Speed Skating Technical Training Based on Sports Biomechanics

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Objectives: With the vigorous development of China's sports industry, sports industry has displayed its own sports spirit on the world stage, especially in the speed skating sports.Methods: The combination of sports biomechanics and speed skating training not only helps to improve our speed skating level, but also helps to inherit the tradition of combining sports theory and practice in our country. Results:The speed skating technique based on sports biomechanics can use the knowledge of biomechanics to combine speed skating with mechanical system better.Conclusion: The high-speed camera can be used to collect the players' training, and the frame rate adjustment function of the computer can be used for frame by frame analysis to ensure the posture correctness of the speed skaters.

Keywords:speed skating; biomechanics; image analysis; research
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With the continuous improvement of China's comprehensive national strength, China's sports industry has been booming, especially in the speed skating sport. Compared with the previous performance in speed skating, the speed skating team in China has performed very well in the international arena [1]. In the past speed skating technology, China has always paid attention to the role of coaches, and does not emphasize the application of modern mechanics theory in speed skating. Due to excessive emphasis on words and deeds, our speed skating technique have not been effectively improved, which further limits the upgrading of China's speed skating technique [2].

At present, most of the sports in the world have the form of sports biomechanics, and the application of sports biomechanics in speed skating is one of the keys to the improvement of the speed skating technology in China [3]. Through the above analysis, this paper takes speed skating as an example, combines sports biomechanics with speed skating technology, uses high-speed camera to track the athletes throughout the process, and captures the movements of athletes and uses the special frame rate display function of the computer. The frame difference method is used to analyze the bones and input them into the database. A specific algorithm is used for video cutting, analysis, integration and display in the computer interface. The computer interface consists of a computer model of each joint point. Finally, the obtained data is compared with the standard action which has been inputted in the 3D database, and the scoring system is used to score the movements of the athletes. With intuitive scoring to each athlete, it can effectively avoid the wrong action, and then improve the level of competition [4].

Compared with other sports, speed skating is a new sport, which has not been long in the

international arena. However, because of its strong competition and high ornamental, it has set off a boom in the world rapidly [5]. The speed skating competition doesn't have a long time. But in just a few minutes, it will make people feel very strong competition, and make people feel excited. In addition, it can also convey the strong connotation of this competitive sport [6]. In this paper, the speed skating technical training is studied from the aspect of sports biomechanics. In view of the fact that the speed skating movement is generally demanding, the guiding positions of the coaches in the past are abandoned, which makes the movement truly go to science. With the help of modern science and technology, it really makes it scientific [7].

In the process of speed skating, high-speed video camera is used to capture the video, and the excellent algorithm is used to analyze the movement of the computer and find out the lifting space of the movement from the scientific level [8]. In the algorithm analysis, it uses the measured node data to analyze it, and finds the specific action node. The local locking method is used to lock the motion track of the athlete, and the 3D model is displayed in front of the user [9]. The development of modern science has been applied in all walks of life, and has achieved great results. The application of sports biomechanics in speed skating technology makes the combination of theory and practice, and realizes the improvement of speed skating sports level [10].

METHODS

Construction of Speed Skating Skill Training Algorithm Based on Sports Biomechanics

According to the theory of biomechanics, the algorithm of speed skating is constructed. The model of speed skating is constructed by frame difference fixed value algorithm, and the 3D model is created for each skater's movements. In the process of building a 3D model, the algorithm geometry is used to analyze the geometric construction of athletes' movements, in order to make the movement of each skeleton node of athletes be within the scope of computer model building, and enable the user to accurately compare the athletes' movements with the standard movements. After the construction of the 3D model, the model is analyzed from the point of view of fractal dimension. The system provides an action score evaluation system, divides each action of athletes and makes effective scoring, and classifies them systematically, which tries to make them abandon the traditional rough evaluation system and describes more accurately the athletes' competitive situation.

In the process of constructing the model, the optimized association algorithm is used. The speed skaters' leg movements and swing arm movements are captured by high-speed cameras and added to the 3D database. A three-dimensional model based on sports biomechanics is generated from the 3D database based on the skeleton and joint points of each athlete. By using the general item to sub item framework model, the whole body information file is established for each athlete. The concrete algorithm is carried out by the following method:

$$Ri = \frac{\sqrt{\alpha^2 - (\beta - 1)^2}}{(\lambda - 1)^2} - \frac{\sqrt{(\beta - 1)^2}}{(\lambda - 0.5)^2} \quad (1)$$

According to the basic data generated by the high-speed camera, the correlation algorithm is used to connect the influencing factors of speed skating model. R represents the amount of joint points designed for action; α, β and λ represent the amount of joint points in the motion components of each speed skating sport. At the beginning of the design, the design of joint point design amount is obtained. Through computer analysis, the total amount is obtained.

$$Q(Ri) = \sum_{i-1}^{A} a_i^2 + \sum_{i-1}^{B} b_i^2 + \sum_{i-1}^{C} C_i^2 \quad (2)$$

In the above formula, Q represents the total design amount of the skeleton joint points after the optimization of the generated 3D model using the algorithm, that is, the total number of joint points of the action skeleton generated by the 3D model generated by the algorithm. A, B and C stand for dimension coefficients, respectively; a, b and c represent the starting points of the joint design of the interval. Through the joint operation, the optimal solution of all the units is obtained.

$$RX = S \times CX \times P \times V^2 \quad (3)$$

Where, RX stands for resistance; S represents the cross-sectional area of the body; CX represents the drag coefficient on the windward side of the body; P stands for air density; V^2 represents the square of the velocity relative to the air.

In three dimensions, the body's tilt angle is constructed with the following three equations:

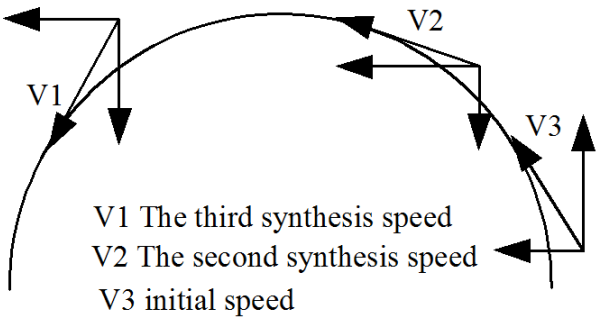
$$\tan a = \frac{A \Delta \alpha}{\lambda} \quad (4)$$

$$\tan b = \frac{B \Delta \beta}{\eta} \quad (5)$$

$$\tan c = \frac{C \Delta \gamma}{\varsigma} \quad (6)$$

After the above formula is calculated, the basic data of speed skating training can be obtained by computer. According to the model, the data structure optimization analysis is carried out, and the optimization is carried out according to the relevance algorithm. The principle structure of the model is shown as follows:

Figure 1
Optimization of the Selection Process of Basketball Training Design Algorithm



Through the construction of the speed skating technical training model based on sports biomechanics, a training model has been initially constructed. On this basis, the trainer can input the training action captured by the high-speed camera into the 3D database to simulate the 3D simulation, perform standard motion comparison, and feedback the information to the trainer to make sure the difference between the training action and the standard action, and correct the action in the future training process. The speed skating technical training model based on sports biomechanics is not only simple to capture the training data of the trainer, but put it into the database. The system has the function of self-study. The big data processing function is used to integrate the trainer's daily training action, and show the strong and weak items of the trainers through the visualization technology. Based on its powerful data processing ability, the training effect that the trainer wants to achieve is input into the database. After the above series of algorithms, the action that can achieve this training effect is extracted from the database. The algorithm is used to integrate and modify the angle of action and other technical means to carry out the innovation of action. Combined with the physical condition of the trainer, it is practical and predictable. Based on the physical condition of the trainer, the time for reaching the training effect is predicted.

Analysis of Speed Skating Training Model Based on Sports Biomechanics

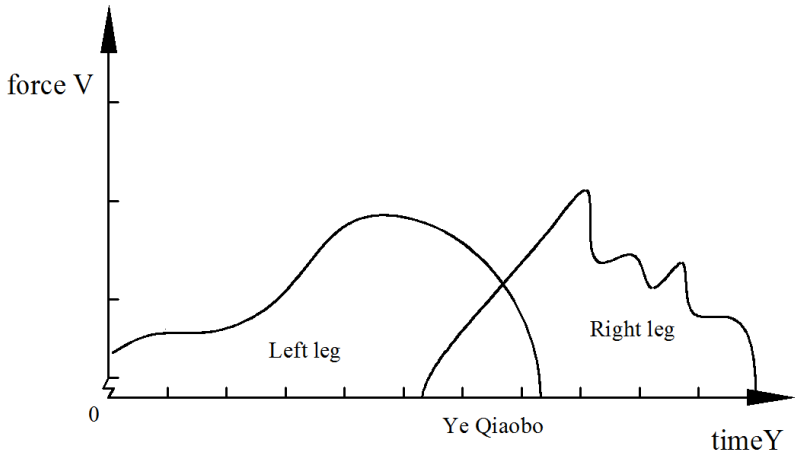
In the above text, the algorithm of speed skating is constructed based on sports biomechanics. Computer analysis is carried out by using excellent algorithm, and imported into the 3D database. Compared with standard motion of speed skating, 3D model is generated. This model designs each movement of the athlete's body in the speed skating process, and decomposes the action into the node. It tries to make every joint point of the trainer in the model, and generate the algorithm. The model is applied to the speed skating process. The athletes are well received and the training efficiency is improved. The future sports field is closely related to science and technology and sports, and sports talent is the future of national sports. The construction of speed skating training model based on sports biomechanics has effectively solved the problems of nonstandard speed skating movement and poor training effect in China. After the 3D model is generated, the system will automatically compare the 3D model with the standard 3D model in the data. The algorithm is used to analyze the difference between athletes' movements and standard movements and make a comparative score, so that trainers can quickly find out their shortcomings and improve their speed skating skills.

Table1
Speed Skating Training Scale

	Waist movement	Leg movement	Swing arm movement
Primary training	4.1	4.5	4.6
Intermediate training	3.9	3.8	3.7
Advanced training	3.4	3.2	3.1

Because most players use the State Sports Bureau website for the usual training and watching the big game, the evaluation system of this model is built in the website of the National Sports Bureau, and the model evaluation system is related to the athlete's account number in the National Sports Bureau. Players can log in directly to their own accounts at the National Sports Bureau and enter their own passwords. Because athletes are familiar with this site, it saves time and cost, which can better leave the time to the usual training. The force system analysis of the evaluation system is shown in the following figure.

Figure 2
Measurement System Analysis of Evaluation System



Through the above construction of atlas of the evaluation system, it is known that the evaluation system not only has great convenience, but also reflects the sport training level is a three-dimensional model based on the actual trainer training action. During the construction of the model, the algorithm is used to classify and encode the training action input from athletes, and the basic data of athletes are generated. The data will become part of the evaluation system of athletes' training effect in the future, which is easy for instructors to analyze the results of athletes at ordinary times. It puts forward the corresponding training plan according to students' aptitude, tailors their own training methods for each athlete, and improves their training level.

RESULTS

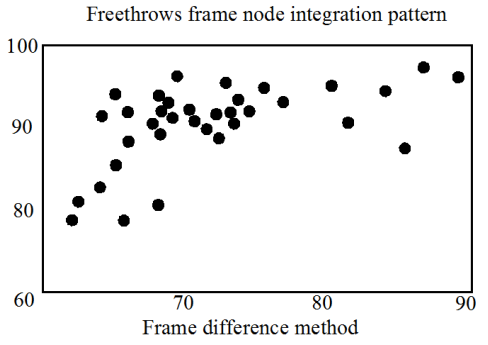
After the establishment of the speed skating sports training model based on sports biology, the swing arm and leg movement test of the motion joint point are carried out by Dartfish. The accuracy of the algorithm is tested by using the program. The test site is selected in the speed skating standard arena, and the real simulation is used to ensure the accuracy of the test. In order to make the experiment barrier free, the frame algorithm required by the model construction is related to the arm movement and leg action algorithm in speed skating. Firstly, the frame algorithm and speed skating algorithm are used to generate the corresponding relationship. The relationship between the specific framework algorithm and action algorithm is shown in the following table.

Table2
Relationship Between Frame Algorithm and Action Algorithm

	Relationship between frame algorithm and action algorithm				
Factor	Data input value	System processing value	design factor	Accuracy	Action level
Frame algorithm	Q1	0.1	1.2	3.2	1
	Q2	0.6	1.5	2.4	4
	Q3	1.3	2.1	4.2	2
Action algorithm	Q4	1.5	2.3	5.6	3
	Q5	0.3	2.1	4.2	5
	Q6	0.5	0.9	6.3	6

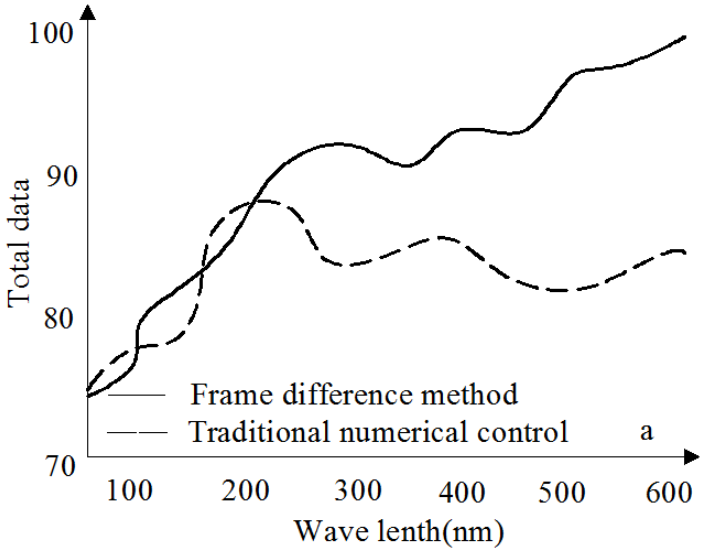
In the process of experiment, high speed camera is used to capture the center of gravity, position, velocity, acceleration, joint angle, angular displacement and angular velocity of athletes participating in the experiment. The performance of the experiment is divided into two kinds of evaluation system: work and endurance. In the process of data processing, a small program is used to random sampling the data stream. The two kinematic algorithms are compared by comparing the kinematic data. The results show that when the data is not enough, the framework algorithm needs relevance algorithm. When the data is medium, the performance of association algorithm is similar to that of traditional framework algorithm. When there are a large number of algorithms in the database, the association algorithm shows excellent performance, and has overcome the traditional framework algorithm with overwhelming superiority. Based on the above test, the huge amount of data training is considered after the model is built. In addition, in the process of testing, when the user requests information, the relevance algorithm is more sensitive to the user's data request. Therefore, the association algorithm is adopted in the model evaluation system. These data can ensure the performance of the system when the amount of data is small. When the amount of data is large, the system performance will be better, and a large amount of data can be transmitted simultaneously.

Figure 3
Optimization of the Relevance Algorithm Generation Model of Basketball Training



The specific algorithm optimization is converted to a two-dimensional chart as shown in the following picture. In the picture, it can be seen clearly that with the increase of the influence of the training effect on the training effect, the standard of the swing arm movement and leg movement does not get obvious interference in the speed skating process. Before using the association algorithm to optimize the motion simulation, it can be seen that the trajectory requirements of the whole algorithm almost linearly increase. It proves that the model does not simulate the athlete's leg movement without the use of association algorithm. The result has some errors, and it has a big gap with the actual experiment. When the relevance algorithm is used instead of the traditional frame algorithm, the request of the athletes' standard action is no longer increased with the increase of the above factors. It shows that the actual effect of the algorithm is consistent with the effect of training in real athletes, which deepens the accuracy of the algorithm, and proves that it can be applied to practice. It can also be seen from the above figure that when the impact factors reach the limit value of the model evaluation system, the optimized relevance algorithm and the traditional frame algorithm are unstable, and gradually deviate from the true value. It shows that the correlation algorithm and the traditional framework algorithm cannot work properly when the influence factors reach a certain value, because the data access amount of the system has reached the limit value of the two algorithms.

Figure 4
New Algorithm Optimization of Basketball Training Relevance Algorithm Generation Model



After analyzing the influence factors of the algorithm, the statistical performance of the traditional algorithm and the correlation algorithm is analyzed as shown in Fig.4. From the graph, it can be seen clearly that the statistical performance of association algorithm is much better than that of traditional frame algorithm, and the association algorithm has incomparable advantages in the time and place of action node. In the figure above, the acceleration of the skater in the speed skating training is evaluated. When the data is small, the accuracy of the two algorithms is almost the same. However, with the increasing number of input action nodes, the traditional association algorithm ability is gradually difficult. When the amount of data reaches a certain extent, the accuracy of the traditional framework algorithm cannot meet the requirements of accuracy. The system exhibits some instability and tends to collapse, but the association algorithm does not have the situation. From the above, it can be proved that the performance of the correlation algorithm is better than the traditional framework algorithm, and the relevance system algorithm is used in the speed skating training model based on sports biomechanics, which undoubtedly improves the accuracy and standardization of the model.

Table 3
Table of Influencing Factors of Training

Speed skating training grade	Wind factor	Acceleration factor	Position factor	Joint angle factor
1	11%	20%	30%	39%
2	15%	21%	32%	22%
3	16%	26%	34%	24%
4	20%	30%	40%	10%

DISCUSSION

Today, the world sports are closely integrated with today's high and new technology, and the construction of speed skating technical training model based on sports biomechanics is essential. Based on sports biomechanics, the optimized relevance algorithm was used in this paper to build the model of speed skating technical training, and applied it to the practice process, so as to improve the effect and level of speed skating training. From the point of view of sports biomechanics, the speed skating training was studied and analyzed. The analysis model was successfully constructed, so as to provide a theoretical and practical sample for the latecomers. In the next step, it is necessary to continue to study how to apply 3D visualization technology to sports training, and strive for greater practical breakthroughs in key technology research and system development. In this way, advanced technology training tools and means can be provided for college sports training, so as to ensure the excellent physical quality of college students, and make better use of their own knowledge advantages for society and the country, as their own contribution. At the same time, it is needed to continue to study how to combine sports biomechanics with other sports, strive for using the model constructed in this paper in other sports, and provide a powerful auxiliary training system for the current sports workers.

Human Subjects Approval Statement

This paper did not include human subjects.

Conflict of Interest Disclosure Statement

None declared.

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