Three-Dimensional Image Analysis and Discussion on the Movement Characteristics of Cross Kick in Taekwondo

Feng Liu*
Henan University, Kaifeng 475001, Henan, China

*Corresponding author e-mail: liufeng810107@hkxy.edu.cn

Abstract. At present, Taekwondo, as a martial arts event, is popular among social groups with the function of fitness and self-defense. In the promotion and practice of Taekwondo, it is necessary to have reliable theoretical knowledge to lay the foundation, analyze with the help of science and technology and theoretical results, and obtain relevant technical action guidance methods, so as to realize the optimization training of related technical functions, which is very important to improve the teaching and training level of Taekwondo related technical movements. In Taekwondo, cross kicking is common and one of the key movements. It also plays an important role in the scores of related sports competitions. However, the current situation of this technical action in the overall competition score is not ideal, which shows some deficiencies in the relevant technical action teaching. In this regard, this paper studies the technical movement characteristics of Taekwondo cross kick, carries out the training of three-dimensional image analysis, based on "Fighting Event Group Training Tester", carries out quantitative analysis on cross kick technical movements. Taking the cross kick of excellent Taekwondo athletes as the ideal index, the relevant movement characteristics and rules are studied to promote the realization of the optimal training goal of the cross kick of Taekwondo.

Keywords: Taekwondo, Cross Kick Technique, Feature, 3D Image

In the related Taekwondo competition, the score rate of athletes in cross kick is not ideal. Its technical movement is more widely used in Taekwondo competition, and in the training of Taekwondo, the grasp of cross kick technical movement is not complete, and there is no best training method to master this technical action. In this regard, with the help of some excellent Taekwondo athletes on the law and characteristics of cross kick technical movement analysis, ideal training method for Taekwondo cross kick technical movement is researched, which has certain guiding significance for the development and optimization of Taekwondo [1-3].

1. Overview of Dynamic Multi-Target Detection and Tracking Technology
Dynamic multi-target detection and tracking technology is a fast developing technology in recent years. By tracking and detecting the dynamic multi-target of Taekwondo athletes' movements, the multi-sensor fusion is used to complete the detection task. The dynamic motion parameter curve can
be constructed more comprehensively and specifically, and the data association and segmentation can be realized to meet the needs of data filtering. With the help of three-dimensional coordinate system, the starting frame is taken as the coordinate origin, and the obstacle point cloud is projected into the coordinate three-dimensional grid according to the corresponding frame data, so that the corresponding grid projection is constructed to construct the three-dimensional dynamic motion model.

Through the analysis of the three-dimensional image and the construction of the model, we can clearly see the athletes in the best state and the worst state of the corresponding conditions in the implementation of cross kick, so as to master the relevant parameters of the best implementation of Taekwondo cross kick, and provide some basis and reference for the specific training of cross kick [4-6].

2. Research Objects and Methods

2.1 Research Objects
From the excellent Taekwondo athletes of Wuhan Institute of Physical Education, eight excellent Taekwondo athletes were selected as the research object. The average age of the eight Taekwondo athletes was 23 ± 2, the height was 1.75 ± 0.5, and the weight was 65 ± 1.5. Among them, six athletes were national athlete level, and two were national first-class Sanda athletes. The basic information of the 8 excellent Taekwondo athletes is as follows:

| NAME | AGE(Y) | HIGHT(M) | WEIGHT(KG) | SPORT AGE(Y) | SPORT LEVEL           |
|------|--------|----------|------------|--------------|-----------------------|
| 1    | 22     | 1.76     | 67         | 9            | ATHLETE LEVEL         |
| 2    | 23     | 1.75     | 65.5       | 8            | ATHLETE LEVEL         |
| 3    | 24     | 1.78     | 67.5       | 9            | FIRST-CLASS LEVER     |
| 4    | 24     | 1.70     | 64.8       | 10           | ATHLETE LEVEL         |
| 5    | 21     | 1.69     | 63.5       | 7            | ATHLETE LEVEL         |
| 6    | 22     | 1.71     | 65.1       | 6            | ATHLETE LEVEL         |
| 7    | 23     | 1.76     | 63.5       | 8            | FIRST-CLASS LEVER     |
| 8    | 21     | 1.72     | 64         | 6            | ATHLETE LEVEL         |

2.2 The Research Methods
Eight Taekwondo objects were numbered and asked to carry out cross kicks on the prepared fighting sandbags for three times. The sandbags were equipped with strength and speed sensors. The best and worst performance of the three actions were selected as the sample data.

In the process of sports, the eight Taekwondo athletes were photographed in the process of implementing the cross kick. Finally, the collected related materials and parameters are counted out. In the process of the experiment, the three-dimensional photography method is used and the digital camera is used to shoot, keeping the distance between the camera and the frame at 12 meters and the height at 1.2 meters. Finally, the three-dimensional image analysis software system is used to analyze and process the relevant data, evaluate the relevant motion, and finally obtain the kinematic parameters of the cross kick [7-8].

2.3 Material Preparation
The main materials and equipment needed in this experiment include the following categories:

First, three-dimensional image analysis system. Panasonic 9000 digital video camera made in Japan, APAS system produced by ARILL Company in USA. Domestic DLT 3D radiation framework.

Second, fighting event group training tester. The corresponding tester should meet the reasonable requirements of measuring force range and accuracy.
Third, test the parameters. The important parameters such as the time, displacement, angle of joint, speed of link, striking force, striking speed and explosive force of cross kick are monitored and analyzed.

2.4 The Data Collection
Firstly, the data collection of 3D images. In this data collection, the camera position is kept still, the frame is constructed and the relevant image data are saved. At the same time of shooting, the synchronizer is started, and then the frame is removed. The hitting target is placed on the upper part of the marking point. The height of the corresponding hitting center can be adjusted according to the height of the athlete. Before data collection, it is necessary to make a table in advance to facilitate recording, number and sort the athletes, and record their relevant parameters in cross kick.

Note that before the movement test, the relevant Taekwondo athletes need to prepare before the movement, for no repetition in the actual shooting. Three times of experimental records for the same cross kick technical action was made, in order to ensure the best effect of shooting, and the best and worst one as the recorded data, convenient for comparison. In this experiment, to accurately and efficiently obtain the relevant movement parameters of Taekwondo athletes, the fighting event group training tester developed by Wuhan Institute of Physical Education was used for data collection. When Taekwondo athletes perform target cross kicks, which can adjust according to the actual athletes' height. After data collection, the tester can directly transfer the data to the computer, and the relevant action parameters are directly output by the data analysis and processing software.

3. Result Analysis
Through the experimental statistics, the time distribution of different stages of horizontal kick, the displacement of body center of gravity, kinematic characteristics of swing of left and right legs and the change of supporting leg in the horizontal kick are obtained.

On the whole, it is concluded that the key to ensure the effect of cross kick is the scientific and reasonable exertion of strength of athletes' muscles. In the cross kick of athletes, the muscle strength sequence of related links is controlled. According to the order of big to small, the movement and strength of related links are controlled, and the force of thigh with lower leg is implemented. In this way, it is easy to hit the target quickly and accurately in the cross kick of the opponent. In statistics, the best angle between attack leg and body should be 110°. At this time, the extension of knee joint angle is 160° and the knee joint angle of supporting leg should be 135°. In the attack, focus on the target leg related link muscle tightening to better ensure the hitting effect. To ensure that in the process of cross kick, the muscles of the relevant links can be used in turn, and the relevant links can be effectively connected, so that the best hitting effect can be achieved. If the athletes have the characteristics of muscle relaxation or rigid links in this process, the effect of hitting is often not ideal.

Secondly, in the cross kick, the average strength of the concentrated target of attacking leg is about 436 kg, the maximum hitting force is 591 kg, and the minimum is only 250 kg. The average hitting speed in the process is 16m / s, the maximum speed is 17.5m/s and the minimum speed is 14.0m/s. The average explosive power of athletes is 6800 kg · M / s, the maximum is 9450 kg · M / s, and the minimum is 4260 kg · M / s. When the attacking leg hits the target, the target will be hit greatly, and the speed of the selection link of the attacking leg will decrease rapidly.

In the implementation of cross kick technique by athlete, twice swing of the upper arm is also the key to realize the second power generation of hip. The swing arm is mainly with the help of waist force twist, and transfers the moment of inertia of the upper arm to the attacking leg. At this time, the rotation range and timing of the athletes' waist can ensure the upper and lower body rotation contact, and improve the impact effect of offensive leg. In the muscle movement of excellent athletes, it is found that the shoulder muscle contraction can strengthen the swing of the upper arm, and the back waist muscle contraction can be driven by the hip, from big to small. In the specific Taekwondo training, we can promote the effective coordination between the upper limbs and the body by training.
the swing strength and amplitude of the upper limbs, and keep the attacking legs to rotate and hit at the best time, so as to ensure the overall hitting effect.

Finally, the recovery of attacking legs is also an important prerequisite for Taekwondo defense. Because the athlete's cross kick moves out, the attacking leg is in the kick out state, this is the best time for the opponent to counterattack. Therefore, it is very important to recover the offensive leg to play a self-defense effect. In the technical movements of Taekwondo athletes, the application time of attack leg recovery process is more than 30% of the whole cross kick technical action time. Therefore, in the usual sports training, it is necessary to strengthen the recovery speed training of the offensive leg of the athletes, to train the extensiveness of the back group muscles of the thighs, and to strengthen the contraction contact of the hind leg muscles of the athletes, so as to improve cross kick effect and avoid being attacked by opponents.

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