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Analysis of tennis technical movement training strategy in colleges and universities under the background of big data technology

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Abstract

This paper first explains the tennis technical action representation and matching technology, using the Euler angle method to represent the coordinates of the tennis action gesture, realizing the deconstruction of the action gesture through the gesture-solving algorithm, and then using the weighted Euclidean distance to match the tennis gesture to the action. Secondly, we constructed the tennis technical movement training strategy for colleges and universities based on the task-driven teaching method, and gave the teaching experiment method to analyze the effectiveness of the strategy. Finally, the data was analyzed by examining the muscle characteristics of tennis technical movements and the teaching effect of task-driven teaching. The results showed that the maximal EMG integral value of the muscles was 32.91uV.s in the level 1 group and 87.91uV.s in the level 2 group, and the maximal angular velocity of the ankle-knee-hip joints was 645.23±189.42°/s and the minimum angular velocity of the hip joints was 461.87±115.08°/s in all the landing modes. 115.08°/s. The task-driven teaching method can effectively improve the students' tennis learning and technical level and enhance the quality of tennis technical teaching in colleges and universities.

Keywords: Eulerian angle method; Stance solving; Action matching; Muscle characterization; Tennis technique.
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1 Introduction

Tennis is a sport of strength, explosive force, and sensitivity coordination, which can make tennis players enjoy the game and bring infinite fun at the same time. With the increasing standardization of tennis teaching in colleges and universities, the importance of tennis teaching in colleges and universities is also increasing, and physical education teachers should pay more attention to the necessity of tennis technical training and implement the tennis technical practice in the actual teaching work [1-2]. In the teaching and practice of tennis technology, the improvement of practical efficiency can help students improve their skills, and the rational use of tennis training strategies can play a good role [3].

At the same time, in the actual development of the college tennis technical movement teaching training process, its teaching level and teaching quality will have a direct impact on the student's physical quality, and even with the ability to cultivate high-quality tennis talents have a very close relationship [4]. The basic technical movements of tennis include serve, forehand stroke, backhand stroke, forehand interception, backhand interception etc. The use of different technical movements in tennis mainly depends on the position of the athletes on the court and their tactical choices [5-6]. How to be able to deeply analyze the technical movements shown in tennis under the background of big data technology to help students better master the technical essentials of tennis is the focus of tennis teaching in colleges and universities.

At present, many colleges and universities have opened tennis elective courses, and the number of elective students is also relatively large, but the lack of tennis technical movement training strategy leads to a great reduction in the effectiveness of tennis teaching. This paper starts with the introduction of tennis technical action representation and matching technology, utilizes the Euler angle method for tennis action representation, and deconstructs tennis technical action through posture solving algorithm and action matching algorithm. In order to test the effectiveness of the tennis technical movement training strategy of colleges and universities constructed based on a task-driven teaching method, a teaching experiment method was designed for the strategy, by analyzing the muscular characteristics of tennis technical movements and the teaching effect of task-driven teaching in order to verify the effectiveness of the tennis technical movement training strategy based on the task-driven teaching method in this paper.

2 Review of research related to tennis teaching in colleges and universities

Tennis belongs to the skill-dominant category of inter-net confrontational sports, and its technical movement types include both closed motor skills of technical movements of serving and open motor skills of forehand and backhand, interceptions, high pressure and chip shots, which reflect the diversity and specificity of technical movements [7-8]. Literature [9] examined cognitive mechanisms based on EEG for tennis players and college students in a motor decision-making task. College students exhibited longer reaction times and lower decision scores when making exercise decisions than tennis players. Literature [10] discusses the basic nature of tennis and shows that tennis teaching can only be improved by fully understanding the psychological qualities of athletes. The article analyzes the brain waves and brain potentials during tennis training with EEG test technology so as to understand the development of athletes' psychological quality in the process of tennis teaching. Literature [11] designed an online tennis teaching information platform with a robot system and software architecture and tested its function and performance. The teaching effect of online tennis teaching information platforms is better than that of traditional teaching methods and can effectively improve students' tennis skills.

Tennis is one of the most popular sports in the world today, and with the advent of the big data era, more and more research is directed at how to integrate tennis training with new technologies, which has also led to the unprecedented development of tennis [12-13]. Literature [14] analyzed the effectiveness of a motion capture system for tennis teaching. The system with portable and low-cost advantages to give tennis more teaching methods can effectively capture the frequency of tennis technical training forehand stroke. Literature [15] used the adaptive Gaussian mixture model to analyze the classification of tennis game scenes, through which the model can effectively realize the classification of tennis scenes and provide a certain data basis for the development of a tennis technical movement training strategy. Literature [16] analyzed forearm fatigue for tennis technical movement training by experts and non-experts for the factors affecting the level of tennis skills, and the batting speed of the expert group was faster than that of the non-expert group.

In the technical movement training of tennis, in order to enhance students' tennis technical ability faster, teachers can develop training methods according to the training situation to ensure that students can fully understand and master the technical requirements and key movements of tennis in a relatively short period of time [17-18]. Literature [19] aims to improve tennis technology and enhance the performance of athletes through the design of a battery-free device and pressure monitoring system. The racket surface can be divided into regions by the system, and technical support is available to detect the regional impact force. Literature [20] for the tennis training process of postural control and muscle characteristics were analyzed. The athlete's postural control can effectively improve the level of the athlete's technical training, reduce muscle stiffness and prolong the relaxation time. Literature [21] discussed that in tennis training, scientific training detection technology can help coaches better understand the students' physical skills and psychological state and realize the reasonable formulation of tennis technical movement training strategy.

In addition to this, literature [22] discussed the importance of serve technique in tennis sports training, and high serve technique may realize the situation reversal of tennis competition. Eight tennis players with high athletic levels were selected as the research object. The adaptive fuzzy system can effectively predict relevant techniques for tennis serves and then better assist athletes in improving their tennis skills. Literature [23] examines the relevant teaching strategies for tennis teaching and the appropriate choice of action training strategies that can effectively enhance tennis technical ability. Literature [24] analyzed the possible sports injuries in the process of tennis technical training. Sports injuries will reduce the technical training of students to a certain extent, and it is necessary to formulate reasonable training strategies to avoid possible injuries in the process of tennis technical training.

3 Tennis technical movement representation and matching techniques

In order to better formulate the tennis technical movement training strategy, it is necessary to discover the problems existing in the training process through the movement of tennis technology and then realize the targeted construction of the movement training strategy. Thus, under the background of big data technology, motion capture technology can better realize the capture of tennis technical movements and then provide technical support for colleges and universities to carry out the analysis of tennis technical movements and realize the training strategy of tennis technical movements in colleges and universities to provide certain reference.

3.1 Representation of common action gestures

Digital analysis of movement data has become a crucial standard for measuring the movement state due to the continuous improvement and development of big data technology. People usually use gestures to describe the motion state of objects, so this paper also uses the method of gesture representation to describe the state of tennis action in the construction of tennis technical action training teaching strategy. Posture can be used to represent the positional relationship between an object's coordinate system and the reference coordinate system. In mathematical research, the mathematical methods that people commonly represent posture nowadays are the quaternion method, Euler's angle method, and the direction cosine matrix method, and they can be converted to each other. Each person's needs dictate which representations they choose, as each has its advantages and disadvantages.

The Euler angle method splits a three-dimensional rotation into three rotations on the z, y, and x coordinate axes to get three rotation angles. These three angles are called heading, pitch and roll angles, and the definition of Euler angles is shown in Fig. 1 [25-26]. The blue XYZ-axes are the three axes of the geodetic coordinate system, and the red XYZ-axes are the reference axes of the object itself, and the intersection of the xy-plane and the XY-plane is said to be the intersection line, which is denoted by the letter N.

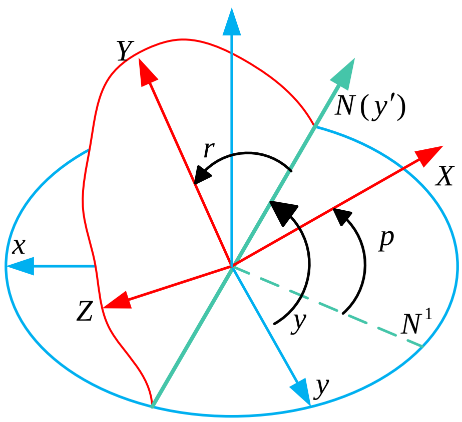


Figure 1. Schematic diagram of the Euler angle definition

From the definition, it is clear that the Euler angles can be easily converted into a rotation matrix. The rotation matrices around axes x, y and z are denoted as:

$$R_x = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos r & \sin r \\ 0 & -\sin r & \cos r \end{bmatrix} \tag{1}$$

$$R_y = \begin{bmatrix} \cos p & 0 & \sin p \\ 0 & 1 & 0 \\ -\sin p & 0 & \cos p \end{bmatrix} \tag{2}$$

$$R_z = \begin{bmatrix} \cos y & -\sin y & 0 \\ \sin y & \cos y & 0 \\ 0 & 0 & 1 \end{bmatrix} \tag{3}$$

In addition, Euler angles can also be interconverted with quaternions, Euler angles to quaternions and quaternions to Euler angles are denoted as:

$$\begin{bmatrix} q_0 \\ q_1 \\ q_2 \\ q_3 \end{bmatrix} = \begin{bmatrix} \cos\frac{r}{2}\times\cos\frac{p}{2}\times\cos\frac{y}{2} \\ \sin\frac{r}{2}\times\cos\frac{p}{2}\times\cos\frac{y}{2} \\ \cos\frac{r}{2}\times\sin\frac{p}{2}\times\cos\frac{y}{2} \\ \cos\frac{r}{2}\times\cos\frac{p}{2}\sin\frac{y}{2} \end{bmatrix} + \begin{bmatrix} \sin\frac{r}{2}\times\cos\frac{p}{2}\times\cos\frac{y}{2} \\ -\cos\frac{r}{2}\times\sin\frac{p}{2}\times\sin\frac{y}{2} \\ \sin\frac{r}{2}\times\cos\frac{p}{2}\times\sin\frac{y}{2} \\ -\sin\frac{r}{2}\times\sin\frac{p}{2}\cos\frac{y}{2} \end{bmatrix} \tag{4}$$

$$\begin{bmatrix} r \\ p \\ y \end{bmatrix} = \begin{bmatrix} \arctan\frac{2\times(q_0\times q_1+q_2\times q_3)}{1-2\times(q_1^2+q_2^2)} \\ \arcsin(2\times(q_0\times q_2-q_3\times q_1)) \\ \arctan\frac{2\times(q_0\times q_3+q_1\times q_2)}{1-2\times(q_2^2+q_3^2)} \end{bmatrix} \tag{5}$$

3.2 Attitude solving algorithm

The essence of attitude solving is to solve the orientation between coordinate systems through coordinate transformation, which is described by the rotation matrix, and to update the rotation matrix during the transformation process so as to solve the attitude.

The purpose of attitude solving is to recognize the coordinate transformation at different moments, update the attitude matrix, and determine the carrier's attitude and other information. Therefore, how to accurately update the attitude matrix in the process of carrier attitude change becomes the key to attitude solving. The following will analyze the application basis of the current, more popular attitude updating methods [27-28].

1) Euler angle method

If the gyroscope output is expressed as $\omega_b = [\omega_x \quad \omega_y \quad \omega_z]^T$ using the angular velocity vector, and the Euler angle method is used to update the solution to the motion carrier attitude change process. Then, the relationship between ω_b and the attitude angular velocity $\dot{\phi}$, $\dot{\theta}$, $\dot{\gamma}$ can be expressed as:

$$\begin{bmatrix} \omega_x \\ \omega_y \\ \omega_z \end{bmatrix} = C(\phi)C(\theta)\begin{bmatrix} 0 \\ 0 \\ \dot{\psi} \end{bmatrix} + C(\phi)\begin{bmatrix} \dot{\theta} \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 0 \\ \dot{\phi} \\ 0 \end{bmatrix} \tag{6}$$

The Euler angular differential equation is obtained from the above equation:

$$\begin{bmatrix} \dot{\theta} \\ \dot{\phi} \\ \dot{\psi} \end{bmatrix} = \frac{1}{\cos\theta}\begin{bmatrix} \cos\theta & \sin\phi\sin\theta & \cos\phi\tan\theta \\ 0 & \cos\phi\cos\theta & -\sin\phi\cos\theta \\ 0 & \sin\phi & \cos\phi \end{bmatrix}\begin{bmatrix} \omega_x \\ \omega_y \\ \omega_z \end{bmatrix} \tag{7}$$

Since the actual outputs of the carrier's gyroscopes are all in the b-series, they are converted to the n-series and the differential equation is solved to obtain the carrier's attitude angle.

2) Quaternion Method

Because the relative rotation relationship of a coordinate system expressed by quaternions implies the magnitude and direction of the rotation angle as well as the axis of rotation, it is able to skillfully describe the rotation relationship of a moving coordinate system with respect to a fixed coordinate system, and it is gradually becoming well known.

In geometric mathematics, quaternion is defined as:

$$Q(q_0,q_1,q_2,q_3)=q_0+q_1 i+q_2 j+q_3 k=\cos\left(\frac{\alpha}{2}\right)+u\sin\left(\frac{\alpha}{2}\right) \tag{8}$$

Where is q_0, q_1, q_2, q_3 are real numbers, α is the equivalent rotation angle of the rigid body, u is the rotation axis, i, j, k are mutually orthogonal unit vectors. If $\|Q\|=1$, the quaternions are called canonical quaternions.

When describing the rotation of the system b with respect to the system n in terms of quaternions, it can be expressed according to the law of multiplication of quaternions as:

$$C_n^b=\begin{bmatrix} q_0^2+q_1^2-q_2^2-q_3^2 & 2(q_1q_2+q_0q_3) & 2(q_1q_3-q_0q_2) \\ 2(q_1q_2-q_0q_3) & q_0^2-q_1^2+q_2^2-q_3^2 & 2(q_2q_3+q_0q_1) \\ 2(q_1q_3+q_0q_2) & 2(q_2q_3-q_0q_1) & q_0^2-q_1^2-q_2^2+q_3^2 \end{bmatrix} \tag{9}$$

And quaternionic differential equations:

$$\dot{Q}=\frac{1}{2}Q\otimes\omega_{nb}^b=\frac{1}{2}M(\omega_{nb}^b)Q \tag{10}$$

Among them:

$$M(\omega_{nb}^b)=\begin{bmatrix} 0 & -\omega_x & -\omega_x & -\omega_x \\ \omega_x & 0 & \omega_z & -\omega_y \\ \omega_y & -\omega_z & 0 & \omega_x \\ \omega_z & \omega_y & -\omega_x & 0 \end{bmatrix} \tag{11}$$

where ω_x, ω_y, and ω_z denote the three-axis angular velocity measurements of the gyroscope.

From this, the quadratic differential equation can be written as:

$$\dot{Q}=\begin{bmatrix} \dot{q}_0 \\ \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \end{bmatrix}=\frac{1}{2}\begin{bmatrix} 0 & -\omega_x & -\omega_x & -\omega_x \\ \omega_x & 0 & \omega_z & -\omega_y \\ \omega_y & -\omega_z & 0 & \omega_x \\ \omega_z & \omega_y & -\omega_x & 0 \end{bmatrix}\begin{bmatrix} q_0 \\ q_1 \\ q_2 \\ q_3 \end{bmatrix} \tag{12}$$

In the attitude solution process, the differential equations are first solved, then the quaternions are updated using the gyroscope measurements, thus updating the attitude matrix, and finally, the real-time attitude is solved based on the attitude matrix.

3.3 Action Matching Algorithm

After clarifying the key action postures of long jump to be evaluated in the previous section, this section of the study uses a matching algorithm to extract the key frames from the tennis sports video to be tested, including the three action posture key frames of jumping, hitting, and landing, and is used for the subsequent posture evaluation. In this paper, the BlazePose human pose estimation algorithm is used to detect the joint points of the athletes and match them based on the coordinates of the joint points as well as features such as the joint pinch angle in comparison with the standard poses established in the previous section.

Therefore, in this paper, we use the weighted Euclidean distance for similarity calculation and set different weights for different eigenangles. Assuming that the eigenangle vector of the pose to be measured is $p^{(i)} = (p_1^{(i)}, p_2^{(i)}, \ldots, p_n^{(i)})$ and the corresponding eigenangle vector of the standard pose is $q^{(i)} = (q_1^{(i)}, q_2^{(i)}, \ldots, q_n^{(i)})$, the weighted Euclidean distance $d_\theta^{(i)}$ is:

$$d_\theta^{(i)} = \sqrt{\sum_{j=1}^{n} \omega_j^{(i)} (p_j^{(i)} - q_j^{(i)})^2} \tag{13}$$

Where $i = 1, 2, 3$, 1 denotes the jumping stance, 2 denotes the hip spreading stance, 3 denotes the stomaching stance, $p^{(i)}$ and $q^{(i)}$ denote the eigenangle vectors of the corresponding stances, $d_\theta^{(1)}$ is the weighted Euclidean distance between the jumping eigenangle of the stance to be tested and the corresponding standard jumping stance eigenangle. $d_\theta^{(2)}$ is the weighted Euclidean distance between the stance jerk eigenangle and the corresponding standard stance jerk eigenangle, $d_\theta^{(3)}$ is the weighted Euclidean distance between the stance tuck eigenangle and the corresponding standard tuck eigenangle. n denotes the number of eigenangles, and $\omega_j^{(i)}$ denotes the weight of the j th eigenangle of stance i [29-30].

In order to improve the accuracy of the matching, this paper sets the threshold value $t^{(i)}$, and calculates the cosine distance between the coordinate vectors of all key points of the to-be-tested poses and the coordinate vectors of the key points of the corresponding standard poses for $d_\theta^{(i)} < t^{(i)}$. Assuming that the coordinate vector of the to-be-tested pose is $\vec{p}_t = (x_1, y_1, x_2, y_2, \ldots, x_n, y_n)$ and the coordinate vector of the standard pose is $\vec{p}_s = (x_1', y_1', x_2', y_2', \ldots, x_n', y_n')$, the cosine distance between the coordinate vectors of the to-be-tested pose and the standard pose is:

$$d_{cos} = 1 - \frac{\vec{p}_s \cdot \vec{p}_t}{|\vec{p}_s||\vec{p}_t|} \tag{14}$$

Since the attitude to be measured and the standard attitude are in different coordinate systems, all coordinate points of the attitude to be measured, and the standard attitude is normalized before calculating the cosine distance in order to make them have the same magnitude and comparable. For each coordinate point (x, y) in the original coordinate system, it is normalized to (x', y'):

$$\begin{cases} x' = \dfrac{x}{\max(X)} \\ y' = \dfrac{y}{\max(Y)} \end{cases} \tag{15}$$

Where $\max(X)$ and $\max(Y)$ are the maximum values of the horizontal and vertical coordinates of all coordinate points in the original coordinate system, respectively.

The combined distance between the to-be-measured attitude and the standard attitude is obtained by considering the eigenangle Euclidean distance of the to-be-measured attitude and the vector cosine distance of the coordinate points d . then:

$$d^{(i)} = \mu_i d_{\theta}^{(i)} + \rho_i d_{cos}^{(i)} \tag{16}$$

Where μ_i and ρ_i are the coefficient weights for matching the corresponding action gestures, and $\min(d^{(i)})$ is taken as the final matching result.

4 College tennis technical movement training strategy design

In order to better formulate the tennis technical movement training strategy for colleges and universities, this paper proposes to utilize the task-driven teaching method to conduct tennis movement training. For the effectiveness of the teaching method for the relevant research objects and teaching experiments set, for colleges and universities to further improve the tennis technical movement training teaching ability to provide reference.

4.1 Research Objects and Methodology

1) Research object

This paper takes the effectiveness of the application of task-driven teaching strategy in tennis technical movement training as the research object.

2) Research Methods

(1) Literature method

Based on the research needs of this paper, we utilize the China Knowledge Network Database, Wipo Database, Wanfang Database, etc., to carry out relevant literature with keywords such as “teaching effectiveness”, “task-driven teaching method”, “tennis”, “experimental research”, etc. “experimental research” and other keywords for relevant literature search. Checked the research on physical education teaching in the past two decades, organized the relevant content and academic views and other subject knowledge, after analysis and summary, laid a solid theoretical foundation for the practical research of this paper.

(2) Questionnaire method

Designed a questionnaire on the basic situation of the students, which was distributed to the students for the survey before the experiment and was collected immediately after the students filled it out. A questionnaire on teaching effect was designed and distributed to the students in the experimental group at the end of the post-test after the experiment, and it was immediately recovered after it was filled out. To ensure the reliability of the teaching effect questionnaire, the retest method was used, and the questionnaire was distributed again 15 days after the first distribution of the questionnaire. The results of the two measurements were tested to be highly correlated with a correlation coefficient of 0.913.

(3) Teaching experimental method

Select the N province A university in the 2021 grade tennis elective students in the simple physical fitness, ball sense test, in the two smaller deviations of the class to extract the results of the smaller deviation of the 60 students, 30 students as the experimental group to adopt the task-driven teaching mode, 30 students as a control group using the traditional mode of teaching, for a period of 20 hours of teaching experiments, from the technical action of the serve, the technical level of normative The experimental effect was evaluated comprehensively in many aspects, and the conclusion was finally drawn.

(4) Mathematical statistics

Using EXCEL statistical software and SPSS software to process and analyze the data obtained from the tests before and after the experiment, on the one hand, the data of the experimental group and the control group before and after the experiment were respectively subjected to paired samples T-test, vertically comparing the experimental subjects before and after the experiment to see if there is any significant difference between the groups. On the other hand, independent sample t-tests were conducted on the data of the experimental group and the control group after the experiment to verify horizontally whether there were intergroup significant differences between the two groups of experimental subjects so as to improve the scientific and effective data support for this study.

4.2 Experimental design of task-driven pedagogy

1) Experimental hypothesis

In the teaching experiment, the task-driven teaching method and traditional teaching method were applied to teach students in the experimental group and the control group, respectively, to verify whether the task-driven teaching method is more suitable for the teaching of tennis technical movement training in colleges and universities than the traditional teaching method and can improve the teaching efficiency. Based on the research of scholars on the impact of task-driven teaching methods on students' physical fitness, learning motivation, skill mastery and course satisfaction, the study puts forward the following experimental hypotheses:

H1: After the experiment, the physical fitness of the students in the experimental group was significantly improved compared to the control group.

H2: After the experiment, there is a significant improvement in the skill level of the students in the experimental group compared to the control group.

H3: After the experiment, there is a significant improvement in the learning motivation of the students in the experimental group compared to the control group.

H4: After the experiment, students in the experimental group were more satisfied with the course than the control group.

2) Experimental purpose

Through scientific and reasonable experimental design, to verify the impact of task-driven teaching method on improving the tennis learning interest, physical quality and tennis skill evaluation of college tennis technical movement training students, so as to enrich the teaching methods and means of tennis classroom, improve the students' tennis learning interest, physical quality and tennis special technical ability, and improve the teaching effect of tennis classroom.

3) Specific process of task-driven teaching

The traditional teaching method consists of teachers explaining and demonstrating, students imitating and practicing, teachers correcting the link, and finally, carrying out the corresponding summary evaluation. This paper is based on the task-driven teaching method of the technical movement training strategy process, as shown in Figure 2.

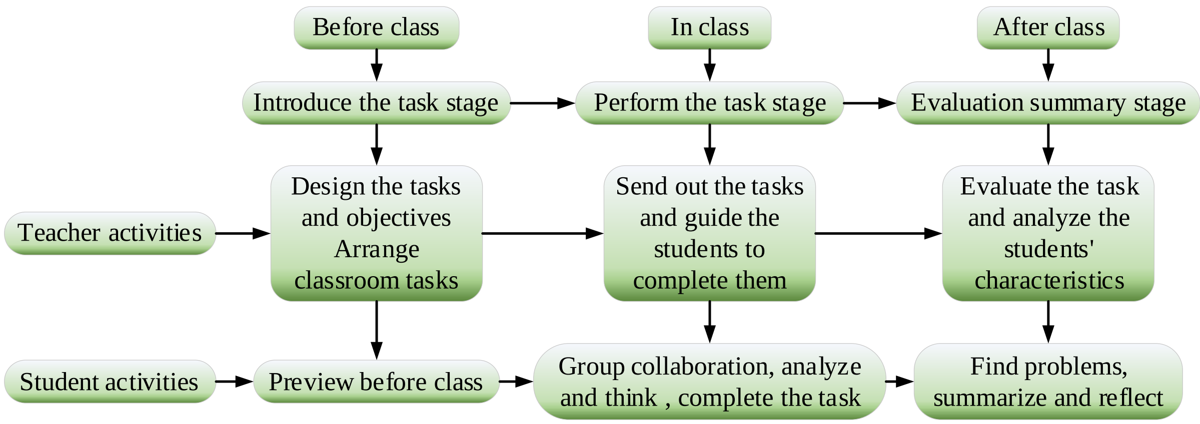


Figure 2. Task-driven teaching specific process

5 Analysis of the application of technical movement training strategies in college tennis

Under the background of big data technology, more and more colleges and universities have set up tennis technology courses, through which students' physical quality can be improved and their tennis technology level can be enhanced. Task-driven teaching method has become a very effective method of teaching tennis technology, which can reduce the difficulty of students learning tennis technology in the early stage and enhance students' interest in learning tennis as well as enthusiasm so that students can quickly master the basic technical movements of tennis. This chapter focuses on the tennis technical movement technology given in the previous section and analyzes the effectiveness of the application of the tennis technical movement training strategy based on the task-driven teaching method in order to further improve the tennis technical movement training in colleges and universities to provide a research basis.

5.1 Forehand Interceptor Technique Integral Myoelectricity

For the training of tennis technical movements in colleges and universities, this paper utilizes the algorithms of attitude solving and movement matching to realize the decomposition of movements, and utilizes motion capture to realize the testing of muscle initiation of tennis technical movements. The forehand interception stroke is mainly divided into four stages: preparation posture, pad step to lead the racket, swing to hit the racket and follow the ball to follow the swing, which is divided into four stages: starting, leading the racket, hitting the racket, and following the swing. It is meant to be tested by various athletes in Level 1 and Level 2 groups. The starting phase's EMG characteristics will be analyzed in this section.

Figure 3 shows the relevant contribution of each muscle during the starting phase for different levels of athletes. During the training of tennis technical movements, the comparison was made for the right anterior deltoid (M1), left posterior deltoid (M2), right pectoralis major (M3), right biceps brachii (M4), right triceps brachii (M5), right brachioradialis (M6), and right ulnar carpal flexor (M7), respectively.

From the results of the comparison of the relevant contribution of each muscle under the starting phase, the contribution of the right anterior deltoid and the right brachioradialis of the Division I athletes during the starting phase was 14.02% and 19.35%, respectively, which were 2.01% higher and 26.47% lower than the relevant characteristics of the Division II athletes. The muscles in group I and group II had a maximum EMG integral of 32.91uV.s and 87.91uV.s, respectively. There was a significant difference between the athletes of two different levels in the starting stage, and the method given in this paper can obtain the muscular movement of the athletes in the process of exercise, which is a more intuitive understanding of the athletes' power movements, and provides data support for improving the athletes' tennis technical level to provide data support.

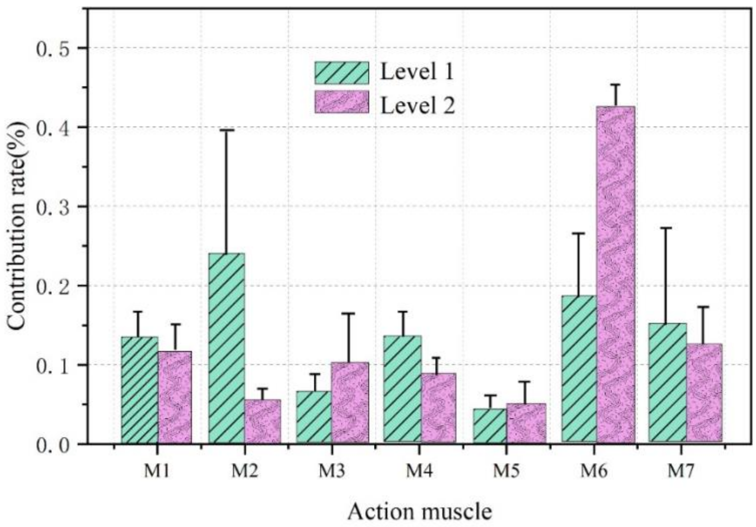
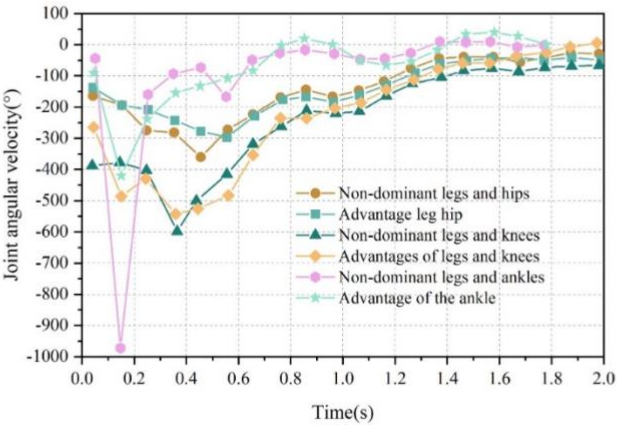


Figure 3. Muscle contribution rate in the preparation stage

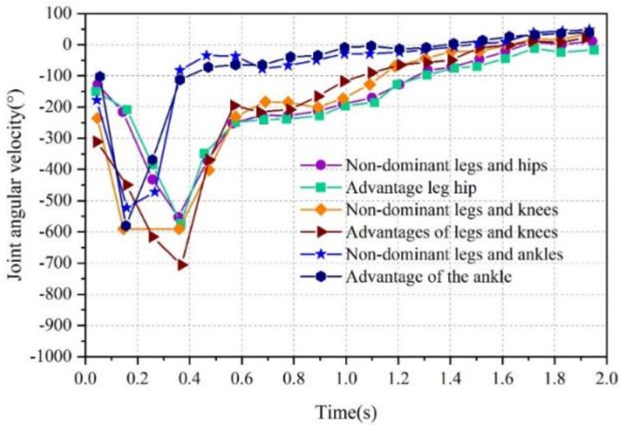
5.2 Joint angular velocities of tennis movements

Players' technical level can be partially reflected by their ability to master joint angular velocity in tennis movement. In this paper, the angular velocity parameters of three different landing methods were selected for experimental study from the moment of landing to the time of landing and stabilization. The three different landing methods are forward tilt landing, normal landing and backward tilt landing, respectively, for the non-dominant leg and the dominant leg of the selected lower limb hip, knee and ankle joint angles to carry out experiments. The results of the joint angular velocity experiments at different angles are shown in Figure 4. Figures 4(a), (b), and (c) show the angular velocities of different joints during forward-leaning landing, normal landing, and backward-leaning landing modes, respectively.

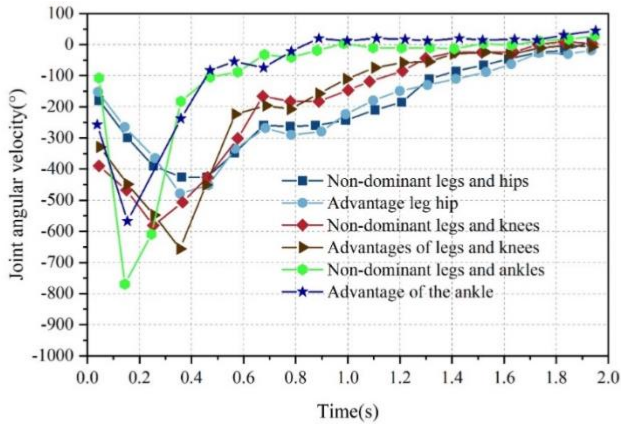
In this process, the angular velocities of all three joints increased first and then decreased, and the time sequence of the maximum value was "ankle-knee-hip". The maximum angular velocity of the three joints in all landing modes was the ankle, with an angular velocity of 645.23±189.42°/s, and the minimum was the hip, with 461.87±115.08°/s. However, the standard deviation of the ankle was a maximum ±189.42, and the minimum was ±34.58. 115.08°/s, but the standard deviation was ±189.42 for the ankle joint and ±34.58 for the knee joint. In comparing the dominant and non-dominant leg, it was found that the anterior and posterior landings of the hip and knee joints showed significant differences between the dominant and non-dominant leg. Whereas, anterior and posterior tilt landing styles of ankle joints showed a highly significant difference between dominant and non-dominant legs at a 1% level. In comparing the three landing styles, it was found that the standard deviation of the maximum angular velocity values of the hip, knee and ankle joints was found to be the largest to the smallest for the anterior tilt landing style, the posterior tilt landing style, and the normal landing style, with values of ±245.64, ±124.35, and ±36.97, respectively, and the maximum angular velocity values of the three joints in the normal landing style were the closest to each other. In the three landing modes, there were very significant differences between the hip joints of both legs and the other two modes, the same situation for the non-dominant leg and the hip joint in the ankle joint, and there were very significant differences between the dominant leg only in the forward-leaning landing mode and the other two modes. In the knee joint, only the dominant leg showed a significant difference between the anterior tilt landing approach and the other two approaches. In tennis, the use of the dominant leg in the forward tilting landing position enables the acquisition of greater joint angular velocities, which in turn leads to a better-hitting force.



(a) Forward fall to the ground



(b) Normal landing



(c) Back to the ground

Figure 4. Joint angular velocity changes

6 Conclusion

Tennis is one of the most popular sports in the world today, and it also enjoys the reputation as a “noble sport”, “civilized sport”, “elegant sport” and so on. The development of big data technology also provides a new opportunity for the optimization of tennis technical movement training strategy in colleges and universities. In this paper, we start with the tennis technical movement representation and matching technology and collect and decompose the tennis technical movements through technical means so as to provide the basis for exploring the relevant characteristics of tennis technical movements. Based on the task-driven teaching method, the tennis technical movement training strategy for colleges and universities is constructed, and the specific tennis technical movement training design is given. To verify the effectiveness of the tennis technical movement training strategy constructed in this paper, the teaching effect was analyzed. The maximum value of the EMG integral of the athletes in group I was 32.91uV.s, and the maximum value of the EMG integral of the athletes in group II was 87.91uV.s. The maximum angular velocity of the three joints of “ankle-knee-hip” in tennis technical movements was the ankle joint, and its angular velocity was 645.23±189.42°/s, and its angular velocity was 645.23±189.42°/s, and its angular velocity was 189.42°/s, and its angular velocity was 645.23±189.42°/s. 189.42°/s, and the smallest is the hip joint with an angular velocity of 461.87±115.08°/s. Through the task-driven teaching method, the training strategy of the tennis technical movement can effectively improve the students’ level of hitting and serving in tennis, and can further improve the students’ tennis skills.

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