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PASSIVE FUZZY CONTROL WITH RELAXED CONDITIONS FOR DISCRETE AFFINE T-S FUZZY SYSTEMS

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Abstract. *This paper investigates the stability analysis and controller synthesis of nonlinear systems which are presented by discrete-time affine Takagi-Sugeno (T-S) fuzzy models. For extending the area of feasible solutions of controllers and for attenuating the influence of external disturbances, this paper presents new stability conditions for the proposed affine T-S fuzzy models. In addition, the passivity theorem and Lyapunov theory are applied in this paper to achieve the system passivity and closed-loop stability. Afterwards, the relaxed stability conditions are presented in the form of Linear Matrix Inequality (LMI) which can be calculated by the optimal convex algorithm. Finally, the application of the proposed design methodology is manifested via a numerical example with computer simulations.*
Keywords: Affine Takagi-Sugeno fuzzy models, Passive systems, S-procedure, Iterative linear matrix inequality, Relax stability conditions

1. **Introduction.** During the last few years, the stability analysis and controller synthesis of nonlinear T-S fuzzy models [1,4-8,12,17,19-22] have been studied widely. It may be due to the fact that the T-S fuzzy models can provide an effective solution to the control of plants that are complex, uncertain, ill-defined, and that have available qualitative knowledge from domain experts for their controllers design. Unlike conventional modeling techniques which use a single model to describe the global behavior of a nonlinear system, the fuzzy modeling is essentially a multi-model approach in which typically sub-linear systems are fuzzily combined to describe the global behavior of a nonlinear system. In addition to sub-linear systems, the framework of T-S fuzzy model contains a decision membership function. The membership function is decided by engineers or designers but these sub-linear systems in T-S fuzzy model are obtained via different linearization technologies. In general, the linearization technologies include sector [21] and Jacobian linearization [12] techniques. During deploying the linearization technique, the types of sub-linear systems are exhibited as homogeneous and affine types. The most significant difference between of them is that the affine T-S fuzzy model [7,8,12,17] has a nonzero bias on each sub-linear system; and another model has zero bias. Based on the nonzero bias,