Virtual simulation in physical education teaching

Jihua Yang

Changchun University of Technology
Jinlin, People's Republic of China

ABSTRACT: Simulation technology is widely used in the field of sports, whereby simulations are made of skills and tactics. It is an important supplementary method for the teaching of physical education (PE), where virtual simulations can be constructed of movements that are, then, used for sports training, as well as in physical education. The application of virtual simulation technology to PE teaching and sports training is explored and described in this article. This virtual system is beneficial for acquiring skills; realising the effective organisation of teaching and training, and for providing a good learning and training environment for the teaching of physical education and sports training.

INTRODUCTION

Computer simulations, with computer graphics technology, can create an attractive 3D model of a system. Users are immersed in a virtual environment and by the use of sensors are able to interact with the virtual environment [1].

Computer simulation technology has developed rapidly in recent years. Initially used by the military for gun control, flight control and missile systems, it is also used now to simulate the orbits of spacecraft and for lunar exploration. It has other applications, including occupational training and other general fields of daily life.

At present, simulation systems have been used to train drivers and pilots. Some companies specialise in the development of simulators that simulate systems in conditions so extreme that a real system would not be risked in such conditions or to simulate systems of high cost, so that the cost of the real system is not incurred [2].

With the development of computer simulation technology, demand has arisen from the sports industry for simulation systems. Both domestic Chinese and foreign scholars have begun to research the use of virtual simulation systems for sports.

TEACHING SPORT SKILLS

Numerous theories exist for dealing with various aspects of learning sport skills, but, there is not one complete theory. The author has set aside the various learning theories in analysing the learning of sports skills in physical education (PE) teaching. The process of mastering sport skills must follow certain rules no matter the speed, efficiency or quality of the learning. As long as students have enough time to study, and there are no physical or intellectual limitations, then, the mastering of sport skills will follow these rules.

There are various phases in the development of sport skills, viz. generalisation, differentiation, consolidation and automation phases. These correspond to the stages of initial formation of the skill, to its consolidation and, then, to the stage of proficiency. Looked at cognitively, the stages represent going from the cognitive orientation to developing the skill, to having a partial skill, to grasping the whole skill and, finally, to the stage of perfecting the skill. Yet another way of stating this is the progress of moving from the stage of roughly grasping an action, to the stage of improving the action, to the stage of consolidation and skilful ability [3].

Fitts and Posner proposed the classical theory of sport skills learning in 1967. In their model, the learning process has three phases: cognitive learning, associating and learning, and automation. In this article, learning sport skills in PE is

divided into three stages: imitation, improvement and automation [3]. Based on these stages, the theory of teaching sport skills was developed, as shown in Table 1.

Table 1: Theory of teaching sport skills.

Stages of forming sport skills	Features	Theoretical underpinning
Learning and imitating sport skills	1. Present the learning content	Theory of meaningful learning (humanism)
	2. Observe the teacher's demonstration; imitate the teacher's action	Theory of observational learning (humanism)
	3. The teacher explains the action	Theory of observational learning (humanism)
Improving sport skills	1. Continuous practice sets up a conditioned reflex	Theory of conditioned reflex (behaviourism)
	2. Observe the movement of peers; improvement and reinforcement	Theory of observational learning (humanism)
	3. Teacher's guidance	Theory of external reinforcement (behaviourism)
	4. Rehearsal and reinforcement; improvement through practice	Theory of self -reinforcement learning (humanism)
Mastering and automation	Master sport skills through practice	Theory of insight learning (humanism)

SIMULATION OF SPORT SKILLS

A simulation is a model of a real system, built using computer technology. It is an experimental model based on the science of a system, its design and control. Computer simulations are used in the field of sports to demonstrate the teaching, aim of the training, the organisation of the training, as well as the athletes' training process. This can be used to analyse, forecast and evaluate a sports system.

The key technique of simulation technology is mathematical modelling and the acquisition of motion data. Virtual reality and simulation technology is playing a more and more important role, which broadens the application of high-technology in the sports field [4]. Modelling the human body is a very important subject, and is actively studied in human engineering, computer graphics, artificial life and biomechanics.

The application of virtual simulation technology in teaching and sports training can create a new training environment, with interaction between the real and virtual environments [5]. It can create a *self-training* teaching environment, which can change the traditional teaching mode, from *depending on teaching to promote training, to teaching to improve practice*.

It is a new training and teaching mode where knowledge and skills are acquired by the interaction with a virtual environment. The application of virtual simulation technology in teaching and sports training can shorten the training time and produce a direct, realistic effect. This can cultivate independent self-training, reduce the funds needed for training and help develop network virtual training.

Motion Capture Technology

A motion capture technology system is used to capture the real-time 3D trajectory of a moving object. The motion capture system is high technology equipment for the accurate measurement of a moving object in 3D space. Its working principle is based on computer graphics. A number of video capturing or recording devices are used to record the moving object (tracker) in the form of images, which are processed by the computer, so as to determine the spatial co-ordinates (X, Y, Z) as a function of time.

The Newton Euler equations are used in determining the motion of an athlete. This requires parameters relating to the linear and rotational motion of the human body producing equations of personalised motion, hence, providing the basis for calculating a real motion. As shown in Figure 1, motion validation and feedback allows a complete 3D simulation.

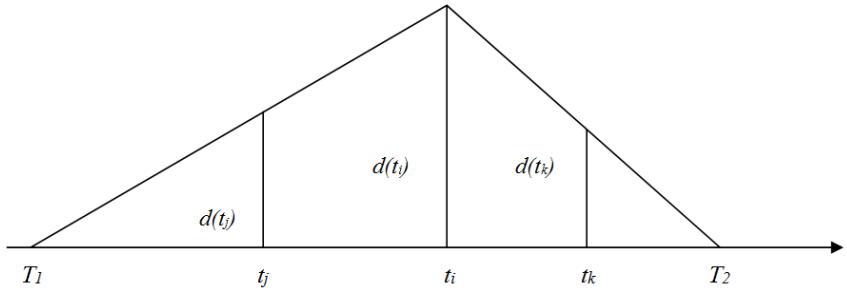

Figure 1: The construction of the offset.

Motion capture technology can catch, for example, the action of basketball players. With knowledge of human physiology and physics, it is possible to produce scientific training; hence, getting rid of subjectivity. Comparing poor performance of athletes with the performance of elite athletes can help the training process and provide an accurate, quantitative basis for scientific training.

Motion capture technology and computer image processing can greatly improve basketball training by providing a quantitative analysis of technical motions. Results can be displayed graphically, including displacements, velocity and forces (see Figure 2). Based on these data, it is possible to determine the ideal action, as well as an athlete's actual movement, providing guidance for athletes by which to improve their technique.

Through the training and comparisons using virtual simulation technology, teachers can evaluate an athlete's skills and point out deficiencies.

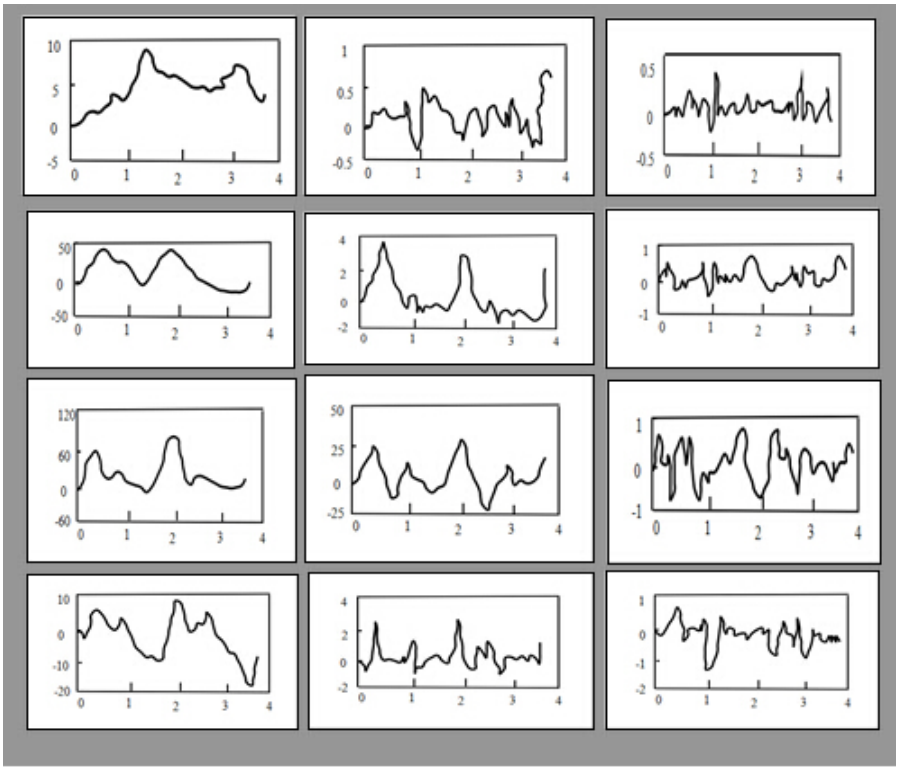

Figure 2: Kinetics data acquired by sports technology capture.

IMPROVING TRAINING USING SIMULATIONS

Available equipment and facilities limit sports teaching and training, e.g. it may not be possible to include driving a car or flying in dangerous situations. Virtual simulation technology as an auxiliary to sports training can allow such training. In modern sports, tactics have become more complicated, which may be difficult for the teachers and athletes to express them clearly in the training process. But, sports tactics can be displayed using virtual simulation technology, which can yield twice the result for half the effort.

Virtualise Individuals

Virtual simulation technology can virtualise historical figures, sports stars, teachers, students, etc, creating a personalised learning environment which, in turn, can create an interesting *fun* training atmosphere [6]. For example, in

a virtual classroom, students can interact with virtual sports stars so as to exchange, discuss and solve problems in learning.

Break the Constraints of Space and Time

Virtual simulation technology can simulate unreachable objects or dangerous places or even non-existent things in nature or real life. This breaks the constraints of time and space. For example, consider freestyle aerial skiing. Even using multimedia the motion is over very quickly and is seen from a fixed location, essentially in two dimensions. But, virtual simulation technology can produce an all-round observation of freestyle aerial skiing from any direction or angle.

Benefit by Sharing Resources of Modern Teaching and Sports Training

Virtual simulation technology can improve the training environment and expand the capabilities of physical education teaching and sports training. Using virtual simulation technology, teaching and training no longer need be confined to a fixed place, but rather the training space and training time can be expanded. This can promote the 'three selves', i.e. self-learning, self-analysis and self-training. Virtual simulation and network technology expands sports training and facilitates resource sharing.

CONCLUSIONS

Although computer technology is mature, the use of simulation technology in sports teaching and training is only just beginning and will continue to develop. However, even now it is clear it can improve a student's practical ability, and greatly enhance the enthusiasm of students for learning.

Simulation technology can also facilitate rehabilitation training among other problems. Simulation systems have played an important role in promoting the teaching of physical education; how to better develop its capabilities requires close co-operation between the computer experts and sport teaching and training experts.

REFERENCES

1. Feng, L.Z. and Chen, J., Motion capture technology application in sports. *J. of Hangzhou Normal University*, 21-23 (2005).
2. Rose, C. and Cohen, M., Multidimensional motion interpolation. *Computer Graphics and Applications,* 18, **5**, 32-40 (1998).
3. Chen, J., Research and development of a multimedia database system for basketball techniques. *J. of Shanghai Sports Institute*, 29-31 (2007).
4. Wang, H.G., *The Principle and Application of Computer Simulation*. National Defense University of Science and Technology Press (2004).
5. Monzani, J.S., Baerlocher, P., Boulic, R. and Thalmann, D., Using an intermediate skeleton and inverse kinematics for motion retargeting. *Computer Graphics Forum*, 19, **3**, 101-121 (2000).
6. Luo, X.D., Virtual reality technology and its application in teaching. *Educ. Technol.*, 53-54 (2003).