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GA-BASED ADAPTIVE NEURAL NETWORK CONTROLLERS FOR NONLINEAR SYSTEMS

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Abstract. *In this study, we propose a method of stability analysis for a GA-Based reference ANNC which is capable of handling these types of problems in a nonlinear system. First of all, radial basis function networks are utilized to well approximate an uncertain and nonlinear plant for the tracking of a reference trajectory. Next, the initial values of the consequent parameter vector are decided via a genetic algorithm (GA), after a modified adaptive law is derived based on Lyapunov stability theory for the purpose of controlling the nonlinear system which is used for tracking a user-defined reference model. The requirement of the Kalman-Yacubovich lemma is fulfilled. A boundary-layer function is introduced into these updating laws to cover parameter and modeling errors, and to guarantee that the state errors converge within a specified error bound. After this, an adaptive neural network controller (ANNC) is derived to simultaneously stabilize and control the system. Finally, a numerical simulation is carried out. The simulation results show the rapidity and efficiency with which the control methodology can control nonlinear systems.*

Keywords: Neural network controller, Lyapunov stability theory, Genetic algorithm, Modified adaptive law

1. **Introduction.** Intelligent control [1-3] is becoming a more common tool in many engineering and industrial applications where fuzzy logic is utilized [4,5]. It is also used for genetic algorithms (GA) [6-8] and neural networks [9-12]. All methods of intelligent control have the following features: learning ability and adaptability; robustness; a simple control algorithm for relatively user-friendly human-machine interfacing. As a consequence, practical applications of these systems have been increasing.

Over the past few years, there have been significant efforts devoted to researching system analysis and control designs (see [13-17] and the references therein). Undoubtedly, the Lyapunov theory is one of the most common approaches dealing with the stability analysis of systems. However it has been necessary to develop more effective measures to overcome the conservatism that arises from the use of Lyapunov methods. There are many important issues that require study related to control systems, such as time delays [13,14], GA [15,16] and robustness [17].

As has been explored previously, neural networks (NN) and their artificial neurons, synaptic weights and thresholds, are designed to emulate the capabilities of the human brain. NN systems are essentially intelligent inference systems, implemented in the framework of adaptive networks. A backpropagation algorithm [10-12] is usually used in the