Research Article

Feature Extraction-Based Fitness Characteristics and Kinesiology of Wushu Sanda Athletes in University Analysis

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This paper designs a feature extraction-based physical characteristics and kinematic analysis of collegiate martial arts Sanda athletes by profoundly studying the model of athletes’ action feature extraction and constructing physical characteristics and kinematic model of collegiate martial arts Sanda athletes. This paper provides feature extraction category support by describing the data types of clustered objects, calculating behavioral operator distances, identifying multiple behaviors occurring in collegiate martial arts Sanda tactics, and delineating the correct thresholds for operator identification. A comparison experiment is designed to verify that the proposed method can improve the accuracy of feature extraction for athletes’ technical and tactical use and is more applicable to the comprehensive assessment of athletes’ behaviors. The underlying features of the athletes’ motion technique forming image features are analyzed, the image features are regionally divided, the feature sets of different levels of developing actions are obtained, and the image features are allowed to map to the corresponding feature dimension space. The AdaBoost algorithm filters out the feature data of the athletes’ action images that contribute most to the intelligent visual analysis. It is used as training samples for training and recognition to complete the extraction of athlete action image features. The action times of the five different phases of side kick up, knee lift, kick strike, and strike: recovery is 0.2986 s, 0.1819 s, 0.1322 s, 0.0708 s, and 0.9986 s, respectively, which reflects that the time of different action phases of athletes with extra body weight is more related to the athletes’ weight, strength, flexibility, and coordination.

1. Introduction

With the increase in the number of competitive Sanda matches, the need for scientific research on the competitive status of Sanda athletes is also increasing, prompting the diagnosis of competitive rate to become the focus of current scientific research. Dedicated to developing local fighting programs, the sport of Sanda is gradually gaining attention [1]. To adapt to the increasing number of competitive competitions and ensure that the casual fighters achieve the desired competition results, the focus on the competitive status of Spartan soldiers has gradually begun. To adapt to the increasing number of competitive matches and ensure the ideal performance of Sanda athletes, we gradually began to pay attention to the diagnosis and training of Sanda athletes. As early as the 1950s, kinesiologists began researching the diagnosis and monitoring of athletes’ athletic status [2]. Still, due to the single diagnosis method in the early stage, it was limited to the use of medical procedures. Influenced by the rapid development of sports and the need for sports training, the methods of diagnosing, maintaining, and cultivating the competitive state were improved to a large extent, which prompted more experts and coaches in sports training to devote themselves to the research of the competitive state of sports.

The traditional physical training of Sanda mainly focuses on the large muscle groups of the limbs. It neglects the small muscle groups’ stabilization and explosive power training in the deep core area, following traditional physical training principles and methods [3]. This involves the efficiency of power transmission, the size of the explosive power and stability power in the core area, and the coordination ability of
the nerve control muscles to do work. According to Tian’s “barrel theory” in the “twin model” of competitive power, the lack of a particular ability will limit the development of the athlete’s overall competitive ability, so it is imperative to apply functional training to Sanda’s activity scientifically and reasonably [4]. The research on practical training in sports training in China mainly focuses on using available training. Every sport is actively studying the methods and ideas of functional training to improve the efficiency of such activity [5]. Introducing practical training into Sanda training to enhance the quality of Sanda techniques is an inevitable trend in developing modern Sanda training and sports training.

As the research of functional training in competitive sports gradually deepens, it has been widely applied and developed. People’s awareness of available training is getting stronger and stronger. Still, practical training is mainly used for the special training of athletes, while sports training methods are applied to ordinary people, including university students [6]. However, there is a lack of research in physical education for university students, which focuses on physical development, so it is necessary to study the application of functional training in the physical education of university students. Fighting is the most demanding sport regarding physical ability, skills, and tactics, and the opponent will suppress the slightest disadvantage [7]. According to statistics, Sanda has the highest usage and score rate during the competition, which is the core of the whole Sanda technique. Based on the actual effect of functional training, we apply the theory and method of practical training to the movement Sanda techniques and design a unique, helpful training program [8]. We have also conducted the training and application of a functional training program for Sanda sports to explore the effect of practical training on the speed and strength quality of Sanda techniques, which can enrich the physical training program of Sanda sports in the future and improve the actual training effect of Sanda sports. This study will help to improve the efficiency and technical quality of Sanda training and thus enhance the overall competitive ability and practical value in Sanda combat.

2. Related Works

As a primary sport, Sanda requires athletes to have good reaction skills; they must react quickly to the opponent’s movements and tactics and make quick decisions to defend or counterattack its reactions to be invincible in basic activities [9]. In addition, athletes must have good physical fitness to maintain a good response and fast movement over an extended practice period. Athletes must also have good explosive power to hit well and make the most of their skills to beat their opponents. At the same time, only with good physical ability and explosive power can one have reasonable control of the body and make the game more ornamental. Better explosive and physical ability are inseparable, and the perfect combination can meet the requirements.

Since the country’s founding, China has developed rapidly in various fields, but slowly to now; there is impatience in many areas, which is also true in physical training. In the current activity of Sanda athletes, it is easy to pay attention to the technical movements and tactics but not to the essential physical exercise [10]. The second situation is the lack of science and systematization of physical activity due to the lack of awareness and professional talents in China. The lack of theoretical knowledge in this area means there is no scientific training method in the training process, although there is a will to strengthen physical training [11]. There is no relevant knowledge as support, so it is challenging to have scientific and systematic training; this makes it easy to cause athletic injuries and stagnation in athletes’ performance [12]. In addition, the current situation is the lack of training of relevant professionals. Physical activity requires a lot of professional talents, from developing training programs to evaluating the current status [13]. This is a sequel to our education system and the lack of relevant skills and specialties in our universities and schools. In summary, this is the current situation in sports training, which also exists in the physical activity of Sanda sports. This paper will support future physical exercise, especially for Sanda athletes, and a reference for another related research [14].

Han et al. used the power and reaction speed meter board to collect data, and the results of the study showed that increasing the complexity of the movement would prolong the reaction time of subjects in all age groups; the movement complexity line had a more significant effect on the reaction time of preschool children and the elderly; the relationship between the speed of the reaction and the accuracy of the movement was more important than the relationship with the speed of the action [15]. Cynarski used mathematical statistics to explore the factors affecting movement speed, and the results that the factors affecting movement speed in the competition are the technical level, tactical awareness, and psychological aspects of athletes; strengthening the training of unique and general qualities, psychological quality and tactical training can effectively improve movement speed in the competition [16]. Vasconcelos et al. compared the technical use of Chinese and foreign Sanda athletes and conducted data statistics; the main research conclusions are as follows: in punching techniques, medium-level athletes mainly use straight punches and swinging punches, but swinging points score well and are often used in the leg technique [17]. In wrestling, the number of times using close wrestling is the most, and the success rate of catch wrestling is higher [18]. Sun and Bin studied the technical characteristics of China’s male lightweight athletes and pointed out that the boxing of the best lightweight athletes is obviously inferior to that of the heavyweight class in terms of power, and the use of boxing rarely scores points; boxing is used more often as a false wobble, primarily relying on leg kicks to grab points and rarely to use high leg kicks, the wrestling technique is single, and the awareness and ability to change wrestling are not heightened, but the power to prevent wrestling is vital [19].
3. Feature Extraction-Based Physical Characteristics and Kinematic Model Construction for University Wushu Sanda Athletes

3.1. Athlete Action Feature Extraction Model Construction.
In the process of athlete action image feature extraction, each action of the athlete is expressed as a continuous sequence of states, and each state is prompted to have its own apparent and dynamic features. On this basis, the local characteristics of the athlete action image are extracted, and the spatial and temporal neighborhoods of all the athlete action image local parts are divided into multiscale grids, and the distribution of the athlete action image local features is counted. The distribution of various grids is connected to form the overall parts of the athlete action image by the motion technique. The flowchart of athlete action image feature extraction is shown in Figure 1. Feature extraction is based on feature selection; it is the process of extracting new features from the original data; this extraction process is usually performed automatically using a specific algorithm (function mapping) to transform or map the multidimensional or related original features through the data to get a new feature space. However, the new feature space is obtained based on the original features, but with direct observation may not see the association between the new data set. The actual data set is a kind of dimensionality reduction mapping operation of the original features.

In the process of athlete action image feature extraction, if \((X, Y, T, \delta, \tau)\) represents the continuous sequence of athlete action states and \((X, Y, \tau)\) represents the dynamic features of each athlete action, the overall athlete action image feature extraction model obtained from the distribution of multiple grids is established by using equation (1) to complete the athlete action image feature extraction.

\[
h = \sum \left[ \frac{(X, Y, \tau)}{(X, Y, T, \delta, \tau)} - \det(u) + \text{Trace}(u) \right]. \tag{1}
\]

However, the traditional algorithm can only coarsely divide the action images into several subclasses. It cannot obtain an accurate action feature set, which leads to the problem of poor action image feature extraction and the proposed method of athlete action image feature extraction based on hierarchical features [20].

The similarity classification of similar behaviors appearing in martial arts Sanda practice describes the kind of data of the clustered objects. The distance between the similarity function and the distance function behaviors in the same spatial dimension is calculated using the identification behavior operator. The following calculation formula can express the behavioral operator distance.

\[
d(X, Y) = \sum_{i=1}^{n} \frac{(x_i + y_i)^2}{(x_i^2 + y_i^2)^2}. \tag{2}
\]

In Equation (2), \(d\) denotes the behavioral distance of martial arts Sanda practice techniques and tactics under the Euclidean calculation method; \((X, Y)\) denotes the high-dimensional spatial points; \(i\) denotes the number of technical and tactical behaviors; and \(n\) denotes the characteristics of behavioral operators. Based on the correct identification of the technical-tactical behavior operator, the badminton multi-ball player’s connectivity is processed with comprehensive morphology using motion morphology to crop the behavioral edge image, obtain the technical-tactical sports movement behavior target, and obtain the secondary-led behavioral image. Assuming that the current recognition frame of athletes’ technical and tactical sports behaviors is \(f(X, Y)\), and the reference frame of technical and tactical behaviors is \(b(X, Y)\), then the correct threshold value of badminton multi-ball technical and tactical behavior operator recognition at this time can be expressed as follows:

\[
RC(X, Y) = \frac{\sum f(X, Y) - T - 255}{b(X, Y) - T}. \tag{3}
\]

In Equation (3), \(RC\) denotes the correct threshold range and \(Td\) denotes the threshold value detected by multiple recognition experiments. According to the above formula, the obtained local behavioral operators and operator thresholds are used as the spatial region description for feature recognition. The behavioral segments are divided using recognition classifier science to provide category support for technical and tactical motion feature extraction.

To realize the extraction of sports pose features of Wushu Sanda athletes, it is necessary to construct a visual feature sampling model of Sanda athletes’ pose images first. The fusion boundary filter detection method is used to reconstruct the visible features of the stance of the Sanda player. A 3D visual fusion model of volleyball players’ stance image information is constructed with a grayscale pixel set \((I, J)\), a multiscale decomposition of the collected Sanda players’ stance images is performed, and a multi-feature fusion model is established by using a physical model reorganization method to obtain the distribution of Sanda players’ motion stance information as

\[
P(K) = \int_{j=1}^{m} u_j(k - dk) - \sum \frac{x(k)}{\sqrt{m - j}}. \tag{4}
\]

The target features are reconstructed for the Sanda player’s batting stance image. The set of edge contour features distribution of the Sanda player’s action stance image is rebuilt. The feature maps at multiple scales are extracted to obtain the pixel feature acquisition \(Q(I, J)\); the boundaries are

\[
Q(I, J) = \sum \left[ \text{INT}\left(\frac{W}{2}\right) - \text{INT}\left(\frac{h}{2}\right) \right]. \tag{5}
\]

In Equation (5), \(W\) and \(h\) are the width and height of the pixel feature acquisition result map, respectively, using the filter function for image fusion filtering and feature decomposition to obtain the convergence value of the filtered output as
In Equation (6), $\lambda$ is the filter coefficient and $e(T)$ is the filter function; reconstruct the action characteristics of the active state image of the casual athlete, and obtain the sampling model of the sports posture image of the everyday athlete as

$$
t = \lim (\lambda e(T) - T). \quad (6)
$$

The above-mentioned motion behavior recognition operator is used to detect the point of interest where the athlete’s behavior occurs. The operator interest detection region provided by dollar is integrated to implement feature descriptions for Sanda athletes and calculate the regional behavior feature quantification results. The calculation formula is as follows:

$$
S = \sum [w(k) + \phi \ast p(\sqrt{k - 1})]. \quad (7)
$$

In Equation (8), $X$ denotes the behavioral feature quantification criteria; $h$ denotes the identification classification of Sanda sports features; and $\text{BIN}(i)$ represents the histogram of Sanda sports behavioral features. According to the above formula, if the window behavioral features span one frame, different athletes’ behaviors are clustered according to the k-means pair implementation. And the continuous behavioral components formed after clustering are segmented according to segments; each segment contains independent feature behaviors. The calculation formula is as follows:

$$
e = \int (x, y) + \frac{b}{\sqrt{b - S}}. \quad (9)
$$

In Equation (9), $e$ denotes the frequency of quantitative feature behaviors of Sanda sports practice techniques and tactics; $b$ denotes the starting frame of feature behaviors; and $S$ denotes the ending edge of feature behaviors. According to the above formula, the influence caused by excessive behavior extraction is reduced to obtain a relatively standard feature description.

3.2. Physical Characteristics and Kinematic Model Design of University Martial Arts Sanda Athletes.

The role of wrestling as one of the basic techniques in Sanda cannot be ignored in real-world competition. Mastering the wrestling techniques and giving full play to them on the field is critical for athletes to win the competition. In a Sanda match, the practical wrestling techniques are double leg over the chest, single leg-pulling, single-leg parting, neck over the back, leg catching and pressing, leg catching, parting wrestling, leg catching, topping wrestling, etc. Take the leg hook drop as an example: when the opponent kicks with the right side of the leg, the left hand is copied to hold his calf, the right hand is passed over the opponent’s right shoulder.

![Flowchart of athlete action image feature extraction.](image-url)
and pressed down on his neck, while the left hand is raised and the right foot is kicked in the direction of the support leg to drop the opponent. The source of force for the wrestling method can be described as the whole-body muscle coordination with the staff. Wrestling is an intense and ever-changing confrontation in which the opponent is quickly and powerfully thrown to the ground by the flexible movement of their technical skills. Therefore, to be able to use wrestling successfully, the athlete must not only have solid physical qualities such as strength, flexibility, speed, and endurance, but most importantly, must be able to grasp the timing in the fierce confrontation, so the athlete must have the critical qualities of quick reaction, quick movement, and fast and accurate action. The characteristics of a Wushu Sanda athlete are shown in Figure 2.

Training of Sanda reaction speed: First is training of reaction speed of simple movements: a single or straight-forward combination of activities as required by the technical specifications of the trends. The improvement of the reaction speed of one depends mainly on the athlete’s familiarity with the action. The primary method to improve the reaction speed of simple movements is to listen to the coach’s reaction to a signal or a password. For example, they accompany the call with a quick instructional activity such as a straight punch. Or practice rapid in-and-out running and running in disguise after hearing the signal. Perform the corresponding offensive or defensive counter-wrestling action according to the instruction given by the coach or partner. When the coach or the companion is throwing the leg, he can quickly make the reaction action of catching the leg drop [21]. Secondly, the reaction speed of complex movements is practiced. The Sanda competition is very intense. The opportunity to fight is often rapidly changing, so there is a better requirement for the reaction speed of complex movements. And these complex movements are inseparable from technical and tactical training. Therefore, the most important thing is to create conditions for athletes to practice complex reactions, actively participate in invitational tournaments and friendly matches, and even complete the training tasks in a specific way by using tournaments as training [22]. Therefore, the necessary method of daily exercise for high-level athletes is to carry out real-life competitions according to the training objectives set by the coaches in advance, master the speed and timing of complex movements and skills in confrontation training, and further improve the accuracy of completing complex activities. When formulating the training plan for the reaction speed of difficult movements, coaches try to follow or simulate the similar situations that may occur in the competition as much as possible so that athletes can practice the movements repeatedly according to the similar situations in the routine training, so as to shorten the reaction time of the athletes in the actual competition. The process of visual image recognition of martial arts Sanda action is shown in Figure 3.

The construction of structural models of physical fitness characteristics of Sanda athletes is an integral part of establishing a physical fitness system. The stock indexes of each element screened in the last part of this study can summarize the basic information on the physical fitness characteristics of Sanda athletes more comprehensively and objectively. The significance of the physical fitness structure model for Sanda athletes is as follows: (1) the physical fitness structure model reflects the typical characteristics of the physical fitness of Sanda athletes and is the most abstract generalization, and high refinement of the physical fitness characteristics of the sport; (2) the establishment of the physical fitness structure model can provide a guide for the scientific selection and essential training of Sanda athletes and improve the success rate of excellent athletes; (3) the physical fitness structure model is the best way to evaluate the current physical fitness development level of athletes and to formulate training plans; (4) the physical fitness structure model is the theoretical basis for evaluating the current physical fitness development level and formulating training plans and is the basis for physical fitness diagnosis and evaluation.

According to specific laws and unique ways, the so-called physical fitness system refers to the organic combination of interrelated and interacting elements in physical fitness. The method of physical fitness characteristics of excellent Sanda athletes is based on the physical fitness development level of high-level athletes and the unique attributes of Sanda athletes as the theoretical basis through the establishment of a comprehensive index system to evaluate the elements of physical fitness of high levels and athletes, to provide a quantitative basis for the comprehensive scientific training monitoring of the physical fitness development level of high-level Sanda athletes [23]. The indexes reflect the basic structure of the evaluation system, and the weight of the indexes demonstrates the importance of each index in the whole evaluation system; the greater the weight, the higher the importance of the indexes; the evaluation standard is the criterion and scale for value judgment of the evaluation object, which can be divided into scoring evaluation standard and level evaluation standard.

4. Analysis of Results

4.1. Analysis of Physical Characteristics and Kinematic Models of Wushu Sanda Athletes in Universities.

Physical ability is the key to winning in the Sanda competition. If the footwork is not fully mastered, it is difficult to carry out coherent and orderly combination movements and achieve the effect of implementing and using offensive and defensive techniques. Hence, correctly using and mastering footwork is essential in daily study and combat; the footwork is a practical prerequisite and fundamental guarantee for the combined action of Sanda. In actual combat, the attacking and defending parties put their energy on the boxing and leg movement, so if they want to complete an effective attack or defense and ensure the accuracy and consistency of the combined action in actual combat, they need to rely on flexible footwork adjustment to achieve it. Distance is the magic weapon for combatants in real war and the key to victory [24]. Distance affects the speed of attack or defense, and reasonable distance is obtained mainly through footwork movement. In actual combat, footwork movement
creates the offense or security of the Sanda technique. The speed, distance, and timing of footwork movement directly impact the effect of attack and defense. Footwork is mainly used to stabilize one’s center of gravity and put oneself in a favorable position; when attacking, the use of footwork can quickly adjust the good attacking position to facilitate the subsequent use of combination movements for fast and consistent attacks; when defending, one can rely on footwork to avoid the strong attacks of the opponent to achieve the purpose of defense with the minimum dodging distance, and to seize the favorable attacking and defending positions. In addition, you can use footwork to control the angle of attack and defense, determine the angle of protection according to the specific direction of the opponent’s attack and the distance of attack, use flexible footwork to approach the opponent to attack quickly, and use false movements of footwork technology to distract the opponent from achieving the purpose of effective attack or defense. The
Focus on the physical characteristics of students, use a variety of exercises to improve the body's working ability, ensure that students master more complex knowledge, and enhance the ability to use movement techniques based on good acceptance of learning to lay a solid foundation for improving the learning ability of Sanda. Therefore, the first half of footwork teaching can be speed and sensitivity exercises to improve movement speed and own reaction ability and enhance coordination and control ability; the second half of footwork teaching can use light equipment for strength exercises and endurance exercises, and endurance exercises can be arranged after speed, strength, and sensitivity exercises as much as possible [25]. The learning of the Sanda footwork technique can be divided into three stages: the goal of the first stage is to comprehend the footwork movement, master the footwork technique, achieve proficiency, and strengthen the physical quality practice; the second stage aims to improve the reaction ability and use the physical quality practice as a supplementary practice item, to improve the level of using the footwork technique; the goal of the third stage is to consolidate the footwork technique, recover the physical strength, focus on the reaction practice, and conduct a few hours of footwork exercises to reduce footwork techniques and with a small number of physical activities.

The Sanda action is a typical open chain movement; the large joints drive the small joints; in turn, the torso is the support point when lifting the knee, and the coordination of the action is sequential force, which indicates the improvement of the stability effect. The fluidity of the Sanda motion is more important, reflecting the development of coordination from certain angles. Incredible speed is generated before the end of the movement, and the various aspects of the training of the whipping action a specific chronological character. In general, the body's large muscle groups move first, then the smaller muscles are in sequence, and finally, the fast forces at the end of the limb will end the activity. The first contraction of the large muscles increases the amplitude and speed of the movement; the post-contraction of the forces improves the accuracy of the limb movement, and the whipping action uses minimal time intervals to make movements at different stages; usually, this time interval is less than 0.2 second. Skilled whipping activities can be done under "low conscious control," i.e., mechanical movements. A comparison of the success rate of spanking action feature extraction is shown in Figure 5.

At the kinematic level, the kinematic diagnosis can be based on the spatial and temporal characteristics of the technical Sanda movements, the spatio-temporal features of the kinematic diagnosis, the observation, recording, and analysis and evaluation of the performance of the action. Sanda technical activities belong to the classification of forwarding motion in this dynamic movement. In kinesiology, we usually consider the time required from the initiation phase to the stabilization phase as the total time to complete the campaign. The speed of the movement determines the rate of the Sanda movement. Of course, achieving Sanda movement also depends on the time required for each phase of initiation, braking, and stabilization. Therefore, the total time to complete a Sanda movement is inevitably related to the training method, the technical level of the activity, the characteristics, and the distance. Rahman et al. analyzed the data by capturing kinematic images of Sanda after filming with an infrared camera; at the kinematic level, the analysis of a moving object can be based on two perspectives: force and state of motion [26]. In this paper, to study the effect of functional training on the kinetics of Sanda, the upward and forward force values of the right knee joint and the impulse of the force during the knee lift phase were chosen as the key indicators. The upward pressure is the vertical component of the upward force, part of which makes the body move upward, which is related to the subject's weight and can be used to balance the body's weight. However, in the mean value analysis, there is an error in the mean value of the force due to internal and external factors. The weight factor can be disregarded, and only the mean value of the overall difference change before training is analyzed. The maximum and minimum values of the stability parameters of this method are stable.

In contrast, the maximum and minimum values of the stability parameters of the other two ways have some fluctuations. It is verified that the stability of this method for feature recognition is better. The comparison results of the mean values of the kinematic stability parameters are shown in Figure 6.

Analyzed from the personal level of the Sanda player, their own technical and tactical level is the direct influencing factor. For example, the party with a higher technical level can effectively use the objective conditions of the playing field, control the situation and rhythm of the field, use feint tactics and edge tactics to find offensive opportunities in the corner area of the ring, and then use down tactics to force the opponent to fall out of the ring, to win the score or even directly win the match [27]. The losing side, on the other hand, due to its relatively weak strength, does not cooperate appropriately with various techniques and tactics. Sometimes, it may appear that they can only carry out a single defense, and it is difficult to get rid of the dilemma of being in the edge corner, coupled with poor psychological quality; when forced to play by the opponent will produce fear of falling out of the ring, so it is also easy to be seized by the opponent, allowing the opponent to attack, resulting in the loss of points or even losing the game.

From an objective point of view, a player who steps down twice in a game loses the game due to Sanda rules, so the player should fully use the controls. The playing field is an open ring with no fence, so the players will not be prevented from using their skills and tactics when they are in the corners. The referee's decision will have a direct impact on the match. When the passive side is in the corner position, the referee’s decision will have a substantial psychological effect on the inactive side if there is a negative game in moving backward. As well as the environmental factors of the field of play, such as the shouts and words of the spectators, can affect the psychology of the players.
4.2. Feature Extraction-Based Physical Characteristics and Kinematic Implementation for University Wushu Sanda Athletes.

According to the rules of Sanda and the characteristics of human movement, single or multiple actions are combined to form a group of activities with the nature of actual combat. This group of measures is called Sanda combination actions; the punches and kicks are the most frequently used in actual combat [28]. Firstly, from the point of view of the structure of the action, a too single action cannot effectively grasp the opportunity to attack; secondly, from the point of view of the striking effect, the combination of boxing and leg technique has more memorable moments, and the action is connected quickly,
which is easy to destroy the opponent's action structure; thirdly, from the point of view of defense, a single action is easy to be defended by the opponent, and the combination of boxing and leg up and down in a continuous attack way makes the opponent dizzy and unprepared. It is challenging to defend comprehensively; finally, the movements made by different numbers and combinations have great potential for development, reflecting whether the opponent has a comprehensive technical system. The number of combinations can be divided into three, four, five, and more than five. The advantages of using MATLAB for simulation test analysis are high programming efficiency, efficient and convenient matrix and array operations, user-friendly, expandability, and interactivity. To verify the application performance of the method in this paper in realizing the volleyball players' hitting stance features, MATLAB is used for simulation test analysis; the number of chunked grids for volleyball players' hitting stance image acquisition is $12 \times 12$ and $28 \times 28$, the number of superpixels is 248, the threshold value of visual feature sampling is 0.34, and the single frame length of Sanda players' action stance image is 100 frames; according to the above parameters, the output results of the sports pose filtering of the Sanda player are obtained, as shown in Figure 7. As the image acquisition frequency increases, its image filtering amount gradually decreases. The image filtering amount is about 40 when the acquisition frequency is 300 Hz, indicating that the longer the method runs during the experiment, the less interference is conducive to stable operation.

Different training methods should be adopted for different types of opponents; for example, for opponents with outstanding boxing skills, the distance must be controlled well, not to allow the opponent to close confrontation, you can use the whip leg to interfere with the opponent's attack rhythm when the opponent starts the attack with boxing skills, and you can use the front stomp leg or side kick leg to block, to strengthen the flexibility training of footwork and movement; for opponents with better legwork skills, their advantages are reflected in. For this kind of player, you should quickly close the distance, limit the use of the opponent's leg, do not give him the length of the leg, and can use boxing to meet the opponent in time to finish the leg action to give each other a blow. You can also use fake moves to cheat the opponent's kicks in the process of confrontation to counterattack or use the leg drop technique. This requires the athlete to strengthen the accuracy of punching strikes and leg catching techniques in daily training. For good wrestlers, the athlete must attack with fast punching and retrieval speed and needs to implement strikes or counterattacks to cooperate with fake moves. The test chart for the speed of martial arts Sanda movements is shown in Figure 8.

The test results showed that the mastered Sanda movement technique positively affects learning the Sanda combination movement technique. The first learning or mastered taekwondo combination movement technique has a positive transfer of motor skills to the teaching of Sanda combination movement technique. To test the performance of this paper's method in implementing visual image recognition of martial arts Sanda movements, simulation experiments were analyzed under the simulation tool MATLAB. The sample data were selected according to the parameter settings. The data used in the experiments were obtained from Baidu Gallery, with 10,000 visual images of some martial arts Sanda actions. The 1000 images were randomly divided into five groups of test data. The above sample settings were used as the database for this experiment. The martial arts Sanda action visual images were used as the test samples. The edge feature segmentation method was used to process the martial arts Sanda action visual feature expression. The edge contour feature analysis model of the martial arts Sanda graphical action images was established. The martial arts Sanda athletes’ physical performance feature extraction results are obtained in Figure 9.

The amount and intensity of physical characteristics should be based on the current training status of the athlete. When the athletes’ performance and training level improve, they should also be arranged reasonably and scientifically according to the actual situation at that time to adapt to the internal changes of the athletes’ bodies; for example, when a Sanda athlete carries out endurance training, the athlete’s heart rate can reach about times minutes after running the kilometer training distance in minutes, after a period of

![Figure 7: Filtering output results of sports posture of Sanda players.](image1)

![Figure 8: The examination chart of the speed of martial arts Sanda movements.](image2)
systematic training, the heart rate is only about times minutes after running the same kilometer with the same time. After a routine activity, the heart rate is only about a minute when running the same number of kilometers simultaneously. Thus, we can see the improvement in their endurance; we can compare their heart rate value in the prescribed kilometers training with the scientific best heart rate value to verify whether their training has reached the best effect. Then, we can decide the magnitude and direction of our training intensity adjustment. To continuously improve the performance, we need to rationalize the training means further, using less time to complete the same training load. This training program uses the optimal value as a standard, a training model that uses the external performance characteristics of the athlete and the heart rate as a basis for feedback on physical training.

5. Conclusion

Wushu Sanda sport, the theoretical basis of the theory of Wushu Sanda, and the technical use of Wushu Sanda athletes in mixed martial arts competition are still weak, and relevant research is needed to fill the gap. This paper proposes a method for extracting physical characteristic stance features of Sanda athletes. The edge contour features are removed from the collected pose images of Sanda athletes. According to the feature extraction results, the motion tracking recognition of Sanda athletes’ physical fitness features pose pictures is carried out to realize the physical fitness features pose features extraction of Sanda athletes. The experimental results are compared with video tracking and PID methods, the extraction accuracy of this paper’s method is higher, and the image fusion level is better. However, the way in this paper only compares the feature extraction accuracy. It does not investigate the feature extraction speed, so in the following study, we try to add network iterations to reduce the extraction time consuming and improve the feature extraction speed. This paper establishes the visual feature analysis and adaptive feature extraction model for martial arts Sanda action and realizes the optical image recognition of martial arts Sanda action according to martial arts Sanda action’s visual feature extraction results. It is analyzed that the accuracy of visual image recognition of martial arts Sanda action using this paper is high, and the error is low, which has good application value in guiding martial arts Sanda action training.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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