

# Preliminary research on modeling and simulation technology of artificial intelligence system

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**Abstract.** The complex system of large-scale intelligent, concurrent and polymorphic organizational structure is a hot topic in the field of simulation. Qualitative and quantitative research on such systems requires integration of related technologies in the fields of computer simulation, system theory, and artificial intelligence. Mufti-agent simulation uses system theory and Mufti-agent system modelling method to build a system high-level model, and uses the system computing model established for the simulation software and hardware support technology based on the agent model to realize the simulation. Because it can effectively deal with the interlinear, interactivity and emergence of complex systems, it is considered to be the most dynamic and breakthrough methodology for complex system simulation. Based on this paper, the concept, theoretical method, technology and application of intelligent system engineering are mainly discussed. The application of artificial intelligence in modelling and simulation is analysed with examples.

**Keywords:** Artificial intelligence; Modeling; Simulation.

## 1. Introduction

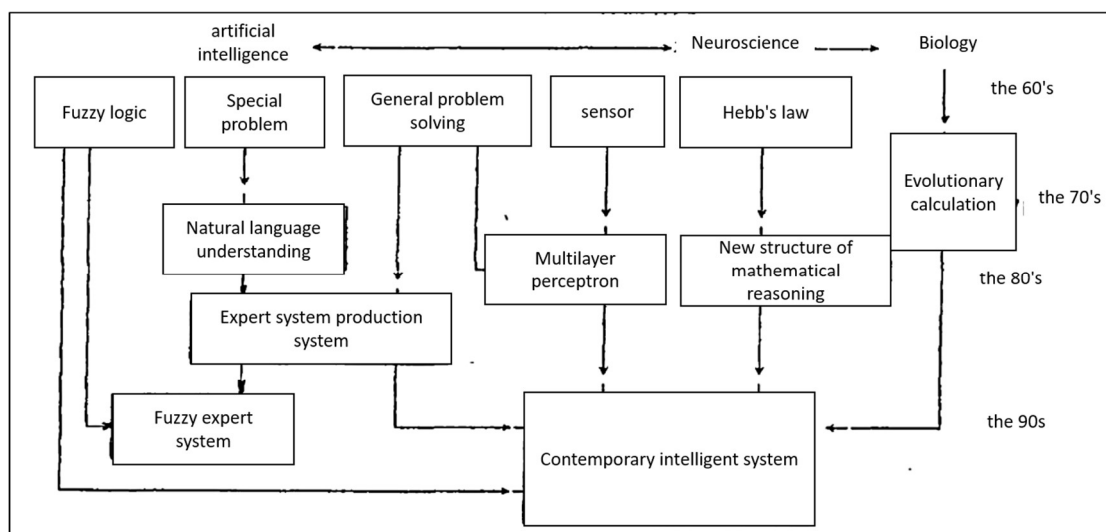
Since the 20th century, system modeling and simulation technology has developed a comprehensive professional technical system under the impetus of various application requirements and related discipline technologies, and has rapidly developed into a versatile and strategic technology. . Together with high-performance computing, it is becoming the third important means of understanding and transforming the objective world after theoretical research and experimental research. From simulation to analog-digital simulation, this period belongs to real-time simulation, and from analog-digital simulation to digital simulation is non-real-time simulation. Due to the rapid development and popularization of computer technology today, simulation technology has developed into non-real-time without physical intervention. In the all-digital simulation stage, this kind of simulation is called computer simulation or digital simulation [1]. We need to carry out computer simulation on a system or object. First, we must grasp the basic characteristics of the object, grasp the main factors, introduce the necessary energy, and propose a scientific and reasonable abstraction. Choose a reasonable mathematical tool to build a mathematical model based on this.



## 2. Overview of basic concepts

### 2.1. Artificial intelligence system

Artificial intelligence (AI) is a high-tech that is used to emulate, expand and expand human intelligence methods, skills, theoretical knowledge, and application systems for research and development. Artificial intelligence has formed two important research paradigms from the beginning, namely symbolism and connectionism. Symbolism believes that human intelligence is mainly reflected in clear knowledge expression and acquisition, symbolic strict logical reasoning ability and problem solving. From the physiological background of the brain and nervous system, the connectionism simulates their working mechanism and learning style by establishing mathematical models of the brain and nervous system. It can be said that symbolism attempts to conduct macroscopic research on intelligence, while connectionism is a microscopic exploration. At the same time of AI research based on symbolism and connectionism, significant progress has been made in the study of fuzzy logic theory and its applications. Fuzzy logic breaks through the thinking mode of traditional logic and plays a decisive role in the profound study of human cognition. In particular, its good integration with expert systems, neural networks and control theory proves that it is also playing an important role in AI research [2]. At the same time, the evolutionary computation theory developed in the theory of natural selection and evolution also has its specific advantages in machine learning and optimization calculations, and has become one of the main research results of AI. Therefore, the research history of fuzzy logic and evolutionary computation is also an integral part of the history of AI development.

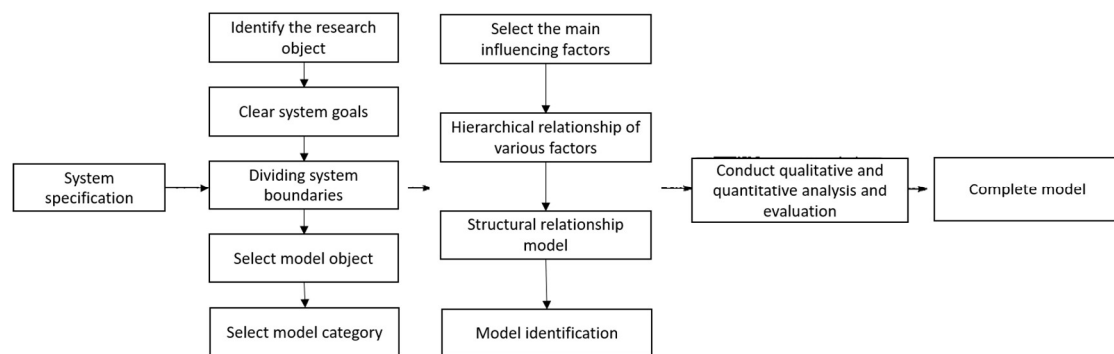


**Fig 1.** Schematic diagram of the history of artificial intelligence research

## 2.2. Simulation and Modeling

The model is the basis of simulation, and the model analysis method is one of the basic research methods of modern science. All of the simulation models describe the characteristics of objective things in the objective world. It mainly includes the natural environment, the object/system, the people and the interaction between them. Through the abstraction or essential discussion of the actual system, construct a mathematical or physical model with the anthropomorphism or anthropomorphic relationship with the actual system, based on model analysis and model experiments, to achieve the understanding, manufacture and optimization of the actual system. . The modeling of the natural environment and the modeling of the virtual environment are quite complex. For the semi-physical simulation, the measurement and detection simulation environment required for the sensors of various systems will be

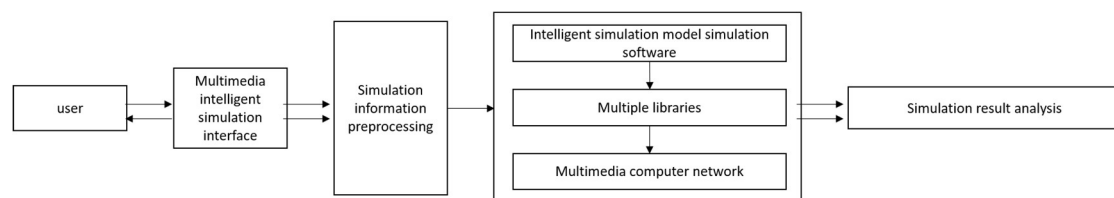
established. For the system of human existence, the needs of the human being will be established. Virtual simulations of vision, hearing, and touch. For a complex system, the basic modeling process can be divided into three stages: the proposed system conceptual model, the structural relationship model and the performance analysis, evaluation and synthesis of the model. Figure 2 is a schematic diagram of the modeling process [3].



**Fig 2.** Modeling process diagram

### 3. The combination of artificial intelligence and modeling and simulation and key technical analysis

Artificial intelligence technologies include: expert systems, knowledge engineering, pattern recognition, and more. Simulation techniques include: modeling, algorithms, simulation software, and more. In recent years, due to the vigorous development of artificial intelligence technology and the enhancement of computer processing capabilities, it has opened up the possibility of application of intelligent technology in simulation. At the same time, the modeling of some uncertain complex systems also uses artificial intelligence technology to optimize the model, and the numerical model is combined with the non-numeric model. Intelligent simulation systems can change the pitfalls of entry modeling [4]. This is because: intelligent simulation has intelligence, simulation input information preprocessing, simulation model generation, simulation algorithm has flexibility, effectiveness, simulation results analysis and interpretation, etc., which reflects high intelligence level; applicable to a wide range of generalized simulation models, The intelligent real algorithm with high efficiency is solved, and the multi-library collaborative simulation software supports the environment, so the applicability is good; the multimedia intelligent simulation interface is used for human and machine interaction, and the interface is friendly.



**Fig 3.** Overall scheme of intelligent simulation system

#### 3.1. Object modeling method with cumbersome behavior and vital features

In order to make the objects in the scene more vivid, different modeling methods are adopted according to different objects. In order to ensure that the physical model of the object is more realistic, it can

generally be implemented by the modeling method of the interactive picture, or the state and texture of the virtual object can be modified by the drawing technique in the computer.

### 3.2. Human animation for IVE

In order to better complete the animation of the human body, two solutions are generally adopted: the first is to set up a large human body posture library, which can solve the problem effectively and quickly in the early stage of design, but lacks agility, due to human gesture. There are many movements, and the combination of various movements is also various. Therefore, it is difficult to realize the human body posture inventory in various human body postures; the second method is based on the movement law of the human body. Research, research from the kinematics and behavior of the human body. Although it is more difficult at the beginning of the design, it can form a good behavior animation because it can help the high-level to provide relevant data to control the animation.

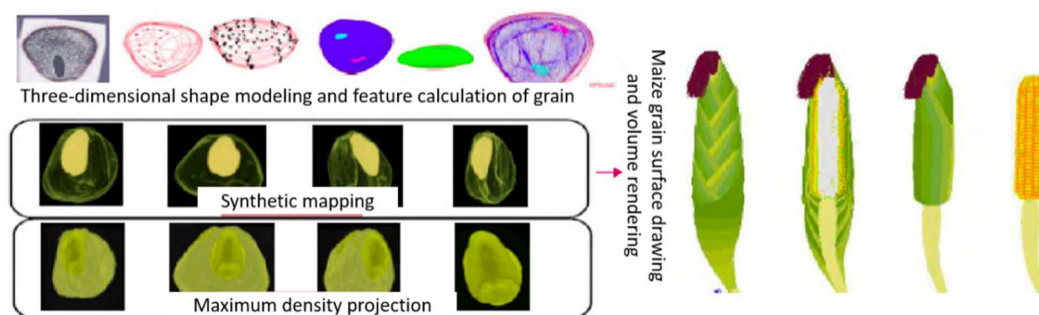
### 3.3. Real-time rendering

In order to make the intelligent virtual environment have more realistic effects, it can be realized by a variety of accelerated drawing techniques, which can be judged by visibility, and it is better not to draw objects that are not visible; for less important image objects, simple use can be utilized. The model is drawn; objects that are farther away can be represented by textures. At present, most of the machines in China can be drawn by hardware texture mapping. However, for large-area texture images, multiple times of pour-in and rewind operations on texture buffers will have a serious impact on the speed of hardware texture mapping. Therefore, we need to classify texture images according to different properties to improve the speed of hardware texture mapping.

## 4. Artificial intelligence system modeling and simulation technology combined with cases

### 4.1. Intelligent Agriculture Field—Intellectual Simulation of Virtual Plant Autonomous Growth

Intelligent simulation of virtual plant autonomous growth based on autonomous intelligent technology and virtual reality technology. As shown in Figure 4. The virtual object intelligent behavior modeling technology mainly realizes the geometric simulation, physical simulation and behavior simulation of object objects, and enhances the intelligence, social, diversity and interactive reality of virtual object behavior. The virtual environment is mainly realized by human and environment fusion technology. Resolution stereo display, azimuth tracking, gesture tracking, data gloves, tactile feedback, sound localization, etc., realize the organic combination and efficient interaction between virtual reality, enhanced display and other technologies.

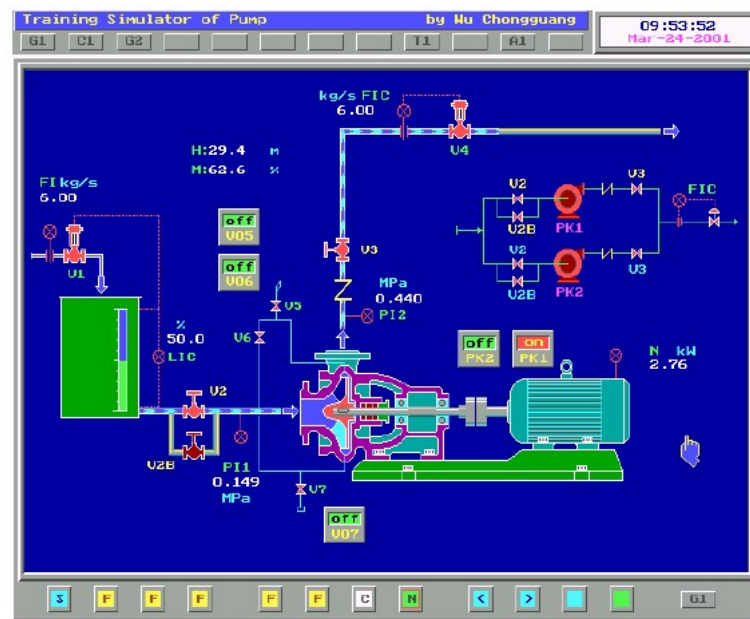


**Fig 4.** Virtual plant autonomous growth intelligent simulation application system

### 4.2. Intelligent Industrial Field—Description of Process Flow of Centrifugal Pump and Liquid Level System

The centrifugal pump system consists of a water storage tank, a main centrifugal pump, a spare centrifugal pump, piping, controllers and valves. The upstream water source is controlled by the control

valve V1 to enter the water storage tank via the pipeline. The upstream water flow is measured by the orifice flow meter FI. The tank level is controlled by the controller LIC and the output of the LIC is connected to V1 [6]. The inlet line of the centrifugal pump is connected to the lower part of the sink. The pipeline is provided with a manual valve V2, a bypass standby manual valve V2B, and a centrifugal pump inlet pressure gauge PI1. The centrifugal pump is provided with a high point exhaust valve V5, a low point drain valve V7 and a communication valve V6 on the high and low point communication line. The main centrifugal pump motor switch is PK1, and the backup centrifugal pump motor switch is PK2. The centrifugal pump motor power N, total head H and efficiency M are digitally displayed. The outlet line of the centrifugal pump is provided with an outlet pressure gauge PI2, a check valve, an outlet valve V3, an outlet flow detecting instrument, an outlet flow controller FIC and a control valve V4.



**Fig 5.** Centrifugal pump and liquid level system simulation flow chart

## 5. Current prospects for modeling and simulation of artificial intelligence systems

### 5.1. Development of Intelligent System Modeling and Intelligent Simulation System

Research on the mechanism of human intelligence systems (brain and neural tissue) based on simulation technology, as well as various knowledge-based systems are important application areas of simulation technology, and it promotes further development in this field. Typical such as simulation-based embedded intelligence systems (such as embedding simulation techniques into knowledge-based systems to describe time-related knowledge or express time-related inference processes); at the same time, AI makes simulation more widely available Modeling techniques that bring decision making and planning capabilities to simulation. Typical applications are simulation environments with intelligent front ends, knowledge-based collaborative modeling and simulation environments, and simulation environments with intelligent assessment analysis. Among them, knowledge model and its representation standardization research (especially for agent-oriented model, ontology-oriented model, network model for distributed reasoning, reasoning model for mobile communication, evolutionary model, self-organizing model, fault-tolerant model) Research, and knowledge-based intelligent integrated modeling and simulation evaluation environment will be the focus of further research and development of intelligent system modeling and intelligent simulation systems.

### *5.2. Development Prospects of Modeling/Simulation Technology for Complex Systems/Open Complex Giant Systems*

Complex systems/open complex giant systems usually have complex systems with complex system relationships, complex system behaviors, and complex interactions and energy exchanges between subsystems and systems [7]. Such as military system confrontation systems, complex manufacturing systems, ecosystems, social-economic systems. Research on them has become a critical issue for human development. Complex system simulation has become the most important means of studying various complex systems. Complex system simulation methods include parameter optimization, qualitative simulation, multi-agent-based simulation, distributed interaction simulation, and comprehensive simulation of qualitative and quantitative integration. Moreover, based on knowledge, intelligent agents, ontology, etc., the comprehensive integrated simulation method combining qualitative and quantitative research is an important trend of future complex system simulation research.

## **6. Conclusion**

Due to the emergence of emerging disciplines, interdisciplinary subjects, and marginal disciplines, new problems are emerging, demonstrating the correctness of these new ideas and verifying their experimental, and solving some of the key problems in frontier learning. In the new century, system modeling and simulation technology is developing in the direction of capitalization, contextualization, networking, intelligence, integration and synergy; simulation technology is serving the full life, system and management of the system. The direction is developing rapidly. The development of system modeling and simulation technology must be closely integrated with the application. The development path should be to develop the modeling and simulation system with application requirements, and to drive the modeling and simulation technology breakthrough with modeling and simulation system to model and Simulation technology promotes the development of modeling and simulation systems, and the modeling and simulation system serves the benign cycle of applications. The modeling and simulation technology for artificial intelligence systems is a new model, new method and new format of modeling and simulation in the era of “new Internet + big data + artificial intelligence +”. With the development of the times and the development of technology, it is necessary to continue Study new developments in models, tools, and formats for modeling and simulation.

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