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FUZZY STATIC OUTPUT FEEDBACK GUARANTEED COST RELIABLE CONTROL FOR UNCERTAIN NONLINEAR SYSTEMS WITH TIME-DELAY

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Abstract. *This paper is concerned with the fuzzy static output feedback guaranteed cost reliable control problem for Takagi-Sugeno(T-S) fuzzy systems with time-delay and uncertainties. A linear matrix inequality(LMI)method for the design of a stabilizing fuzzy static output feedback guaranteed cost reliable controller is investigated, which provides different upper bounds on the guaranteed cost function for the normal case and actuator fault cases. A suboptimal fuzzy static output feedback guaranteed cost reliable controller is given by means of a LMI optimization procedure, which not only provides different upper bounds on the guaranteed cost function for the normal case and actuator fault cases, but also provides an optimized upper bound on the guaranteed cost function for the normal case. Finally, simulations on the continuous truck-trailer system are given to illustrate the effectiveness of the proposed design method.*
Keywords: Static output feedback control, Guaranteed cost control, Liner matrix inequality(LMI), Reliable control, Takagi-Sugeno fuzzy model

1. **Introduction.** Recently, fuzzy logic control based on Takagi-Sugeno(T-S) fuzzy model [1] becomes more and more popular for nonlinear systems [2-5]. It is an effective approach to model and control. In the so-called T-S type fuzzy model, local dynamics in different state-space regions are represent by linear models and the overall model of the nonlinear system is represented as the fuzzy interpolation of these linear models. The control design is carried out based on the fuzzy model via the so-called parallel distributed compensation(PDC) scheme. The resulting overall controller is nonlinear in general which is a fuzzy blending of each individual linear controller designed for each local linear model.

Time-delays often occur in many dynamic systems, such as rolling mill systems, chemical processes, network systems and so on. It is shown that the existence of delays usually becomes the source of instability and deteriorating performance of systems. In recent years, some authors have paid attention to the control of nonlinear systems with time-delay via T-S fuzzy models [3-6].

In practical applications, system states are not always measurable [7,8]. Thus, state observers are required to estimate states of the systems. It is easy to see that when state observers are included into the synthesis of controllers, the design problem becomes complicated. Instead of using system states to control systems, static output feedback control directly use system outputs [9-11]. Though static output feedback control is conservative, the structure of static output feedback controller is simple. Thus, from the design viewpoint, if a static output feedback controller can be found to be satisfactory, why it bother to design a complicated dynamic feedback controller.