by-step position and hydrostatic pressure to the thigh are supplementary to each other, which must coordinate with each other.

Dancers should adjust their breathing to control the contraction and relaxation state of the entire body when increasing the rotating speed. The contraction of the entire body includes the inner thigh muscles, ribs and hips, making breathing process in coordination with the music rhythm melody. When dancers stretching the spine, shoulder line and the atmosphere should come down in time and the weight of the body should be all conducted between the two through thigh. Thus the body is full of the sense of rhythm and harmony.

The control and regulation of the human sense of

rhythm is an "action dynamic stereotype" process conditional reflex control. It forms a conditioned reflex after being thoroughly tempered in the cerebral cortex of the central nervous system, and makes the body movements and thinking simultaneously work. Dancers after the correct "action dynamic stereotype" training can directly begin neural control in case of thinking is not reachable. Only with familiar melody and expertly action in harmony drilling process, can we appreciate the valuable dance. But in impromptu dance process, mental control needs surpass the neural control. Even if the mental control is prior action dynamic stereotype, it can also regulate the physical linkage of coordination.

CONCLUSIONS

The analysis of rumba point turn technique through human motion mechanics theory is in line with the actual action essentials and of good reduction and confirmation effect;

In rumba dance men give women a boot signal, and the women must accept the men's boot to make it fit with the rhythm of the music;

Before rumba rotation human arm placed in opposite direction toward rotation, the rotation process provides rotary power and resistance, in order to adjust the speed, increase or decrease the angular momentum of rotation.

Helical turn of the rumba open point turn process should be slightly downward, adjusting the center of gravity position lower, reducing the overturning moment arm and increasing the angle of the rotation edge and the shaft, to increase the stability of the body-movement process;

To start body rotation, it needs the action technical procedures, master well the order of priorities and actions collaborative, be clear about which part is the active site and which is driven part and collaborative part;

when body rotation is over, swing feet should first stabilize centroid, and then the fulcrum feet land, which is helpful for the fulcrum feet to buffer and raise centroid stable;

There are many other actions in rumba dance process, this article merely analysis the rumba open point technique dynamically. In addition to the technical points and motor coordination, there is also the support power of the body. Scientific training is a must to various body elements. This paper restores the technical process truly and come to the above conclusion through analysis, which provides a theoretical basis for the rumba open point turn the technique.

REFERENCES

[1] Bingde Li; Teaching theory. Beijing: People's Education Press, **(2001)**.

[2] 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)**.

[3] Deng Xiling; The Factors Influencing the Expression of Aerobics. Journal of Shanghai Sports Institute, **(1)**, 52-53 **(2001)**.

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

[5] Jiao Xibian, Shuai Wei; Analysis on Five Major Techniques of Standard Dance. Sports Technology Essays Bulletin,**17(4)**, **(2009)**.

[6] Li Jianshe; Several Theoretical Questions on the Development of Sports Biomechanics. Sports Science, 4 **(1997)**.

[7] Li Jianshe; A General Explanation and Study on German Biomechanics Theories and Research Methods. China Spoorts Technology, 35 **(1999)**.

[8] Li Jianshe; A General Study on Sports Biomechanics Research Methods and Measuring Technologies. Sports Science, **2(19)**, **(1999)**.

[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] Qian JInguang, Song Yawei, Yeqiang, Li Yongqiang, Tangxiao; Biomechanical Theories of Walking Motions and Gait Analysis. Journal of Nanjing Sports Institute, **5(4)**, **(2006)**.

[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] Tian Maijiu; Sports Group Training Theories. Beijing. People's Sports Publishing House of China, 112-115 **(1998)**.

[15] Tian Maijiu; Training Theories of Sports. Beijing. Beijing. People's Sports Publishing House of China, 59-63 **(2000)**.

[16] Xiao Guanglai, etc.; Aerobics. Beijing: People's Sports Publishing House of China, **(2003)**.

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

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

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

[20] Xu Liang; A Study on the Transplanting and Interference of Sport Skills. Hubei Sports Technology, **20(3)**, 69-70 **(2001)**.

[21] Yang Xirang; Practical Kinesiology. Beijing: Higher Education Press, 74-76 **(2004)**.

[22] Yang Wei, Yuan Shuihai; Tutorial of Modern International Standard Ballroom Dancing. Shanghai. Shanghai Translation Publishing House, **(1990)**.

[23] Zhu Pengping, Wang Xiaomei; The Application of Classical Ballet Training System in Sport Aerobics. Journal of Chengdu Sports Institute, **(1)**, 54-56 **(2004)**.