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IMPROVEMENT OF TRACKING PERFORMANCE IN MODEL-FREE ADAPTIVE CONTROLLER BASED ON MULTI-INNOVATION AND PARTICLE SWARM OPTIMIZATION

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Abstract. *To improve the convergence rate of model-free learning adaptive controller (MFLAC) and decrease the difficulty of parameters choice in control law, a new design method of MFLAC is presented. The controller proposed in this paper is designed based on pseudo gradient concept with solution by introducing multi-innovation method and the control law parameters optimization by particle swarm optimization (PSO). Finally, we present some numerical examples to illustrate the effectiveness of the proposed method.*
Keywords: Model-free, PSO; Multi-innovation, Adaptive control

1. **Introduction.** As we have known, the model-based control techniques are usually implemented under the assumption of good understanding of process dynamics and they are the dependence on mathematical model of controlled plant. However, these techniques can not provide satisfactory results when applied to poorly modeled processes or complex systems. Therefore, how to design adaptive control system only based on information from the input/output (I/O) data of the plant is significant both in theory and application. Now, several successful methods among the model-free control approaches are Proportional-Integral-Derivative (PID) controller [1], fuzzy controller [2], neural network controller [3] and the model-free learning adaptive controller (MFLAC) [4, 5].

The most widely used industrial controller today is still the PID controller. PID is simple, easy to implement, and requires no process model. Numerous improvements to the tradition PID have been proposed [6, 7]. However, PID has major shortcomings. Firstly, PID works for the process that is basically linear, time-invariant, and may have only small or no dynamic changes. Secondly, PID has to be tuned right by the user; that is, its parameters have to be set properly based on the process dynamics. And last, PID can not work effectively in controlling complex systems which are usually nonlinear, time-variant, coupled, and have parameter or structure uncertainties.

Fuzzy controller is frequently claimed as model-free; nevertheless, in all fuzzy controllers there is a requirement for a rules base (or associative memory matrix) that describes the dynamics of the system in a linguistic-type fashion. Although such information is not in the classical form of differential or difference equations, it is still a representation of the dynamics that seems to qualify as a model. Similar arguments can be made for some