International Journal of Innovative Computing, Information and Control
Volume **3**, Number **2**, April **2007**

ICIC International ©2007 ISSN 1349-4198
pp. 385–396

TWO DESIGN SCHEMES FOR ROBUST ADAPTIVE CONTROL OF A CLASS OF LINEAR UNCERTAIN NEUTRAL DELAY SYSTEMS

Xi-Ming Sun, Jun Zhao

School of Information Science and Engineering
University of Northeastern
Shenyang 110004, P. R. China
wrsxm@126.com; zdongbo@pub.ln.cninfo.net

Wei Wang

Research Center of Information and Control
Dalian University of Technology
Dalian 116024, P. R. China
wangwei@dlut.edu.cn

Received December 2005; revised October 2006

Abstract. *This paper focuses on the problem of adaptive robust control design for a class of linear uncertain neutral delay systems. All uncertainties are assumed to be norm-bounded by unknown constants. Two methods are proposed to estimate these unknown bounds. Then, by making use of the updated values of these unknown bounds, two kinds of memory state feedback controllers are designed. It is shown that the close-loop neutral delay systems resulting from two proposed adaptive robust control schemes are both uniformly ultimately bounded. The corresponding results can be changed into the form of linear matrix inequalities (LMIs). Finally, two numerical examples are given to illustrate the effectiveness of the proposed approaches.*

Keywords: Robust adaptive control, Neutral delay systems, Linear matrix inequality (LMI)

1. **Introduction.** Because delay is often a source of system instability and performance deterioration, much attention has been paid to stability analysis and controller synthesis for delay systems [1]-[12], [28, 29, 30]. There is a special class of delay systems whose state is not only affected by state delay but also affected by derivative of state delay. Such system is referred to as neutral delay systems [13], which can find many applications, such as distributed networks containing lossless transmission lines, and population ecology. On the other hand, due to modeling error, measurement errors, linearization approximation, and so on, it is almost impossible to avoid the uncertainties or perturbations in practical design. Therefore, neutral delay systems with uncertainties have also been paid much attention recently [14]-[16], where the upper bounds of uncertainties are generally supposed to be known, and such bounds are often used to develop some stability conditions.

However, in the practical control problems, it is usually difficult to obtain those bounds because of the complexities of the uncertainties. Therefore, for such a class of neutral delay systems with uncertainty, a parameter adaptation should be taken into account to update these unknown bounds. Many forms of adaptive control schemes are available in