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CONTROL DESIGN OF T-S FUZZY LARGE-SCALE SYSTEMS

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Abstract. *This paper proposes a new fuzzy controller design method to stabilize a large-scale system. The system is composed of a number of T-S fuzzy modeled subsystems. Based on Lyapunov criterion, some sufficient conditions are derived and the fuzzy control is developed such that the whole large-scale closed loop system is asymptotically stable. Finally, a numerical example is shown to illustrate the control design procedure and its effectiveness.*

Keywords: Fuzzy large-scale system, T-S fuzzy model, Fuzzy control, Stability, Lyapunov criterion

1. **Introduction.** Large-scale systems are usually used in the practical world, such as electric power systems, nuclear reactors, aerospace systems, economic system process control systems, etc. The so-called large-scale system is composed of a number of independent subsystems, which share resources, and are connected by a set of interconnections [9,13,14].

Over the past decade and before, a lot of researchers have paid a great deal of attention to the control problems of large-scale system. These problems include hierarchical control, decentralized control, estimation and filtering, model reduction, robust control, etc [3-9,13,16,17,21,22,26-29]. Even though the above studies have gained great harvest, however, the model of a large-scale system may be complicated, or even impossible to be described in practice. Moreover, the form of the interaction could be hardly to be identified also.

On the other hand, fuzzy logic with IF-THEN rules has become one of the most useful approaches for modeling a practical system. It is shown that fuzzy modeling has the capability of modeling complex nonlinear processes to arbitrary degrees of accuracy [1], [25,32]. After Takagi and Sugeno [18,19] proposed a kind of fuzzy inference system so-called the Takagi-Sugeno (T-S) fuzzy model, one step further, it can combine the flexibility of fuzzy logic theory and the rigorous mathematical analysis tools in linear system theory into a unified framework. Consequently, suppose each subsystem of the large-scale system can be modeled by a set of fuzzy rules. Each subsystem dynamic is captured by a set of fuzzy implications, which characterize local behavior in the state space. The global model for the large-scale systems can be then achieved by smoothly connecting the local linear model in each fuzzy subspace together via the membership function. The large-scale system can be called a fuzzy large-scale system.

There are some inspired papers discuss the fuzzy large-scale system problem. Yoshikawa, T *el.* model a large-scale system with fuzzy approach [31], Yanxin, *el.* present fuzzy direct/indirect adaptive slide mode control for a class interconnected large-scale systems