Abstract

In this paper, we conduct research on the mechanical automation technology based on the evolutionary algorithms and artificial intelligence theory. Intelligent control theory after 30 years of development has made gratifying achievements. But intelligent control has not yet formed a complete and systematic theory, based on the analysis, design, and there are many important problems in the practical application. Intelligent information processing is the use of some of the experience and knowledge of information, and the combination of that upper and lower knowledge information processing method. It is expected to solve the problem of insufficient information of pathology, computation complexity and the problem of real-time requirements, using the mathematical model is difficult to describe the nonlinear problem, etc. Under this basis, this paper proposes the new mechanical automation technology based on the evolutionary algorithms and artificial intelligence theory to propose the new perspective of dealing with the related challenges.

Keywords: Mechanical Automation, Evolutionary Algorithms, Artificial Intelligence, Theory.

Introduction

Mechanical automation is a more advanced mechanical manufacturing technology in our country, the progress of basic mechanical manufacturing technology and machinery manufacturing is of great significance. Mechanical automation refers to the external force does not need auxiliary, mechanical itself to complete the process of a complete set of steps that is a good integration of the automation technology and the traditional mechanical method, which realized the qualitative leap. Mechanical automation application in mechanism manufacturing not only improve the production efficiency and product quality of machinery manufacturing industry, but also effectively reduce cost of machinery manufacture, shorten the production time greatly reduce the labor intensity of the production process.

The use of mechanical automation in machinery manufacturing can be summarized as following aspects according to the literature review. (1) Flexible automation technology can be widely used in the modern enterprise, the technology is not completely rely on in automation, on the basis of the flexible production information system improvement, so as to better the implementation of computer management and the mission of the organization, and plays an important role in dealing with market changes. (2) Intelligence is in the scope of machinery manufacturing in order to better improve the mechanical effect, the automation technology and general artificial intelligence technology, effective integration, thereby establishing integrated manufacturing technology. Intelligent manufacturing technology can not only complete the human intelligence that can also in manufacturing process of relevant experts and technical staff of thinking and skills to follow can effectively enhance the work efficiency. (3) In the machinery manufacturing industry is the most main technology is the integration of technology, this technology is mainly the use of information technology to complete the integrated management of machinery manufacturing. In machinery manufacturing can merge the corresponding technology, microelectronics technology, computer network communication technology, etc., various
technology integration, the common use, and at the time of fusion also may produce some high and the new technology [1-3].

The development and application of intelligent is the key to improve the machinery manufacturing, is the core of the enhanced productivity mechanical means. In the present mechanical manufacturing work, the introduction of intelligent has been a key, the core of the mechanical manufacturing work in work we can understand mechanical manufacturing work in intelligent mechanical and mechanical engineering experts together form a comprehensive mechanical manufacturing theory and the system mode, also has realized the work in-depth systematic and comprehensive management and the control process. In the figure one, we show the mechanical automation application scenario.

![Figure 1. The Mechanical Automation Application Scenario.](image)

In this paper, we conduct research on the mechanical automation technology based on evolutionary algorithms and artificial intelligence theory. In the later sections, we will discuss in detail.

**Our Proposed Methodology**

**The Intelligent Control.** Before this century 60s, due to the maturity and popularization of computer technology, the new theory is possible, to produce the modern control theory, modern control theory on the depth and breadth than the classical control theory into a big step, and in summary, we can then organize the related properties into the listed aspects.

- The analysis method of shift. System information obtained by the aid of sensors into in the state model [4-6].
- The structure of the control object. Controlled object by a single input single output system transformation for multiple input multiple output system. It must deal with complex industrial production process optimization and control problems.
- Modeling approach. From the mechanism modeling to statistical modeling, started using parameter estimation and system identification theory.
- The research methods. Such as integral transform to matrix theory, geometry transformation, by the frequency method to research of state space.
- Although modern control theory to solve more complex than classical controls system, we still can't meet the needs of the current technology development. As the space technology, relate information technology and the rapid development of modern manufacturing technology, control theory can deal with more complex system control problems, thus to provide more effective control strategy.
With the deepening of the process of intelligent manufacturing system research, for manufacturing system is a basic link of the general process, put forward the independent/autonomous (independent decisions), self-reliance (independent) and self-discipline (individual self-discipline). Require intelligent control system of each function module to work together, make effective use of human knowledge processing system, dealing with imprecision and the uncertainty (recognition), to the unknown or changing environment for basic learning, decision-making and adjustment to improve performance (independent decision-making control, self-discipline ability) based on the listed aspects as follows. (1) Decision-making functions, intelligent control can according to the samples has been studied and the change of external environment, adjust the control strategy, control process to develop in a direction to improve system dynamic quality. (2) The function of the learning, intelligent control process (or intelligent controller) is not only has access from the outside world and store knowledge ability will also be able to accumulate experience, absorb the good control strategy and enhances the strain capacity of the environment. (3) Decision function, it can according to the perception of situation through the decisions of their own real-time working condition to make a comprehensive evaluation, and determine its behavior accordingly. (4) Learning function, according to the control and processing instructions, decisions, and the resulting state changes and the final processing tasks, learning and accumulation of relevant knowledge to improve decision making and control strategy that also from human experts and other intelligent machine direct access to knowledge.

The Evolutionary Algorithms. Co-evolution algorithm is a hotspot in the basic research of the computational intelligence in the recent years, it is aiming at the shortcomings of the evolutionary algorithm, which is, by constructing two or more species and establish the competition or cooperation relationship between them, multiple populations through interaction to improve their performance, to adapt to the dynamic evolution of the complex system environment, to achieve the goal of population optimization. In recent years, the co-evolution algorithm has in many areas has made a series of the successful applications, such as function optimization, multi-objective optimization, classification, image segmentation, neural network design and engineering design, etc., the field has aroused more and more scholars' interest. Genetic algorithm is based on natural selection and genetic law of a global search method, is a combination of random selection and the survival of the fittest theory. The strong groups have a greater chance of its genes passed on to offspring, genetic algorithm since the produce after get extensive application that has proven to be a good optimization algorithm.

From a mathematical point of view, the co-evolution has the characteristics of game theory and dynamic characteristics of co-evolution through continuous evolution and eventually reaches a stable equilibrium state, because of the characteristic of the problem domain the steady state is the optimal solution. Assuming that general co-evolution algorithm can be represented as a matrix game, as the optimization solution of the game, eventually reach equilibrium of that co-evolution algorithm. The general nonlinear programming problem can be described as the follows [7].

\[
\begin{align*}
\min_{x \in S} & f(X, Y) \\
\text{s.t.} & g_i(X, Y) \leq 0, \quad i = 1, 2, \ldots, p \\
& h_j(X, Y) = 0, \quad j = p + 1, \ldots, q
\end{align*}
\]

(1)

If the results are the same as the previous results in the solution, but to adapt to the value to replace the last solution is better than last time, this cycle continues until I find all the peaks. In an extinction of regeneration, the first phase of operation of the end of the article is still the biggest cycles, but the end of the second stage operation conditions and the two different evolution stages of subspace are maximum cycle times, is the search radius small to a certain set of values updated as follows.
Evolutionary game theory based on bounded rationality of individual, group as the research object, the optimization argues that individual is not in reality behaviors, and individual decision making is through imitation, learning, and mutation between individuals such as dynamic process. The main achievements of evolutionary game theory is the rational requirement of the strong to get rid of the traditional game theory, game theory knowledge, and knowledge together, in the evolutionary game theory, the condition was replaced by the evolution, the Agent species through natural selection process to achieve Nash equilibrium. In the process of biological evolution in different species live in the same environment competition survival resources, the result of competition only those who obtain higher fitness of the population to survive. Evolutionary stable strategy of the basic idea is: all assume that there is a choice of a particular strategy big population and a strategy to select different mutations in small groups, mutations in small groups to enter the large group and form a mixed group, if the mutations in small groups in a mixed group of individuals in the game that get paid more than the original group game in the mixed group of pay, so large groups, small groups can invade the vice could not invade the big group and disappeared in the evolutionary process. If a group of the invasion of the mutations can eliminate any small group, then, said the group reached a state of the evolution stable, at this time the group chosen strategy is the evolutionary stable strategy.

The Mechanical Automation. The modern machinery manufacturing technology such as CAD, CAPP manufacturing technology and computer graphics for effective integration, the effective reform of the traditional manual mapping mode, effectively save the labor cost, and raise the level of the drawings and requirements, in terms of precision and speed, of course that also has improved. CDA technology not only has a major position in the drawing speed, in the event of a fault can be timely correction. Mechanical automation technology is mainly manifested in the following respects based on the discussion of the previous properties.
• Automated machining system, for a series of repeated labor, in the process of production can be finished by automated machining system, can largely reduce the repetition labor workers, at the same time due to the automation system has high precision, can effectively reduce the possibility of the error in manual labor to reduce the probability of defective goods produced, guarantee the quality of products.
• Automation of information flow, including general computer aided design, computer aided manufacturing, computer aided process planning and product data management system, etc. Computer aided design refers to the graphics device by using the computer aided design for mechanical design work. Computer-aided manufacturing is in the process of production or basic application of computer technology in the system, its core is computer numerical control technology, usually referred to as "numerical control technology" [8].
• Automated assembly system, the machine is made up of different parts, these parts according to certain order and technical requirements for assembly we can get a finished product as this process can be finished by the automatic assembly system. This can effectively improve the quality of mechanical products to replace the manual assembly can greatly reduce the effects of artificial error and shorten the production time.
• Automated testing process, with the continuous progress of science, to the requirement of the production of precision mechanical products constantly improved, which makes the number of the use of precision parts in mechanical manufacturing process continuously increased, but also increased the difficulty of product quality inspection work, the traditional manual method is hard to test the high precision and the automated testing system can effectively solve the problem and can accurate to test the machine in the production of each link, ensure the quality of the products.

Conclusion
In this paper, we conduct research on mechanical automation technology based on the evolutionary algorithms and artificial intelligence theory. Mechanical automation refers to the external force does not need auxiliary, mechanical itself to complete the process of a complete set of steps that is a good integration of the automation technology and the traditional mechanical method, which realized the qualitative leap. This paper summarizes the general features and properties of the automation to make the proper discussion on the related issues that will be meaningful.

References

