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# The Analysis of Instrument Automatic Monitoring and Control Systems Under Artificial Intelligence

Qinmei Wang, Tarim Oil and Gas Pipeline Branch of the Western Pipeline of the National Pipeline Network, China*

## ABSTRACT

This integration enables the system to collect and monitor information from remote sources efficiently. During the course of this research, a novel predictive PID approach was developed, splitting the control architecture into two tiers. The upper tier utilizes the extreme learning machine (ELM) as an intelligent predictive model, while the lower tier integrates an enhanced single-neuron adaptive predictive PID control algorithm, combining the strengths of ELM and PID control. The research findings suggest that the AI algorithm-based instrument automatic monitoring and control system holds significant promise. This technology has the potential to enhance production efficiency, reduce energy consumption, improve environmental monitoring, and provide superior safety and quality control.

## KEYWORDS

artificial intelligence algorithm, control system, extreme learning machine, instrument automatic monitoring, PID control

## INTRODUCTION

The rapid development of artificial intelligence (AI) technology has sparked revolutionary changes across various industries. In the realm of the industrial and manufacturing fields, the application of AI has achieved notable success. From optimizing production lines to enhancing quality control, AI is enabling enterprises to boost efficiency, cut costs, and deliver higher-quality products. DALL-E, an advanced AI tool by OpenAI, transforms text prompts into creative and diverse images. This guide aims to provide an in-depth understanding of DALL-E's capabilities and offers practical advice for users. One significant application in this domain is the AI algorithm-based instrument automatic monitoring and control system, which has garnered significant attention due to its intelligence, adaptability, and high reliability.

In traditional manufacturing industries, instrument monitoring and control typically require extensive manual intervention and oversight, which not only escalates costs but also introduces the potential for human error (Xin et al., 2018; Dai, 2022). With the continuous evolution of AI technology, these tasks can be automated through the use of machine learning and data analysis, thereby improving production efficiency and minimizing errors (Kanto et al., 2022).

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*Corresponding Author

Furthermore, AI systems can dynamically adjust themselves based on historical data and real-time conditions to handle changes and fluctuations in the production process (Borza & Borza, 2017). Expert control fundamentally encompasses various forms of expert knowledge related to the controlled object and control laws, which AI technology employs to optimize and make the controlled object as efficient and practical as possible (Gitis & Derendyaev, 2019). Intelligent PID controllers based on neural networks leverage the self-learning capabilities of neural networks and the approximation abilities of nonlinear functions, while adhering to specific optimization criteria (Wang et al., 2022). Kinoshita et al. (2018) introduced a PID controller based on a BP neural network (BPNN), merging the self-learning and adaptability of the BP algorithm with the simplicity and robustness of PID, enabling seamless switching between them.

BPNN does not require prior learning, making it an excellent online adaptive comprehensive controller. To address the slow convergence of neural networks, Jinsong et al. (2017) employed a combination of genetic algorithms (GAs) and the BP algorithm to fine-tune PID parameters. This approach capitalizes on the global optimization capabilities of GA and the rapid error reduction abilities of the BP algorithm, effectively resolving the parameter search space problem and significantly improving convergence speed and global optimization. Huang et al. (2018) discussed a time-delay identification scheme for linear MIMO systems using neural networks, demonstrating the feasibility of this method.

The primary objective of this study is to design and develop an automatic instrument monitoring and control system based on AI algorithms, with the aim of enhancing the efficiency of instrument monitoring and control in industrial production. The system's design will leverage modern AI technologies, such as deep learning, machine learning, and data analysis, to achieve highly intelligent monitoring and control (Jones & Venable, 2022).

In this study, we combine a wireless sensor network and mobile communication network through an embedded platform to enable the collection and monitoring of remote information sources. With a focus on the instrument automatic monitoring and control system as our research subject, we introduce a novel predictive PID methodology. The control framework is divided into two tiers. The upper tier utilizes the Extreme Learning Machine (ELM) as the intelligent predictive model, while the lower tier incorporates the enhanced single-neuron adaptive predictive PID control algorithm, harnessing the strengths of both ELM and PID control. Our simulation results demonstrate that this innovative predictive PID control approach is characterized by its simplicity, precise control, robust performance, rapid learning capabilities, and impressive control effectiveness (Dayyala et al., 2022). It is particularly well-suited for real-time control within instrument automatic monitoring and control systems.

Through this research, we aim to provide a more intelligent, efficient, and reliable instrument monitoring and control solution for the manufacturing and industrial sectors. This, in turn, will advance the field of industrial automation and confer greater competitive advantages upon enterprises. Simultaneously, this study will contribute further evidence to the potential of AI in industrial applications and promote the widespread adoption of AI technology in practical production environments (Savoli & Bhatt, 2022).

## RESEARCH METHOD

### Overall Design Scheme

An instrument automatic monitoring and control system is a technical setup designed for monitoring, measuring, and controlling industrial processes or systems. These systems typically comprise an array of sensors, instruments, controllers, and user interfaces that are used to collect and analyze data, as well as implement control measures to ensure the stable, safe, and efficient operation of industrial processes or systems. Instrument control systems find

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