

## THE OPTIMAL GNN-PID CONTROL SYSTEM USING PARTICLE SWARM OPTIMIZATION ALGORITHM

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**ABSTRACT.** *The PID control algorithm has been widely applied in many industry fields to solve efficiently the control problems of manufacturing processes. However, PID control algorithm belongs to “delay control”, because it functions on basis of the actions occurred in the system. Thus the control accuracy in real-time is limited. In this paper, in order to realize the accurate control in real-time, the grey model based on grey system theory is first proposed to combine with PID control to establish the control system. We define the proposed control system as grey PID control system. Then a residual compensation approach based on neural network (NN) is integrated into grey model to enhance the control accuracy of system. To further improve the control performance, the particle swarm optimization (PSO) algorithm is employed to optimize the control system. Finally, we validated the effectiveness of the proposed control system by computer simulation.*

**Keywords:** PID control, Grey model (GM), Neural network (NN), Particle swarm optimization (PSO)

**1. Introduction.** The PID control algorithm has been widely applied in many control systems of industry manufacturing processes to solve efficiently the control problems of manufacturing processes because of its simple technology and good adaptability. However, PID control algorithm is a kind of “delay control” and requires the control system has the precision mathematical model. When the control process is that of great complexity, more often than not, it associated with uncertainty. In this case, the PID control algorithm cannot realize the real time control and the control accuracy is limited. Thus it is difficult to increase the quality of the control system further [1]. As an improved control algorithm, the fuzzy logic control has been researched by many researchers [2-5]. However, the application of fuzzy logic control needs considerable effort to find the appropriated membership functions and fuzzy rules, especially when the control process is complicated. These increase the difficulties in the designing of the fuzzy logic control [6].

In order to realize the accurate control in real time, Deng proposed grey model based on grey system theory [7] in 1982. As the prediction model, grey model [8] plays an important role to make accurate prediction in many fields, ranging from economics through physics to engineering. In recent years, the control algorithm based on grey model has been successfully in various control fields [9-13]. The grey model realize the control relies on actions of the system in the future, and it has better self-adapting and control accuracy. In this paper, we propose an optimal PID control system based on improved GM(1, 1),