Research on Computer Numerical Simulation System and Information Digitization Using Competition and Confrontation Network

Liangyu Wang1, *
1Basic Courses Department of Shenyang Institute of Technology, Fushun, China
*Corresponding author: liangyuwang@situ.edu.cn

Abstract. The competitive characteristics and training requirements of each event group that can dominate the category of difficult and beautiful performance of technical warfare have multi-dimensional similarities. From the aspects of competition characteristics, determinants of sports performance, structural characteristics of competitive ability, and training requirements, it analyses the antagonistic event group that can dominate the class of technical warfare, and puts forward corresponding training requirements. The development of computer simulation technology of human body system will undoubtedly bring unprecedented opportunities to sports training and sports science research, and is changing the mode of sports science research and training. The article uses the confrontation network to conduct competitive sports simulation training, which can carry out the scientific selection of competitive sports athletes, improve the overall training level and effect of competitive sports athletes, optimize, and innovate the technical movement and movement combination arrangement of competitive sports, and can truly construct competitive sports training scenes.

Keywords: Competitive sports, confrontation sports training, simulation system.

1. Introduction
With the popularization of the concepts of "High-tech Olympics", "Digital Olympics" and "Humanistic Olympics" and the rapid development of computer technology in 2008, modern science and technology have penetrated all fields of sports with its strong affinity, especially in athletics. It played a huge role in sports training [1]. The rapid development of the confrontation network has provided a broader space for the application of high-tech in the field of competitive sports. Aiming at Chinese (quasi) advantageous events in the 2008 Beijing Olympic Games-diving, gymnastics, trampoline, sailing, windsurfing and other events, the use of confrontation network for simulation training, to achieve sports training methods based on traditional human observation To the human motion measurement method of high-precision motion capture and analysis; two transformations from the experience-based method to the human motion analysis method of human motion simulation and simulation.

Skills can dominate the net-based antagonistic event group, including table tennis, badminton, tennis, volleyball, speak takraw and shuttlecock, etc., in terms of sports characteristics, competition characteristics, competitive ability characteristics, sports performance determinants and training characteristics. Have multi-dimensional similarities. The research on the competitive characteristics and
training requirements of the antagonistic event group that can dominate the net with technical warfare is of special theoretical value, and can also provide scientific guidance for various special sports training and competitive competition practice.

2. The significance and methods of human body system simulation

System modelling and simulation is to construct a model that is like the real system for the purpose of studying and analysing the system, and then use this model to perform a series of experiments on the system. This process of experimenting on the model is called System Simulation. The modelling and simulation of human body system makes up for the shortcomings of traditional experimental methods such as large individual differences and frequent interference from accidental factors. It shows the superiority that other experimental methods can't match, mainly reflected in the following aspects: 1) Realizable time and space. The expansion and contraction, with forecasting function. Because the scale and time of the simulation are not necessarily the same as the actual space-time scale. 2) Experiments under extreme or abnormal conditions can be realized. At the current level of technology, some real experiments under extreme conditions cannot be implemented. For example, some experiments are harmful to humans, and real human experiments cannot be carried out. The use of models for simulation experiments is not restricted by these extreme conditions, and you can freely investigate the possible responses of the system under various extreme conditions. 3) It can be used as a pre-research method to lay the foundation for the operation of the real system. 4) The simulation experiment can flexibly carry out different combinations of various experimental conditions, looking for the key factors of the problem and the synergy or antagonism between the factors. Generally, there are two methods for modelling and simulation of human body system: 1) Physical simulation or physical simulation. 2) Mathematical simulation. Physical simulation is to construct a solid model according to the nature of the real system, and run this system to perform experiments. In the era when computers have not yet become popular, system simulation mainly refers to physical simulation. Mathematical simulation means that the characteristics of the system are described by mathematical models, and related experiments are carried out on the mathematical models. Now, many complex mathematical problems can be solved by computers [2]. Therefore, mathematical simulation is generally realized by running a computer program, often referred to as computer simulation or digital simulation. Computer simulation has gone through two basic processes between prototype systems. The establishment of the simulation model is shown in Figure 1.

![Figure 1. Competitive sports computer simulation modelling steps](image-url)
3. Establishment of mathematical model of competitive sports human body

In sports, when air resistance is negligible, the human body moves in the air to follow the basic law of conservation of rotational momentum. Therefore, the conservation of rotational momentum has become the most basic equation for simulating athletes' aerial movement. We can obtain the rotational momentum of the diving athlete now of taking off through the kinematic analysis method. After the athlete takes off, he maintains the conservation of rotational momentum from the completion of aerial technical movements to the time he enters the water. In order to study the biomechanics of diving in the air, we established an 11-step model based on the characteristics of diving in the air. The model includes 11 parts: head, upper torso, lower torso, pelvis, left and right upper arms, left and right forearms and hands, left and right thighs, left and right calves, and feet. The links are connected by hinges with different degrees of freedom. The model has a total of 21 degrees of freedom, among which the left and right shoulder joints and the left and right loose joints are connected by 3 degrees of freedom spherical hinges [3]. The left and right elbow joints, left and right knee joints, and neck joints are connected by a column hinge with 1 degree of freedom. The upper and lower torso, lower torso and pelvis are connected by a hinge with 2 degrees of freedom. The angular momentum of a rigid body system relative to its centre of mass can be represented by the sum of a series of functional terms, each of which is a function of relative angular velocity. This result provides a strong theoretical basis for calculating the angular momentum of the multi-chain system. The article assumes that U is all subsequent rigid body combinations of $O_k$, and L is all remaining rigid body combinations including BI.

\[
\mathbf{h} = \mathbf{h}_g + \sum_i \mathbf{h}_i^g
\]  \hspace{1cm} (1)

\[
\mathbf{h}_i^g = I_{ij} \mathbf{\omega}_j = I_{ij} \mathbf{\omega}_g + I_{ij} \mathbf{\omega}_i
\]  \hspace{1cm} (2)

\[
\mathbf{h}_k^u = I_{uk} \mathbf{\omega}_u + m_u u_f \times (\mathbf{\omega}_u \times u_{ok}) \quad (k = 2, \ldots, 12)
\]  \hspace{1cm} (3)

The above formula shows that the rotational momentum generated by the multi-rigid body system when hinge $O_k$ rotates is only related to the angular velocity $\mathbf{\omega}_u$ at hinge $O_k$, and has nothing to do with other angular velocities.

![Figure 2. The relationship between the displacement and angular velocity vector of joint $O_k$](image)
F is the position of the total centre of gravity. \( \omega_{ul} \) is the rotational angular velocity of U relative to L. \( u_f \) is the position vector of the centre of mass relative to the total centre of mass. \( u_{ok} \) is the position vector of U relative to \( O_k \).

4. Establishment of simulation of sports confrontation network training system

4.1. System structure

The software framework of the system is shown in Figure 3. The data processing layer mainly completes the collection and processing of various data, and transmits this information to other layers. The logic layer completes the logical operation and decision support of various data, including functions such as data logical transportation, trajectory calculation, command control and decision support [4]. The man-machine interface provides various information viewing and operation interfaces. These four levels are connected through a local area network to realize the exchange of information and data.

![Software system structure](image)

**Figure 3.** Software system structure

The system has high requirements for real-time performance, involving many interrupts and threads. Since Windows is not a real-time operating system, this system uses the RTX component of the hard real-time solution based on the Windows operating system developed by Ardency, so that Windows has real-time data response. Ability to provide independent interrupts, fast and accurate timers, and pre-emption of kernel processes.

4.2. Server-side module design

The main function of the server is to receive the information sent by the client in real time and process the information, and send instructions to the client according to the processing result. The server-side program is developed using RTX7.0 SDK, and the development environment is Visual++6.0. Because RTX fully supports standard C, the same hardware I/O and interrupt handling methods as DOS, and the same real-time API usage as Win32, the modules developed based on DOS are very similar to those newly developed in the RTX environment. Good compatibility. The server-side program mainly deals with the real-time calculation of each module of the competitive sports simulation system and the sending and receiving of RT-TCP/IP data between the network servers.
4.3. **Client module design**

The main function of the client is to realize the real-time display of data in the user interface of each client, the data communication between the client and the server, and the real-time three-dimensional display of the surrounding environment of the simulator. The client program adopts C# language and is developed under Visual Studio 2005. Using C# to develop network applications can be based on stream sockets or datagram sockets. Several classes for network communication are used. The IP Host Entry class instance object contains the address-related information of the Internet host, and all public static members are safe for multi-threaded operations [5]. The IP End Point class contains the host and port information required by the application to connect to the service on the host. By combining the host IP address and port number of the service, the IP End Point class forms the connection point to the service. The Up Client class is a C# class that implements UDP communication. It can receive and send data without going through the server. Considering the real-time nature of data exchange, the UDP protocol based on datagram sockets is selected in this system. In this system, each server and client communicate through the UdpClient class.

5. **Competitive sports confrontation training simulation Unpliant**

The sports network confrontation training system developed based on the above design truly reflects the performance of the competitive sports simulation system [6]. Among them, constructing a complex confrontation environment is the difficulty of simulation realization. Figure 4 is a real-time picture of the online simulator, which can display the current sports state parameters of the athletes in real time, and monitor the state data of the athletes in real time.

![Figure 4. Athlete data status monitoring online simulator](image)

The system also realizes the 3D display function of the surrounding environment of the simulator, can display the working status of the competitive sports simulation system network in a complex environment, and can view the aircraft and its environment from different angles. The 3D confrontation situation is shown in Figure 5.
6. Conclusion

This paper discusses the characteristics and principles of the competitive sports confrontation system, puts forward a design method of the competitive sports real-time confrontation simulation system based on the line simulator, and develops and implements the simulation system. Competitive sports simulation confrontation is an effective way to improve combat effectiveness, and it is a hot topic in domestic and foreign research. Through the above analysis, we can be sure that the competitive sports simulation technology based on the confrontation network will play an increasingly important role in the training, competition, recovery, and selection of competitive sports, the competition environment, sports equipment, and sports clothing. Therefore, timely tracking of the development trend of the confrontation network and in-depth study of the confrontation network have important practical significance for the development of competitive sports.

References

[1] Wang, J., Zhao, K., Deng, D., Cao, A., Xie, X., Zhou, Z., ... & Wu, Y. Tac-simur: Tactic-based simulative visual analytics of table tennis. IEEE transactions on visualization and computer graphics, 26(1) (2019) 407-417.

[2] Liang, H. Evaluation of fitness state of sports training based on self-organizing neural network. Neural Computing and Applications, 33(9) (2021) 3953-3965.

[3] Ouarhim, W., Ait-Dahi, M., Bensalah, M. O., El Achaby, M., Rodrigue, D., Bouhfid, R., & Qaiss, A. Characterization and numerical simulation of laminated glass fiber–polyester composites for a prosthetic running blade. Journal of Reinforced Plastics and Composites, 40(3-4) (2021) 118-133.

[4] Pengcheng, G., Xianglin, K., Rusanova, O., Diachenko, A., & Weilong, W. Functional support
of the first part of competitive distance in cyclic sports with endurance ability: rowing materials. Journal of Physical Education and Sport, 20(5) (2020) 2745-2750.

[5] Harper, D. J., Carling, C., & Kiely, J. High-intensity acceleration and deceleration demands in elite team sports competitive match play: a systematic review and meta-analysis of observational studies. Sports Medicine, 49(12) (2019) 1923-1947.

[6] Ren, H. Simulation Analysis of Physical Education Mode Innovation and Process Reconstruction Based on Cognitive Psychology. Journal of Asian Society for Health & Exercise, 1(2) (2019) 71-86.