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A Simplified Recurrent Neural Network Trained by Gbest-Guided Gravitational Search Algorithm to Control Nonlinear Systems

Abstract- *This paper presents a feedback control strategy using a Simplified Recurrent Neural Network (SRNN) for nonlinear dynamical systems. As an enhancement for a previously reported modified recurrent network (MRN), the proposed SRNN structure is used as an intelligent Proportional-Integral-Derivative (PID)-like controller. More precisely, the enhancement in the SRNN structure was realized by employing unity weight values between the context and the hidden layers in the original MRN structure. The newly developed Gbest-guided Gravitational Search Algorithm (GGSA) was adopted for optimizing the parameters of the SRNN structure. To show the efficiency of the proposed PID-like SRNN controller, three different nonlinear systems were considered as case studies, including a control valve, and a complex difference eq.. From an extensive set of evaluation tests, which includes a control performance test, a disturbance rejection test, and a generalization test, the proposed PID-like SRNN controller demonstrated its effectiveness with regards to precise control and good robustness and generalization abilities. Furthermore, compared to other Neural Network (NN) structures, including the original MRN and the Multilayer Perceptron (MLP) NN, the SRNN structure attained superior results due to the utilization of a reduced set of parameters. From another study, the GGSA accomplished the best optimization results in terms of control precision and convergence speed compared to the original Gravitational Search Algorithm (GSA).*

Keywords- *Modified Elman neural network, modified recurrent neural network, artificial neural network, gbest-guided gravitational search algorithm, genetic algorithm.*

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