Summary of Dynamic System Simulation Technology Based on Computer Simulation Model

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Abstract. The application range of simulation technology and its role in every industry and daily are expanding rapidly. The author discusses the simulation model of computer dynamic system in detail from the concept to the principle and the establishment of the model, and puts forward some specific problems for the verification experiment of simulation technology.

Keywords: Computer, Simulation model, Dynamic system

1. Introduction
Computer simulation is a technique that uses a model to imitate and test the motion process of a real system. The design plan in the project and the plan in the social economy can be verified by simulation test whether the scheme or planning can achieve the desired goal. If the target is not reached, the problem can be detected in time, and the plan or plan can be modified. This saves time and security [1]. For example, in the design process of flight attitude control system, from the beginning of scheme demonstration, to the selection of components, the preliminary design of the system, the detailed design and the various stages of prototype production, technology can be used to achieve the following purpose through simulation experiments.

2. Computer simulation technology
2.1. Concept of computer simulation
Computer simulation refers to the computer as the main tool, running real system or pre-research system simulation model, through the analysis and research of computer output information, to achieve the actual system running state and evolution of the comprehensive evaluation and prediction. It is a technical means to analyze and evaluate the operating state of the existing system or to design and optimize the performance and function of the future system. It has been widely used in engineering design, aerospace, transportation, economic management, vital environment, communication network, and computer integration [2]. Dynamic system computer simulation is a new frontier subject which is based on the theory of system science, computer science, system engineering theory, random network theory, random process theory, probability theory, mathematical statistics and time series analysis. It belongs to the category of technical argumentation. The purpose of dynamic system computer simulation is to obtain the system simulation output and master the basic characteristics of the model by
observing and statistics the running process of the dynamic system simulation model, and to infer the real parameters of the simulated object. In order to obtain the actual performance of the simulation object evaluation or prediction, it has to achieve the real system design and structure improvement or optimization.

Computer simulation technology is the technical means of making real system model by computer, which is used for system evaluation. In particular, the real system is taken as the basis of the simulation model, and through the operation of the specific simulation model and the analysis of the computer output information, the comprehensive evaluation and prediction of the actual system running state and changing law are realized, and then the real system design and structure are improved or optimized.

2.2. Development and application of computer simulation technology

With the rapid progress of computer technology, computer simulation technology is mainly used for system analysis and design, which is applied in many fields. Computer simulation technology, as a technical means, can objectively analyze the running state of the existing system and evaluate the performance of the existing design system, plays an extremely important role in the development of many fields. It can be said that computer simulation technology has become an indispensable technical means for systematic analysis and research in modern and high-tech industries. Because in the actual operation process, it is necessary to select the appropriate computer type according to the actual situation, so according to the computer type used in the simulation process and the development process of computer simulation technology, the categories of computer simulation technology can be divided into analog machine simulation, digital machine simulation and analog digital mixer simulation.

Computer simulation technology rose in the 1950s, the simulation computer is the main computer simulation technology used at that time, its working principle is: under the premise of clear mathematical model of simulation system, a simulation circuit is established through a series of operators and passive devices, and later experimental research is carried out through this simulation circuit. However, with the rapid development of computer digitization, in the late 1960s, computer simulation technology began to change from analog form to digital computer simulation. However, the development of large-scale complex systems, such as aerospace, puts forward higher requirements for computer simulation technology, and the traditional digital machine cannot meet the needs of simulation systems in terms of information processing ability. In order to solve this problem as soon as possible, so that computer simulation technology can provide the best service for more fields, the digital mixer mixed with digital machine and analog machine came into being. Digital hybrid machine can not only satisfy the application of complex systems such as aerospace, but also greatly promote the rapid development of these fields.

2.3. Principles of computer simulation

Simulation technology develops rapidly with the development of computer technology. Computer simulation consists of three main aspects: one is the system, the other is the model, and the third is the computer. The contents of these three aspects are mainly connected with each other through simulation experiment, the establishment of simulation model and the establishment of system model. Figure 1 depicts the relationship between the three. Based on the model activities, the whole process of computer simulation can be divided into the following three stages. (1) The establishment of computer model, by establishing the mathematical model of the system, can determine the original state of the system, the accurate establishment of computer model is the basic technology of the effectiveness of computer simulation system. (2) The transformation of computer models, which can be expressed in computer language through the transformation of mathematical models into corresponding analog circuits, and become computer simulation tools that can be directly applied by writing corresponding data processing software. (3) In the computer simulation experiment stage, the simulation output information is compared with the actual system information, and the problems are found, and the existing system is improved and perfected.
3. Establishment of simulation model

Model analysis is widely used as one of the most common methods in modern scientific research because it can establish simplified mathematical or physical models based on the abstraction of real systems or the description of the nature of things \[^6\]. If there is an isomorphism or isomorphism between such models and real systems, we can analyze real systems through this model, and then make reasonable control and optimization of real systems. Two forms of simulation modeling are mainly discussed in detail below. First, the simulation modeling of continuous variable dynamic system is a kind of physical system which is driven by time and the state changes continuously. According to the time and value mode in the system, the continuous variable dynamic system can be divided into continuous time dynamic system, discrete time dynamic system and continuous-discrete time mixed dynamic system, as shown in Figure 2.

![Figure 2. Schematic diagram of analog-digital hybrid computer](image)

At the same time, there are many mathematical models commonly used in the simulation system of continuous variable dynamic system, the most common is the constant / partial differential equation model, in addition, there are sliding average model and controlled autoregressive sliding average model and so on. Secondly, there is also simulation modeling of discrete event dynamic system. Discrete event dynamic systems are mostly man-made system and the relationship between discrete events and other systems is more complicated. The design method of discrete event dynamic system model has been improved in many ways since the early 1980s. For example, the discrete event dynamic system is divided into discrete event dynamic system with time target and discrete event dynamic system without time target. It can also be divided into deterministic discrete event dynamic system and uncertain discrete event dynamic system model. From many literatures and different kinds of discrete event dynamic system description, the establishment and analysis of discrete event dynamic system model is still imperfect, and there is a lot of room for development. There are many kinds of models in this system, so the necessary transformation relationship is needed between the types of models, and the description of each model is usually only applicable to one or several problems. The most commonly used methods of discrete event dynamic system include network diagram or event diagram, formal language and automata \[^7\]. Although the establishment of discrete event dynamic system model creates conditions for the simulation of discrete event dynamic system, not all discrete event dynamic system models can be directly used for calculation. For example, commonly used GSMP models can be used to describe complex processes that are not available or difficult to describe in many model ways, but the practical application of GSMP models on computers is complex and requires professional knowledge. The core problem of discrete event dynamic system simulation is the validity of the simulation model, which guarantees some isomorphism or homomorphism relation with real system behavior. A method in CVDS is to describe the model design using an equation method based on physical rules, which is not
fully applicable to the establishment of simulation models for discrete event dynamic systems. On the other hand, because the discrete event dynamic system is mostly man-made system, the change form shows complex nonlinearity. With the changing requirements of computer simulation technology needs to be continuously improved, the appropriate model should be selected for different times. Figure 3 is a flowchart of the modeling process.

![Figure 3. Schematic diagram of the modeling process](image)

**4. Problems to be verified in simulation experiments**

When conventional analysis and design methods are difficult to deal with or the results are too abstract to be used in engineering practice, people often hope to simulate and try to analyze the system performance or optimize the system allocation by modeling the system and model experiments on computer. Usually, some problems are inevitably taken into account when using simulation experimental results to study complex systems.

**4.1. Influence of model disturbance on simulation results**

Simulation is a model-based activity. Simulation is based on models, which are often derived under a series of idealization assumptions. Then, when there is a difference between the real situation and various assumptions, there is bound to be a difference between the simulation output generated under the ideal model and the real output of the actual system. How big is the difference?

**4.2. Credibility of simulation-based system inference and decision making**

The purpose of the simulation experiment is to analyze the system performance and optimize the system parameter matching. In the simulation of stochastic dynamic system, the sample simulation results are not exactly the same based on multiple simulation experiments of the same model. Therefore, when the
random dynamic system is simulated or the decision is made based on simulation, is the output data of the simulation box representative? What is the credibility of the inference based on the finite simulation experiment?

5. Conclusion
Both the computer simulation model and the dynamic system simulation technology seek a kind of simulation and direct mapping for the problem space in the problem solving space, their essence is consistent. Computer simulation directly models specific systems in the real world, and object-oriented technology provides a good modeling method, which will undoubtedly be beneficial in combining them. In order to improve this dynamic system simulation technology, there is still a need to further develop computer simulation models. At the same time, there is still a lot of work to be done, including deep thinking about scientific relationships between them, formal descriptions, and so on.

References
[1] Hu Feng, Sun Guoji, Wei Jun Hu. Summary of Computer Simulation Technology for Dynamic Systems (I) - Simulation Model [J]. Computer simulation, 2000(01):1-7 11.
[2] Gong Ting. A Review of Computer Simulation Technology for Dynamic Systems -- Computer Simulation Modeling [J]. Silicon Valley, 2014, 000(017):36-36, 31.
[3] Lu Yan. A Review of Computer Simulation and Modeling Technology [J]. Electronic Science and Technology, 2001(11):2-4.
[4] Cai Jiehua, Ludo. Computer Power Simulation Technology for Dynamic Systems [J]. Computer optical disc software and applications, 2013(13).
[5] Shao Shuangquan, Shi Wenxing. A Review of Computer Simulation Technology of Refrigeration and Air Conditioning System [J]. Refrigeration and Air Conditioning (Beijing), 2002(3).
[6] Zhang Zhanlong, Luo Ciyong, what is. Overview of Virtual Reality Technology [J]. Computer Simulation, 2005(03):5-7 11.
[7] Sun Berlin. A Review on the Application of Virtual Reality Technology in American Army [J]. Computer simulation, 2018, 035(001):1-7.