

NEURAL NETWORK ROBUST ADAPTIVE CONTROL FOR A CLASS OF TIME DELAY UNCERTAIN NONLINEAR SYSTEMS

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Received September 2008; revised February 2009

ABSTRACT. *In this paper, a robust adaptive control scheme based on neural network is proposed for a class of time delay uncertain nonlinear systems. The system under study possesses a wide class of nonlinear time-delayed input uncertainties and function uncertainties. The radial basis function (RBF) neural networks are introduced to approximate the unknown bounded continuous input uncertainties with appropriate weight value updated laws. Based on the output of RBF neural network, a robust adaptive control scheme is developed for the time delay uncertain system. To obtain the stable closed-loop system, the parameter updated laws are presented for the approximation error of RBF neural network and the uncertain parameters of time delayed item in the input uncertainty. Finally, an example is given to illustrate the effectiveness of the proposed control scheme.*

Keywords: Uncertain system, Time delay, RBF neural network, Adaptive control, Robust control

1. **Introduction.** In practical control systems, uncertainties and time delays are frequently encountered and they are often the sources of instability and performance degradation. Thus, the considerable attention has been paid to the problem of stability analysis and robust controller design for the time-delay uncertain systems during the past few years [1-14]. Many robust adaptive control schemes such as guaranteed cost control and H_∞ control have been proposed for time-delay system. An adaptive neural network control scheme was proposed for a class of nonlinear systems with unknown time delays in [1]. Hsiao and Hwang [2] studied the stable control scheme for a class of nonlinear singularly perturbed multiple time-delay systems. In [3], a robust controller was proposed for a class of time-delay nonlinear systems. Park [4] investigated the design of observer-based control scheme of linear neutral delay-differential systems. A robust H_∞ observer design scheme of linear time-delay systems with parametric uncertainty was proposed in [5]. Xu and Dooren et al [6] studied the problem of robust stability for uncertain continuous singular systems with state delay. The delay-dependent robust stability criteria for two classes of singular time-delay systems with norm-bounded uncertainties were investigated in [7]. In [8], a robust H_∞ control scheme was proposed for uncertain linear systems with a state-delay. Fridman [9] investigated the stability of linear retarded and neutral type systems by the Lyapunov-Krasovskii function. In [10], the delay-dependent stability conditions were developed for the time delayed system. Two design schemes were proposed for robust adaptive control of a class of linear uncertain neutral delay systems in [11]. In [12], robust adaptive control of uncertain time delay systems with fuzzy logical system