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ROBUST STABILIZATION OF NONLINEAR TIME-DELAY INTERCONNECTED SYSTEMS VIA DECENTRALIZED FUZZY CONTROL

Shaocheng Tong[1], Shuo Tong[2] and Qingling Zhang[2]

[1]Department of Mathematics and Physics
Liaoning University of Technology
Liaoning, Jinzhou 121001, P. R. China
jztsc@sohu.com

[2]Institute of System Science
Northeastern University
Shenyang 110004, P. R. China

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Abstract. *Fuzzy decentralized state feedback and observer-based decentralized output feedback controllers are developed for a class of continuous nonlinear interconnected systems with time-delay and the modeling error. First, an equivalent T-S fuzzy model represents the continuous nonlinear interconnected system with time-delay, then fuzzy state feedback and observer- based fuzzy output feedback decentralized controllers are designed. The sufficient conditions for the stability of the fuzzy decentralized system with time-delay are proposed by using Lyapunov function combining with linear matrix inequalities (LMIs). Finally, the simulation example is given to illustrate the effectiveness of the proposed methods.*
Keywords: Interconnected systems with time-delay, Decentralized fuzzy control, Fuzzy observer, Stability analysis

1. **Introduction.** Various practical control systems such as transportation systems, urban planning, economic models, spacecraft dynamics, power systems, industrial processes and others have the form of interconnected dynamical systems. Moreover, in practice, due to the information transmission between subsystems, time delays are naturally existed in interconnected systems. The existence of time delay is frequently a source of instability and encountered in many engineering systems. Therefore, in the last two decades, decentralized stabilization of large-scale systems with time delay has been widely studied. Stability criteria of time-delay systems so far have been approached in two main ways according to the dependence upon the size of delay. One direction is to contrive stability conditions that do not include information on the delay, while the other direction includes methods which take this into account. The former case is often referred to as delay-independent criteria and generally gives good algebraic conditions. In particular, some delay-independent stability conditions and stabilization approaches have been proposed for nonlinear systems. However, abandonment of information on the size of time delay necessarily causes conservativeness of the criteria, especially when the delay is comparatively small.

The control design of nonlinear systems is a difficult process, and in practical control systems, the plants are always nonlinear. Thus many nonlinear control methods have been proposed to overcome the difficulty in controller design for real systems. However, the control schemes for nonlinear systems are so complicated that they are not suitable for