Design and Integration of Automatic Control System Based on Artificial Intelligence

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Abstract. Since the reform and opening up, with the modernization of our country's socialist market economy, the development of science and technology has also changed rapidly. Under the current international situation, competition among countries has become more intense, and various industries are vying for hegemony. In order to obtain more economic benefits, it is necessary to reduce the necessary working hours in society and improve work efficiency. The experimental results can be drawn that the pso algorithm with initialization function not only converges quickly, but they can also maintain the diversification of ant colony data in a small range, making it similar to or even better than the zn-pso algorithm.

Keywords: Artificial Intelligence · Automatic Control · System Design · Integrated Research

1 Introduction

Designing an automated control system is a task that requires high stability, accuracy and safety. Only a set of control systems with high sensitivity and accuracy can guarantee the quality and safety in the industrial production process [1, 2]. Artificial intelligence technology combines the essence of multiple disciplines. It is a profound expansion of traditional computer functions. This is an innovative technology that combines machine language, mathematical logic, semantic analysis and other knowledge [3, 4]. It is characterized by the ability to simulate and directly absorb human thinking and behavior, and users can automatically perform specific corresponding operations through in-depth calculations. This emerging technology product has many advantages [5, 6], such as independent learning and strengthening autonomy. The expansion of the learning and control system can accurately adapt to the needs of users [7]. To a certain extent, it is necessary to establish a set of industrial automation control system to make up for and improve various possible advantages in the previous system, and these systems can scientifically and effectively realize the ideal industrial automation control.

Some researchers have introduced fuzzy control theory methods to improve and optimize the computer's pid control algorithm to achieve high precision and optimization of the control system, but there are still many shortcomings, such as the large control error of the automatic computer control system, and the automatic computer control the optimization of the system lasts a long time and the computer can not automatically

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optimize the computer control system, these are what we can not really do, these are in line with the actual situation of the automatic computer control system. Neural network technology is a kind of artificial intelligence technology. It has good non-linear mapping and customization functions, and it can also improve the computer automatic control system by optimizing the application of the PID control algorithm.

First, use literature research methods to summarize the application of artificial intelligence automation control systems and the integration design principles of automation control systems, and then conduct experiments on the algorithms of the automation control system. Detect the performance of artificial intelligence automation control system algorithms.

2 Automatic Control System Design and Integration Research

2.1 Application in Artificial Intelligence Automation Control System

(1) Effective data collection and processing

It is also an important basis for checking the abnormal conditions in the operation and providing effective solutions for it. The widespread application of artificial intelligence technology can enable enterprises to achieve comprehensive and efficient collection of various types of business data, and can also help ensure that various dynamic data information that is easy to be lost is captured, and can help ensure data security Instead of being automatically lost, it further ensures safe operation and its quality.

(2) Monitoring and warning system operation

The automatic control system is mainly an automatic equipment that strictly implements the pre-defined design model, operates the equipment and controls the calculation logic under the control of the computer programmer and software, so as to realize the automatic management of the product production process. However, if there are abnormalities and failures in the application or computer, it will directly lead to chaos and failures in the entire computer automation monitoring and control system. Artificial intelligence technology can monitor data and operate the system in real time, and users can analyze and judge them through independent learning methods, and provide warnings that special serious situations may occur, so that they can be used in the enterprise. Give full play to production safety and troubleshooting. The key to the importance of research is to make it easier for managers to control and manage risks in a timely manner.

(3) Perform automatic operation function

Simplicity and convenience in the actual operation process. Fundamentally speaking, the overall control and detailed knowledge of the entire operating system can be achieved through the operation of the computer keys, which effectively ensures that the automation functions are consistent with reality. Thereby Analyze the system on the basis of massive data and experience, and meet the needs of automation design to a large extent, realize the automation of automatic operation, improve management efficiency, reduce the previous system conflict problems, solve the command operation, and reduce the frequency of system failures.

(4) Implement professional control system

The expert automatic control system is a real-time control system based on artificial and machine learning. It mainly uses robots and intelligent technology to organically combine the professional knowledge and professional experience of experts and scientific researchers in various automatic control systems. In order to achieve better control goals. And complete the control of its related products and equipment and their reliability by using a calculation formula. Therefore, when we design and research such a system that can be controlled, the application of professional knowledge becomes the most critical component. The developer of the controller must conduct a detailed control effect analysis of the entire system, and write a set of corresponding source codes during the design process to make it more accurate to recognize and understand their correctness and the technical science of the controller. And use the content of the database and its control model as a tool.

2.2 Integrated Design Principles of Automation Control Systems

(1) Practicality and advancement:

The use of mature computer automatic control technology, computer management technology, safety management technology and electronic computer communication technology makes the automation system more practical.

(2) Reliability and safety

Because the operating environment of industrial control systems is usually relatively harsh, the independent operation of the integrated system itself will emphasize its reliability and safety, and the integration will definitely be more complicated. Whether the embedded system can adapt to this environment is an inevitable test of the system. Secondly, computer monitoring systems often undertake important tasks. Once it fails, it will cause serious damage to the entire controlled process and cause serious problems.

$$\mathrm{u(t)} = K_p[e(t) + \frac{1}{T_i}\int e(t) + T_d \frac{d}{dt} e(t)] \tag{1}$$

In the formula: K p ---proportional coefficient; Ti ---integral time constant; Td ---differential time constant

$$\mathrm{J} = \Sigma_{i=1}^{\infty}(w_1|e(i)| + w_3 u^2(i) + w_3 t_u \tag{2}$$

$$\mathrm{P}\left(x_j, y_j, t\right) = \frac{\tau^{\alpha}\left(x_j, y_j, t\right)\eta^{\beta}\left(x_j, y_j, t\right)}{\sum_{J=0}^{9}\tau^{\alpha}\left(x_j, y_j, t\right)\eta^{\beta}\left(x_j, y_j, t\right)} \tag{3}$$

The consequence of this event is that the financial losses caused are usually far greater than the cost of the computer monitoring and control system itself. Therefore, whether to ensure long-term and reliable operation becomes the primary consideration of the computer monitoring system. Especially for monitoring some important high-impact application systems, systems with high failure rates are not allowed. To avoid such problems, high-reliability control and transmission equipment and measures such as setting system user tables and password restrictions can be used.

(3) Economy and scalability

Integrated system and control is a comprehensive and horizontal technical application field. It integrates computer and network technology, automatic control, information processing and wireless communication, detection technology and equipment, production process and quality management knowledge, and technology. Mainly manifested in the three links of hardware, platform, software and tools, the basic principles of information processing and control strategy system design should not be blindly pursuing new technologies, but should be the use of the most cutting-edge technologies in the initial stage of mature technologies. On the one hand, advanced and stable technology can achieve better comprehensive management effects, thereby bringing better economic benefits to enterprises. Therefore, under the conditions of ensuring its reliability and financial permission, advanced technology should be used as much as possible; secondly,the update of hardware and software is becoming shorter and shorter, and the application of advanced technology also means that they can shorten the service life of the system; third, the computer automation monitoring system is an integral part of the complete set of industrial production equipment, and the high-tech content is often reflected in the industrial process. The use of advanced technology allows them to significantly improve the efficiency and added value of the entire industrial equipment bring significant social economic and social benefits to the enterprise.

3 Experiment of Automatic Control System Based on Artificial Intelligence

3.1 Experimental Design

Based on the matlab simulation platform, the algorithm in this paper and other three traditional algorithms are used to carry out the simulation analysis of the pid parameter tuning of the large time delay process and the optimization iterative process; parameter tuning is applied to the large time In the PID controller of the lag process object control system, it is combined with image comparison at the same time.

3.2 Selection of Parameters

The first-order inertia increases the time-delay object:

$$G_{p1}(\mathrm{s}) = \frac{1}{4s+1}e^{-8x} \tag{4}$$

Mathematical Model of Quantitative Control Loop of Paper Machine:

$$G_{p2}(\mathrm{s}) = \frac{1.703}{30.07s+1}e^{-79.96s} \tag{5}$$

After tuning and optimizing the above two methods, the PID controller parameters are shown in Table 1.

Table 1. Controller parameters

Accused	Controller parameters	ZN-ACO-PID	ZN-PSO-PID	H-PSO-PID	HOI-PSO-PID
$G_{p1}(s)$	k_p	0.40	0.59	0.59	0.46
	k_i	0.07	0.04	0.07	0.07
	k_d	0.33	2.35	1.18	0.39
$G_{p2}(s)$	k_p	0.21	0.26	0.34	0.28
	k_i	0.004	0.002	0.005	0.005
	k_d	2.40	10.38	5.88	2.18

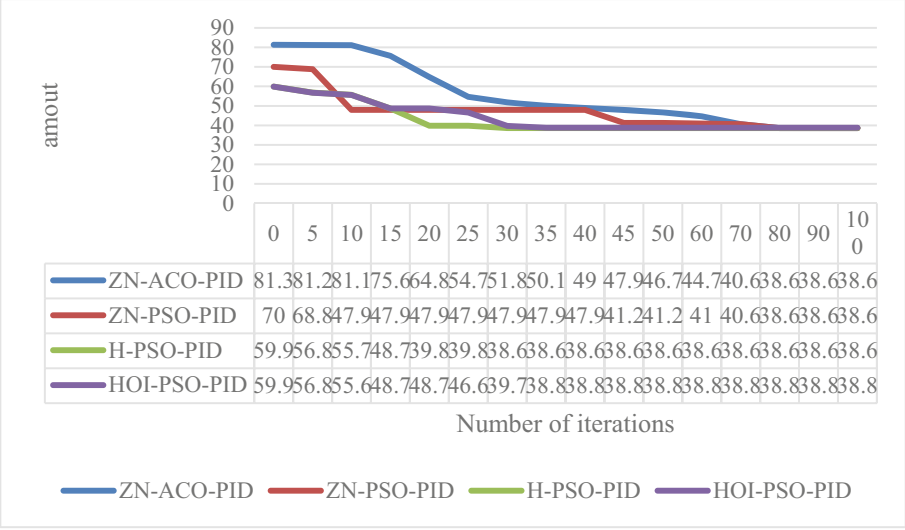

Fig. 1. The process of iterative optimization of G_p1 (s) parameters

4 Analysis of Experimental Results

Figure 1 to Fig. 2 are respectively the process curves of the iterative optimization of the pid parameters of the object with a large time delay using the above four algorithms.

From the figure, we can clearly see that compared with the standard pso algorithm, the h-pso algorithm can reduce the fitness range of the search during the process of pid parameter tuning in the long-term time delay process, and it can reduce the fitness range of the search, avoid the jump of a fitness value to a certain extent and accelerate the convergence of the pso algorithm. However, due to the narrowing of the area, it is difficult to guarantee the number and diversity of particles in the search area. The hoi-pso algorithm uses the theory of information entropy to prepare ant colonies in a targeted manner, so that they can be more dispersed in smaller data and concentrated in a larger search space, and ensure the biodiversity of the ant colony sex. When comparing the

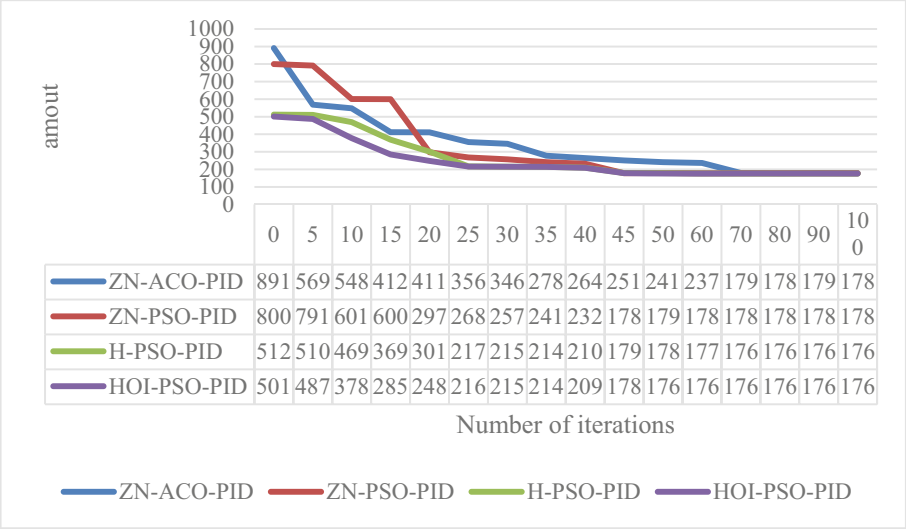

Fig. 2. The process of iterative optimization of G_p2(s) parameters

adjustment process curve controller parameters with longer time delay in the figure, it is not difficult to see that the PSO algorithm with initialization function can not only converge quickly, and can maintain the diversity of the ant colony in a small area, so that it has a global optimization capability similar to or even better than the ZN-PSO algorithm.

5 Conclusions

In the current our country, the widespread use of automated management and control technology provides a very important technical guarantee for the promotion enterprises and companies, promote the research and development of projects, research and technology development of enterprises, and realize the healthy and sustainable development of enterprise production. Integrating artificial intelligence technology into an automated control system can significantly improve the shortcomings of the current existing automated control technology, and also make up for the shortcomings of traditional manual operation technology. This will be regarded as an inevitable requirement for promoting my country's socialist modernization.

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