International Journal of Innovative Computing, Information and Control
Volume **6**, Number **11**, November **2010**

ICIC International ©2010 ISSN 1349-4198
pp. 4825–4841

MULTILAYER FEED FORWARD NEURAL NETWORKS FOR CONTROLLING DECENTRALIZED LARGE-SCALE NON-AFFINE NONLINEAR SYSTEMS WITH GUARANTEED STABILITY

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Received April 2009; revised November 2009

Abstract. *This paper introduces a new decentralized adaptive neural network controller for a class of large-scale nonlinear systems with unknown non-affine subsystems and unknown interconnections represented by nonlinear functions. A multilayer feedforward neural network is used to represent the controller's structure. The ultimate boundedness of the closed loop system is guaranteed through Lyapunov stability analysis by introducing a suitably driven adaptive rule. To show the effectiveness of the proposed decentralized adaptive controller, a nonlinear system is chosen as a case study. Simulation results are very promising.*

Keywords: Decentralized non-affine nonlinear system, Adaptive control, Multilayer feed forward neural network (MFNN)

1. **Introduction.** The design of suitable controllers for large-scale systems and effort to extend them to more general cases have recently attracted much attention. Research in this area is motivated by many emerging applications that employ novel actuation devices for active control of industrial automation, cooperating robotic systems, power systems and aerospace processes. Centralized control of large-scale systems is usually impractical due to 1) the need to exchange large amounts of information among subsystems and 2) lack of computing devices capable of handling huge amounts of computations [1].

The primary studies of decentralized adaptive control initially covered for linear large-scale systems. Knowing that most of actual large-scale systems are nonlinearly coupled to the dynamics of the processes, the researchers are still trying to control these systems [2-8]. Mostly, they either investigate subsystems which are linear in a set of unknown parameters, i.e. [2-4,7], or they consider isolated subsystems to be known, i.e. [8,9]. The majority of recently published papers on decentralized adaptive control of large-scale nonlinear systems focused on systems with first-order bound interconnections. These results cannot guarantee stability when the interconnections between the subsystems are of higher orders [10]. Reference [11] presented a frequency domain method to tune a decentralized PID controller for nominal performance with robust stability analysis. In [12], a reliable robust output feedback stabilizing computer control was proposed for decentralized stochastic singularly-perturbed systems. The authors in [13] studied a new frequency