RESEARCH ARTICLE

A Survey of Computer Modeling, Simulation and Control of Complex Industrial Processes

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Abstract: Complex industrial process control is at the forefront of the control science community. Due to the complexity of its background and the variability of control objects, no substantial progress has been made in practical engineering or even in theory. Therefore, industrial processes in complex environments and tasks should follow a gradual and intelligent approach. In this intelligent process, we try to explore its inner essence from three aspects of computer modeling, simulation and control of complex industrial processes, find out its underlying causes, and point out its inherent limitations to help engage in specific scientific research. Those who consciously abide by the objective laws of understanding.

Keywords: Computer modeling; computer simulation; control; artificial intelligence; complex industrial processes

1. Overview

There is currently no uniform definition of complex industrial processes. Its complexity can be summarized in two aspects: objective complexity and cognitive complexity. The former refers to the new sexuality and mutual relationship that cannot be restored after a certain movement or sexual state crosses the level in the objective industrial process[1]. The latter refers to an effective understanding of the complexity of the objective industrial process and its expression. However, in practical engineering, some experts believe that if the industrial process is weakly influenced by behavioral variables and the process is mainly described by state variables, it can be considered as a simple system, that is, the key to complex industrial processes is caused by behavioral variables. . According to the theory of system science, there are many classification methods for industrial processes: if there are fewer sub-processes or components in an industrial process system and their relationships are simple, they are called simple industrial processes; if there are many or very large sub-processes or components in an industrial process system and their relationships are complex, they are called large-scale industrial processes or large-scale industrial processes. A giant system industrial process is called a simple large (giant) system industrial process if there are not many kinds of neutron processes and their relations are relatively simple and can be described by linear or easily expressed nonlinear relations. If there are many kinds of neutron processes and their relations are complex, the hierarchical structure is complex, and the coupling between the sub-processes is very tight. Generally speaking, it can not be described by linear or easily expressed nonlinear relations, which is called complex large (giant) system industrial process[2–4].

Traditional or modern control theory is used to control complex industrial processes.

There are many limitations, mainly as follows:[5,6]

(1) Uncertainty problem

Traditional control is based on model control, i. e. the model of control, process and disturbance is known or can be obtained by identification. However, many control problems in complex industrial processes are uncertain, or

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even abrupt. For unknown, uncertain or little known control problems, it is difficult to model with traditional control methods, and therefore it is impossible to achieve effective control.

Highly nonlinear problem

In the traditional control theory, for industrial processes with high nonlinearity, although some nonlinear control methods can be adopted, in general, nonlinear theory is far less mature than linear theory, and some methods

The law is difficult to use because of the complexity of the industrial process. However, there are a large number of nonlinear problems in complex industrial processes.

(3) Semi-structured and unstructured problems

Traditional control theory mainly uses differential equations, state equations and various mathematical transformations as research tools. Its essence is a numerical calculation method, which belongs to the category of quantitative analysis control. The result necessarily requires that the control problem is highly structured and easy to describe or model by quantitative mathematical methods. The most concerned and supportive in the complex industrial process is sometimes the semi-structured and unstructured problem.

(4) Uncertainty issues Industrial process uncertainty should include

The operation process and the environment in the usual sense. However, the relationship between sub-processes in complex industrial processes is complicated, the components are highly coupled and mutually restricted, and the external environment is extremely complicated and unpredictable. Some industrial processes involve human sensory factors, such as the sensory quality of cigarettes. The taste of wine, etc. all involve human behavior, and human behavior is a complex behavior with subjective nature.

(5) Reliability issues

Conventional mathematical model-based industrial process control problems tend to be an interdependent whole, although the industrial process of the method often has a contradiction between robustness and sensitivity, but for simple industry.

In terms of process system control, the problem is not outstanding. For complex industrial processes, the entire control may collapse due to changes in conditions.

Therefore, the modeling, simulation and control of complex industrial processes are looking forward to using new theories and methods to solve the practical problems in the industrial field, which is the urgent requirement of the development of industrial and agricultural production, and also the needs of human development.

It is expected that in the development of industry in the 21st century, information technology marked by photoelectric technology and artificial intelligence will be the forerunner, and biotechnology marked by genetic engineering and cell engineering will be the core, with superconducting materials and artificially oriented design materials as the symbol. Based on new material technologies, with new energy technologies marked by nuclear fusion energy and solar energy as the backbone, space technology marked by space shuttles and permanent space stations are extended, marine technology marked by deep sea mining and seawater utilization Internal expansion[8] has caused new breakthroughs in high technology in the field of industrial process control. It is conceivable that the complex industrial process that people study is a highly complex, undeterminable, multi-level, networked system. At one level, it is impossible to fully understand the industrial process, and its research needs to be at multiple levels. Go to[5]. The so-called complex industrial process is a fundamental, universal and far-reaching problem in industrial processes. This requires us to use the new concepts, new methods and new achievements provided by the complex system theory in the future research, combine the conceptual system and methodology unique to the complex industrial process that has been formed, through the study of multi-level and multi-level integration, and ultimately solve and reveal the industrial process at the individual level. At present, the control of complex systems is regarded as the frontier of automation subject by the control circles at home and abroad. Large-scale complex industrial processes and uncertain variable control objects are regarded as important research fields, and their unique complexity promotes the frontier development of this subject[4].

This paper attempts to discuss the methodology of the intelligent process of complex industrial process control from three aspects of computer modeling, simulation and control, focusing on the control object, control method and control objective, so as to explore the evolution and integration characteristics of its complexity and uncertainty.

2. Methodology for modeling the expansion of complex industrial processes

Process modeling is an abstraction of the process of changing things in an objective world. The method is to realize some abstract set description of objective things or processes by mapping isomorphism or homomorphism of objective things or processes[3,7]. The development of modern science and technology benefits from the numerous examples of this method. It can be said that the modeling method is one of the important methods for human beings to understand objective things. Long-term research and practice have proved that classical control is very effective for solving linear constant system control problems, and modern control is also effective for time-varying systems, but the premise is whether it can establish a mathematical model of the controlled process. The emergence of the "black box" theory, although breaking through the limitations of theoretical modeling to a certain extent, still requires sufficient prior knowledge to determine the type of model, which is still difficult enough for the actual complex industrial process and there is model structure identification. Difficulties. In order to solve the control problems of complex industrial processes, the modeling method needs to be expanded: not only quantitative models, but also logical models, semi-qualitative and qualitative models; not only normative models, but also descriptive models such as symbolic models. From a statistical point of view, the control model has both statistical and non-statistical models. From the engineering point of view, the “white box” model and the “black box” model are combined to better understand, accept and recognize the field engineers. Any simple model generally can only reflect one aspect of a thing. By means of multi-model combination or multi-modeling methods, organic fusion and integration can be achieved. By means of weak or strong links between models, the problems that are difficult to solve at the individual level in complex industrial processes can be solved[12].

Expanding the modeling method is a means to solve the control problem of complex industrial processes; exploring new theories, new methods and new technologies and organically cooperating with complex industrial sites is an important way to solve the complex industrial process modeling problems. In practical work, the use of modeling methods, as well as the analysis and calculation of industrial processes have been studied. I do get some experience: for example, unsaturated moisture migration and chemical composition change in tobacco is a complex industrial process of physicochemical reaction in heterogeneous system and discontinuous medium, which is affected by many factors. Previous studies on this area were mostly experimental methods, but due to the complexity of the problem itself, experimental methods have not made much progress. Some people of insight also use modeling methods, but due to the limitations of mathematical methods and computational power, researchers are forced to simplify the model so that the model can be processed with existing mathematical methods to establish a quantitative model. This is of course due to the underdeveloped computing technology. If the model considers too many factors, the model is very complicated, and even the model cannot be solved at all. Too many factors make the model very complicated, and even can not solve this model at all. With the rapid development of computational technology, it is possible to solve large-scale equations. Therefore, on the basis of multi-phase seepage and diffusion evaporation, a four-parameter fuzzy neural network model is proposed to make the model closer to the actual process. Later, in view of the characteristics of dry, saturated and unsaturated regions in porous media at sudden high temperatures, a new on-line real-time model was established by introducing chemical composition physicochemical reaction on the basis of the original four-parameter model, and a class of equations were solved successfully, and satisfactory results were obtained. The physical parameters of the model need to be measured experimentally, and the model is perfected and supplemented by experiments. This shows that experimental methods and modeling methods complement each other, each has its own merits and demerits and uniqueness. The scientific research method should be the organic combination of the two methods.

3. Methodology for the expansion of complex industrial process simulation methods

Simulation is an experimental technique in which humans indirectly study things through models. The simulation method provides an operating environment—the simulation model—for the description generated by the modeling. The simulation of complex industrial process is to use some formal description of industrial process to create the corre-

sponding experimental environment and study the operation mode of industrial process indirectly in this environment, so that researchers can feel, understand or control the mechanism and law of complex industrial process change in the process of "human-model" interaction[18]. Here is an indirect description of some aspect of industrial process attributes by human subjects, thus mapping out the industrial process model, and conducting various experimental operations, through human feelings to deepen the understanding of the various attributes of the things studied.

The traditional computer digital simulation of industrial process focuses on the single mapping model of process information. In the experimental environment, the people who study the subject observe and feel the process information of mapping behavior only from the constraint of the external boundary of the model. The problem of this research model is that on the one hand it is difficult to fully reflect the rich connotation of the objective world, on the other hand, it is a difficult problem in the field of information processing that people in the external environment of the experiment adopt heterogeneous mapping information fusion technology. In fact, humans understand things naturally through a variety of perceptual channels to accept a variety of mapping information, as well as a variety of heterogeneous process information accepted by their own perception channels, through the integration of the human brain to produce a comprehensive reflection. If we can create an information environment generated by a model, and naturally perceive and synthesize the model information of the process, and operate the process model in a natural way in this environment, this idea has already and will promote the simulation technology. A major breakthrough[3,6]. Traditional industrial process simulation, whether it is the early three-layer structure, or the later development of modeling and experimental phase separation to establish two framework methods, are "human-model-experimental" phase separation method, and modern industrial process simulation method The development of a natural and harmonious simulation environment that integrates "human-model-experiment" will be[7].

With the development of computer technology and network technology, people have new requirements for the simulation of complex industrial processes. The traditional centralized and closed simulation system architecture can not meet the needs of the development of information industry. A distributed, open and interactive simulation system architecture, called distributed interactive simulation, is proposed. Ideas are rapidly attracting widespread attention from industry. DIS is a highly integrated product of network technology, simulation technology and computer technology. It integrates industrial process technology, browsing/service mode (B/S), distributed computer and network communication technology. Its development trend is to establish distributed peer-to-peer collaborative simulation with operability, portability and scalability system architecture. The main function of DIS is to define a basic framework for connecting different types of simulation industrial processes in different geographical locations, so as to realize a realistic and complex virtual world for highly interactive simulation activities, relying on network information transmission to play various distributed industrial processes. The computational processing power to construct a complex simulation environment[18].

Based on the above requirements, the research will be fully introduced into the new achievements of modern computer technology, combined with the study of human behavior science model, to create a more realistic and natural model experimental environment for researchers to reflect virtual reality. A series of technical topics are as follows: creating and editing the model experimental environment of virtual reality; generating the media information that researchers can naturally perceive; generating the implementation of various operations imposed on the virtual reality model, we must pay full attention to the model research subject-human behavior pattern[18]. Therefore, human beings are required to create, describe and operate the model experiment environment including human beings in a natural, intuitive and acceptable way, and expand the simulation technology branches of qualitative simulation, distributed interactive simulation, parallel simulation, multimedia simulation, virtual reality simulation and so on.

4. Epistemology of complex industrial process control

The above discussion is the extension of the modeling and simulation methods of complex industrial processes, which are methods of research for solving complex industrial process problems. The ultimate goal is to be more suitable for the control strategy of complex industrial processes. From the current development trend, the intelligent control strategy in industrial process control, decision support "expert" has become inevitable. By means of knowledge engi-

neering, the qualitative knowledge, human experience knowledge and skills, and heuristic logic reasoning of related objects are effectively integrated to form a knowledge base system to support the optimization of control strategies and algorithms and the optimization of operation state. It has become an important technical means of complex industrial process control. Its essence is to enlarge and enhance the ability of people. Computer Integrated Process System (CIPS) is the product of industrial process control entering the computer era. The continuous production process is the research object, and its goal is to realize computer integrated automation. Although the computer plays a very important role in the system, it is still an assistant tool. Man still plays an irreplaceable key role in the overall closed-loop of the monitoring level. This system, including human beings, is essentially a man-machine intelligent system, which will show more ability than human intelligence and ability in the process of synergy[16]. But the key lies in strengthening the close combination of control theory with production practice, paying attention to introducing intelligent method, intelligent technology and knowledge engineering method, gradually forming different forms of simple and practical control structures and algorithms, making control theory intelligent and engineering, so as to speed up the intelligent process of complex industrial process control. The following 3 aspects are recognized.

4.1 Intelligent Control

Since the American mathematician Wiener founded cybernetics in the 1940s, the automatic control theory has experienced two important development stages of classical control theory and modern control theory. In dealing with the control problems of complex systems, the traditional control theory always tries to break through the old model to meet the new requirements of society for automation. Control theorists all over the world are also exploring the establishment of a new generation of control theory to solve the control problems of complex systems. In recent years, the traditional control theory is combined with artificial intelligence technology, such as fuzzy logic, neural network, pattern recognition, genetic algorithm, wavelet analysis and so on, which makes full use of human control knowledge to control complex systems. After a long period of incubation and exploration, people realize that the application of artificial intelligence principles and methods as well as human experience and intelligence to complex industrial processes is a promising and promising way to solve complex industrial process control problems.

(1) Fuzzy logic control

By the principle of "complex" and "accurate" incompatibility, imitating the control principle of the human brain, fuzzy logic control naturally becomes one of the methods to solve complex industrial process control problems. Fuzzy logic only cares about functional goals rather than mathematical models. Fuzzy systems can be regarded as a model-independent evaluator, and mainly rely on fuzzy rules and membership functions of fuzzy variables, without having to consider accurate mathematics between input and output. Relationships, thus avoiding the difficulty of complex process modeling[11], which reduces the complexity of process modeling. In the early (before 1990) literature, as in the literature[19,20], etc., it is considered that fuzzy control is an effective choice when other model-based control methods are not well controlled, and the membership of fuzzy controllers The function and control rules are determined based on the pre-summary of experience. There is no correction function for the rules in the control process, and there is no learning and adaptability. Even so, fuzzy control has made some successful applications, such as kilns, industrial robots and so on. However, fuzzy control often has low precision when controlling more complex uncertain systems. The summary of control rules relies too much on field operation, and the debugging time is too long to meet the requirements. At present, many scholars have made many improvements to the traditional fuzzy control, which has developed into a variety of forms of fuzzy control. Fuzzy models and identification[21,22], fuzzy adaptive control[23] have appeared, and progress has been made in stability analysis[24–26], robust design[27]. Buck-ley[25] calls fuzzy control based on model and analysis method as modern fuzzy control. It brings new vigor to fuzzy control and becomes one of the important branches of intelligent control.

(2) Expert system control

Expert system is a knowledge-based system. It is mainly oriented to various unstructured problems, especially to deal with qualitative, heuristic or uncertain knowledge information, through various reasoning processes to achieve the task objectives of the system. From the perspective of scientific development, computer science, cybernetics, artificial

intelligence, etc. flourished under the requirements and influence of the Second World War in the early 1940s, and have yielded some fruitful results so far. Since knowledge engineering was proposed at the International Conference on Artificial Intelligence in 1977, the expert system has been developed by leaps and bounds. It is mainly manifested in two aspects: the application in medicine, military, education, economy and other fields; and the intelligent system of man-machine combination[15]. In the practice of artificial intelligence research, people gradually realize the role of knowledge in intelligent behavior, that is, human beings have intelligent understanding and behavior, because human beings have the ability to acquire knowledge and to use these knowledge and re-learn in complex situations. In a certain sense, the controller can also be seen as the use of knowledge for reasoning, decision-making, control effect of the device. For the control of complex industrial process, knowledge engineering and expert system technology can avoid the difficulty of modeling when the control process is difficult to identify. At the same time, the control performance of the system can be improved by making full use of human knowledge and experience to establish control strategy[10].

(3) Neural network control

Studying human intelligence has always been the most meaningful and challenging issue in scientific development. The subject of intelligent theory comes from "environment-problem-purpose", which has great temptation and pressure. Its development direction will be based on the neural network theory based on connectionism, the theory of artificial intelligence expert system based on symbolism and The three research fields of artificial life based on evolution are spontaneously and organically combined under the general goal of common pursuit[11]. Neural computing and evolutionary computing are more closely related to high-speed information network theory, and play a huge role in the field of computer networks; discrete symbolic computation, neural computation, and evolutionary computation promote each other, and eventually lead to the unification of these three calculations. A major problem we can't avoid[30]. The research of neural network structure is the premise of the realization and successful application of neural network, and also the superior physical premise. With the application of a large number of neural computers and neuro-chips in high-tech fields, the theory and methods of neural networks will be endowed with new content, but also some new theoretical topics will be put forward, which is a driving force for the rapid development of neural networks. In short, the research of artificial neural network makes it a new mainstream in artificial intelligence research. Its parallel performance and many possible aspects of the simulation of human brain function make it an attractive area for solving complex industrial process control problems. The adaptive ability and learning ability of neural network for complex model-free uncertain problems can be used to control the compensation link and adaptive link of the system; the ability to describe any nonlinear relationship can be used for the identification and control of nonlinear systems; It quickly optimizes computing power and can be used for optimal calculation of complex control problems; Distributed storage capability and parallel processing and synthesis capability for large quantities of qualitative or quantitative information can be used as information conversion interface in complex control systems and as well as processing and utilization of image information; the fault tolerance brought about by its parallel distributed processing architecture can be applied to control unstructured processes, etc.[2] Intelligent control shows attractive prospects.

4.2 System set theory

Due to the complex and versatile composition of complex industrial processes, as the industrial process itself changes with environmental changes, the objectives and objectives of industrial process control change, making research more difficult. It can be said that the understanding of complex industrial processes is far from the “necessary kingdom” into the “freedom kingdom”, which is not only the commonality of complex industrial processes, but also the personality of a specific type of complex industrial process, such as continuous and intermittent industrial processes. Etc., awareness also needs to be deepened. On the other hand, the theory, methods and techniques of complex industrial process research are still immature. In terms of the field of intelligent control, its theory, methods, and techniques need to be greatly deepened. The formation and improvement of its system also requires an iterative and spiraling process. On the other hand, the theories, methods and techniques of complex industrial processes are not yet mature. As far as intelligent control is concerned, its theory, method and technology need to be greatly deepened, and the formation and

perfection of its system need a continuous and spiral process. At present, several intelligent control technologies that have been put into practice still have shortcomings and shortcomings. For example, fuzzy logic technology has not become a perfect system analysis technology, fuzzy system as a trainable nonlinear dynamic system, there are still problems such as stability, and knowledge engineering and expert system technology are limited by the breadth of knowledge and can not innovate knowledge. However, the problems concerning Lyapunov stability, equilibrium point, limit, equilibrium attractor and chaos need further study[16]. It is not only unrealistic but also impossible to attempt to solve all control problems of complex industrial processes with one technology.

4.3 Autonomous Human Machine System

(1) Limitations of autonomous systems

From the birth of cybernetics and for a long time thereafter, whether it is empirical cybernetics or modern cybernetics, people have been pursuing so-called “automatic systems” that are completely automated without human intervention. Practice and research advances have found their limitations: they can only make a difference in a “clean environment” where the working environment is fixed; and for complex processes, the conditions of this “clean environment” are indeed unsatisfactory[14]. In the early days of intelligent control, people tried to join the ranks of control systems through artificial intelligence to further explore the possibility of "autonomous system". Starting from the simulation of special problem class to solve intelligent behavior, and then explore the particularity of human intelligence and the mechanism of the general law of artificial intelligence and the way to achieve it. The significance of this stage to the emergence and development of AI is enormous, and the impact of its achievements on modern science is also epoch-making. However, a lot of practices such as AI are slow or even stagnant in terms of image and sound recognition, machine learning and common sense reasoning, and thus are thought-provoking. By the end of the 1960s, people realized the role of knowledge in intelligent behavior in AI practice research. Since then, knowledge-centered research based on symbolic structure has become the mainstream of AI research, and expert system control has achieved some results[13]. However, the fact that the expert system is limited by the breadth of knowledge and can not innovate knowledge compels people to rethink the AI research route and policy. Compared with human achievements in macroscopic and microscopic research, research on human beings is far worse. Further study of human brain science and life science is the gospel that mankind is eager to wait for. Although the study of artificial life is very hot, it just stays on the guidance of methodology, far from meeting people's expectations. It has been proved by practice that AI adopted reductionism in its methodology and pursued "autonomous system" in its goal. Therefore, it is not easy or even impossible to achieve "autonomous systems" for complex processes through intelligent control, since the knowledge of complex industrial processes has not entered the realm of freedom before.

(2) Man-machine system inevitability

Under the current constraints on human understanding and the level of complex process understanding, it is not unrealistic and impossible to attempt to fully simulate human functions and develop an “autonomous system” for all industrial processes[14]. The essence of human ability to deal with many problems, we still lack understanding, or even know nothing about it, such as management decisions in CIMS and the art of decision-making in humans, the existing computers can not be simulated, because we lack understanding of this "art of decision". Therefore, to achieve comprehensive automation of industrial processes, it is difficult to meet the requirements for the development of a complete "autonomous system". On the other hand, as far as the computer itself is concerned, it has its limitations. Computers cannot compete with human capabilities in calculating logic depth, the ability to remember symbol strings, and the speed and ability to process accurate information, such as the ability of the human brain to store knowledge and the ability to find associations in a large amount of knowledge. Strong "fault tolerance" and association ability, good at generalization, analogy, promotion and other capabilities, are beyond the reach of modern computers [14]. Preliminary results of neurobiologists'research on the brain show that there is a huge difference between the way the von Neumann computer and the human brain store and process. Therefore, the establishment of man-machine system to achieve the effective control of complex industrial processes is not an expedient measure of human helplessness, but an objective and human understanding of the current level of necessity. It is an inevitable way for human beings to reach the new

shore to realize the organic combination of man and machine, to form complementary, mutual proof, and to form a comprehensive system of abilities.

5. Prospects for current research

In order to realize the integrated automation of complex industrial processes, a series of control theory and method problems need to be solved, and the key guiding role of theory and method needs to be played. The following problems should be solved in complex industrial processes.

(1) Research on modeling, control and optimization of complex industrial processes. This proposition has ways been a concern, and the proposition that has not been satisfactorily solved fundamentally needs to explore and open up new paths.

(2) Research on information system analysis and processing methods. Faced with the fact that the amount of information is large, and the acquisition of effective and critical information is still quite difficult, it is necessary to conduct an in-depth and effective analysis of the completeness, redundancy, contradiction and economy of information, and to develop information compression and precision. Selection and processing techniques.

(3) Research on the theory and method of the security system of complex industrial processes. In the industrial production, the concept of "safety first", the industrialized large-scale production uses the industrial process safety guarantee system to make it truly implemented.

(4) Theories and methods of intelligent control of complex industrial processes and several new types of control theory and methods. For example, quality process control systems, self-learning process control strategies, and qualified domain process control strategies have great potential for development.

(5) Research on production scheduling theory and method of continuous and intermittent industrial processes. They are complex optimization proposition, is of great economic value, are important in theory and practice.

(6) Research on the theory and method of man-machine-environment engineering and the integration of process design and control design.

(7) In recent years, foreign countries have proposed "complex adaptive systems" and are committed to establishing a new discipline – complexity science. At present, there are many vivid examples on the network to simulate the evolution process of complex systems and "emergence", but no universal method has been proposed. The qualitative and quantitative integrated method is a methodology proposed to deal with open complex giant systems. It has its own characteristics, contributes to the study of complexity, and achieves some encouraging results.

It is not an easy task for complex industrial process control theories and methods to take a new path and open up a new situation. It is necessary to work hard through hard, realistic, theoretical and practical.

6. Conclusion

The cybernetics of complex industrial processes is a highly integrated discipline that represents the latest research direction of 21st century human cutting-edge technology. The rapid development of its research poses new challenges for the cybernetics of complex systems in the new century, and shows many new research topics. The "complexity" of the control of complex industrial processes is the basic property of the world. It cannot be attributed to simple complexes, but the disordered and ordered, different or transcendental time-space points of system evolution traverse to different levels, and Pass its integration function to each level[8]. Therefore, the problem of solving the control of complex industrial processes needs to be carried out at multiple levels, summed up as "disciplinary cross, different in common", "crossing of people, complementing each other", "method crossing, intellectual stimulation"[9] The method of thinking of Dacheng In order to solve complex industrial process problems with a certain coarse grain size at the personality level. In short, using Marxist positions, viewpoints and methods to think about the application and innovation complexity methods from the perspective of system theory has both important theoretical significance and long-term engineering practical significance.

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