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DECENTRALIZED OUTPUT FEEDBACK FUZZY H_∞ TRACKING CONTROL FOR NONLINEAR INTERCONNECTED SYSTEMS WITH TIME-DELAY

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Abstract. *In this study, a fuzzy model reference H_∞ tracking control is developed for nonlinear interconnected systems with time-delay and unmeasured states. First, an equivalent Takagi and Sugeno (TS) fuzzy model represents the nonlinear interconnected systems, and then a decentralized fuzzy observer is designed to estimate the states of each subsystem. Consequently, an observer-based fuzzy output-feedback decentralized controller is proposed by solving the H_∞ tracking control design problem for nonlinear time-delay interconnected system in terms of a linear matrix inequality problem (LMIP). The simulation example is given to illustrate the design procedures and tracking performance of the proposed method.*

Keywords: Nonlinear interconnected systems with time-delay, Decentralized fuzzy H_∞ tracking control, Linear matrix inequality problem (LMIP)

1. **Introduction.** With the development of fuzzy systems, some fuzzy control design methods have appeared in the field of fuzzy control. Among various kinds of fuzzy control methods, Takagi and Sugeno (T-S) [1] proposed a design and analysis method for overall fuzzy systems, in which the qualitative knowledge of a system is represented by a set of local T-S fuzzy models. Up till now, a lot of research results on T-S fuzzy systems have been reported [2,3], particularly in recent years. Linear matrix inequality (LMI) based design approaches for T-S fuzzy models have been developed [4,5].

The past three decades have witnessed serious applications of large-scale interconnected system methodologies to urban planning, economic models, space craft dynamics, power systems, industrial processes, transportation networks and others. The properties of interconnected systems have been widely studied [6-9]. There exist two kinds of control design methods, one is centralized control, the other is decentralized control. Due to the physical configuration and high dimensionality of interconnected systems, a centralized control is neither economically feasible nor even necessary. Therefore, decentralized scheme is preferred in control design of the large-scale interconnected systems. In other words, decentralized control scheme attempts to avoid difficulties in complexity of design, debugging, data gathering, and storages requirements.

The control design of nonlinear interconnected systems is a difficult process, and in practical control systems, the plants are always nonlinear. Thus many nonlinear decentralized control methods have been proposed to overcome the difficulty in decentralized