Moving Target Detection Method of Three-Dimensional Image of Whip Leg Technique in Sanda

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Abstract. In the training of Chinese Wushu, Sanda has a history of more than 20 years. In the research of Sanda athletes, experts, scholars and so on, it integrates some foreign Sanda economic technology and constructs a set of relatively perfect technical system and theoretical framework, which makes Sanda become one of the international competitive events with rapid development. From the point of view of Sanda related theoretical research, it is not matched with the development of practice, which is obviously backward. In order to realize the scientific and effective promotion of Sanda, we must strengthen the treatment of this problem and enrich the relevant theory as soon as possible. In Sanda, whip leg is one of the key leg techniques, which is aggressive and can play a good role in attack and also an important score item in competition. The score rate of this part of skills in the economy is relatively high, but the utilization rate is not. It can be seen that there are some deficiencies and problems in the teaching and training of whip leg technology. In this regard, based on the perspective of sports biomechanics, this paper analyzes the technical action of whip leg with the help of three-dimensional image detection method, so as to provide some theoretical guidance for the training of whip leg technical action in Sanda.

Keywords: Sanda, Whip Leg Technique, 3D Image, Moving Target Detection

With the increasing influence and attention of sports at home and abroad, residents pay more and more attention to their own sports and health. All kinds of sports are developing rapidly. At the same time, it is also necessary to have theoretical basis related to sports as guidance to promote the effective development of sports. At present, there are few researches on the mechanics and kinematics of the whip leg in Sanda, and the theoretical basis is relatively weak. Therefore, it is of certain reference value to study the motion mechanics image of this technical action for enriching and developing Sanda whip leg technical action.

1. Summary of Whip Leg Technique in Sanda
Sanda is a kind of martial arts, which can also be classified as a sport. And Sanda whip leg technical action is the basic leg method of Sanda, through the leg flexion and extension, strength control, flexion and extension and sweep can be performed with strong attack and fast recovery speed. In the action of kicking, the other whip leg can sweep and twist the waist through the axis of the supporting leg to
carry out the relevant actions of legs. With the transmission of strength, the acceleration and control of related links are realized. Finally, the target is flicked and kicked by the instep in the maximum speed [1-4].

Research data statistics shows, from the statistics of the three major events in the past 15 years, in the men's court 117 games, 260 games, the use of whip leg technique accounted for nearly 80% of the leg techniques, which shows that the use rate of this technical action is high and occupies an important position in the application of leg technique. However, with the low score rate in actual use of sports, it can be seen that the relevant sports training effect needs to be strengthened. With the development of sports training related technology and theory, more and more people see the guiding role of modern science and technology and theoretical research results for practice. In the theoretical development of sports training, sports biomechanics is a direct and effective method for analysis and evaluation of sports skills. There are few researches on quantitative analysis of whip leg movements in Sanda by applying this method. In this paper, with the help of three-dimensional image analysis, the relevant parameters of whip leg action of excellent Sanda athletes are integrated and quantified. Through such research and analysis, this paper provides some ideas and references for further optimizing the teaching and training of Sanda whip leg technique and promoting the effect of sports training [5-8].

2. Sports Biomechanics Test Method and Three Dimensional Force Measuring System

The test method is divided according to the attribute of the measured object, which can be divided into kinematic parameter measurement, dynamic parameter measurement and biological quantity measurement. Through the application of relevant measurement methods, the movement time, characteristics, torque, impulse, acceleration, displacement, muscle force, mechanics are measured. Some reference for the optimization training of sports is provided by the relevant measurement.

The three-dimensional force measuring system is an important part of dynamic parameters measurement. The principle of force measuring system is basically the same for the body or the machine, but there may be some differences in the sensor structure and installation. Generally, piezoelectric crystal sensors and strain sensors are commonly used with high accuracy, but only evaluate the average force can be measured, which is difficult to reflect the details. With the application of high-speed photography technology, we can record the motion technology image without disturbing the objects, and finally obtain the corresponding parameters through analysis, so as to effectively carry out kinematic factor analysis. The use of such a detection and analysis method can also effectively reduce the cost, and by the relatively large amount of motion information feedback, it is widely used in the current sports biomechanics test.

3. Research Object and Method

3.1 Research Object
This paper makes an experimental study on six excellent male Sanda athletes in the regional institute of physical education. The average age of the six excellent Sanda athletes is 22 ± 2.2, the height is 1.72 ± 0.51, and the weight is 65.5 ± 1.5. Among them, five athletes are national athlete level, and one is national first-class Sanda athlete. According to the statistics of the six excellent Sanda athletes' physical condition, the basic information is shown in Table 1:

| NAME | AGE(Y) | HEIGHT(M) | WEIGHT(KG) | SPORT LEVEL |
|------|--------|-----------|------------|-------------|
| A    | 23     | 1.71      | 66         | 8           | Athlete level |
| B    | 22     | 1.72      | 65.5       | 9           | Athlete level |
3.2 Test Preparation and Index Determination

3.2.1 Test preparation. In order to meet the needs of the test work, the relevant instruments and equipment shall be prepared as follows:

First, digital video camera, Panasonic-9000 video camera made in Japan;
Second, APAS system, ARILL Company of The United States.
Third, 3D radiation frame, domestic DLT.

3.2.2 Indicators determination. The major test indicators in this test mainly include the following five:

One, angular velocity;
Two, hip velocity;
Tree, knee velocity;
Four, foot velocity;
Five, supporting leg knee angle.

3.3 Test Method

Six objects were numbered, and asked to whip the prepared fighting sandbags for three times. The sandbags were equipped with force and speed sensors. The best and worst completion of the three actions was selected as the sample data.

Secondly, in the implementation of whip leg action process were recorded.

Finally, the relevant materials and parameters were collected, corrected and analyzed the relevant data by APAS system, and the human model in this process is analyzed by Synthesis of 3D coordinates of DLT, including 21 joint points and 25 link control points. A large number of data are filtered with digital filter 12.

4. Research Results

Through the digital processing of relevant technical images by computer, the average level of relevant parameters of whip leg, swing leg and supporting leg of 6 Sanda athletes was obtained, and the knee angle variation relationship between swing leg and supporting leg was concluded, and the speed of relevant joint points was also mastered. The relevant statistical data are shown in Table 2 and table 3:

| THE MINIMUM ANGLE OF KNEE | ANGULAR VELOCITY | HIP VELOCITY | KNEE VELOCITY | FOOT VELOCITY | SUPPORT LEG KNEE ANGLE |
|---------------------------|------------------|--------------|---------------|--------------|------------------------|
| 77.2°                     | 66.5 rad/s       | 2.04 m/s     | 6.38 m/s      | 7.56 m/s     | 158.5°                 |

Table 2. The worst-case average of the relevant parameters

| THE MINIMUM ANGLE | ANGULAR VELOCITY | KNEE VELOCITY | FOOT VELOCITY | SUPPORT LEG KNEE |
|-------------------|------------------|---------------|--------------|------------------|

Table 3 The best-case average of the relevant parameters.
5. Conclusion
Through experimental comparison and analysis, it is concluded that the difference of knee angle is the core of research and analysis in the whip leg techniques. It can be seen in Table 2 that the average minimum knee angle is 77.2 in the case of swinging uprising and knee lifting. According to the analysis of the factors of rotation, the mass distribution of the relative axis of the rotating body is an important factor affecting the moment of inertia. In other words, the farther the body mass and the axis distance are, the greater the radius of rotation will be. In this way, with greater rotational inertia, the swing of the limbs will be more difficult. Therefore, in the whip leg movement, it is necessary to control the rotation radius of the attack leg properly and analysis rationality of hip joint and knee joint quality in the process of swinging leg.

Through the comparison of the worst-case parameters and best-case parameters of the two tables, it is found that the maximum knee angle of the swinging leg at the moment of concentrating the target should be 170° and the angular velocity is much faster, about 446 rad/s, and the instantaneous speed when the foot hits is about 17 m/s. It can be seen that the hip joint speed is relatively stable while the knee joint speed is slowed down significantly at the instant speed of the hit. It means that when the speed of athlete’s thigh white is accelerated, the lower leg will quickly fold, making the mass distribution relative to the hip joint smaller. Under the condition that the athlete raises the knee to break, the lower leg can realize rapid extension, and the mass distribution also gradually increases accordingly, so that the athlete can dynamically adjust the rotation inertia to achieve the best hitting effect.

In the process of observing the changes of relevant parameters, it is found that the knee angle of athletes has experienced a process from falling to rising rapidly, which indicates that in the application of whip leg technique in Sanda, the knee joint flexes first to realize the backward swing of the leg, and then the leg swings forward and kicks directly at the target. In this process, the range of increase and decrease of the knee angle is more obvious, that is to say, in whip leg action, the knee flexion will bring great changes in angular velocity, which shows that the knee flexor and extensor has obvious effect, therefore, the coordination of flexor and extensor muscles should be improved in sports training.

In general, in the whip leg technical movement of Sanda, through the measurement and analysis of three-dimensional images, it can be concluded that in the whip leg movement, if the athlete keeps the knee angle of the left supporting leg small, the stability of the body's center of gravity can be maintained, which can promote the improvement of the body's rotation speed. In the process of movement, the thigh should be first accelerated forward swing, knee joint flexion, leg folding, before the thigh swing to the target, quadriceps femoris contraction, lower leg fast kick out, at this time should be as far as possible to keep the leg relaxed, so as to maintain strength. Data shows that hip flexors and knee extensors play an important role in sports. It is necessary to strengthen the exercise of knee flexors to promote the muscle coordination ability of athletes and achieve quick folding for the lower leg before kicking out.

In addition, in the parameter analysis of relevant joint speed, when the hip joint speed is small in the process of change, the athlete's knee joint speed changes greatly. At this time, the athlete's knee joint reaches the maximum speed at an earlier time, and then decelerates. The relevant strength reaches the maximum by kicking the target, and high-level whip leg technique can be complete by maintaining such curve characteristics.

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