

## **A simplified PID-like ANFIS controller trained by genetic algorithm to control nonlinear systems**

### **ABSTRACT**

This paper proposes a simplified ANFIS (Adaptive Neuro-Fuzzy Inference System) structure acting as a PID-like feedback controller to control nonlinear systems. Only few rules have been utilized in the rule base of this controller to provide the control actions, instead of the full combination of all possible rules. The proposed controller has several advantages over the conventional ANFIS structure particularly the reduction in execution time and memory resources without sacrificing the controller performance, and hence, it is more suitable for real time control. In addition, the real-coded Genetic Algorithm (GA) has been utilized to train this ANFIS controller, instead of the hybrid learning methods that are widely used in the literature, and hence, the necessity for the teaching signal required by other techniques has been eliminated. Moreover, the GA was used to find the optimal settings for the input and output scaling factors for this controller, instead of the widely used trial and error method. Three nonlinear systems, including the CSTR (Continuous Stirred Tank Reactor), have been selected to be controlled by this controller to demonstrate its accuracy and generalization ability. In addition, this controller robustness to output disturbances has been also tested and the results clearly indicated the remarkable performance of this controller. The result of comparing the performance of this controller with a conventional ANFIS controller and a conventional PID controller has shown the superiority of the proposed ANFIS structure.

**Keyword:** ANFIS; Conventional PID controller; Genetic algorithms; Neuro-fuzzy systems