International Journal of Innovative Computing, Information and Control
Volume 7, Number 4, April 2011
 ISSN 1349-4198
pp. 1753–1764

RELAXED RESULTS ON STABILIZATION AND STATE FEEDBACK H_∞ CONTROL CONDITIONS FOR T-S FUZZY SYSTEMS

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Received November 2009; revised March 2010

Abstract. *This paper further studies stabilization and state feedback H_∞ control conditions for discrete T-S fuzzy systems. By extending a nonquadratic Lyapunov function and applying a nonparallel distributed compensation (non-PDC) control law, first a relaxed stabilization conclusion is presented that is an extension of some previous results in the literature, then a sufficient condition which can guarantee the existence of state feedback H_∞ controllers for the T-S fuzzy systems is proposed. In comparison with the existing results, the proposed conditions not only provide more relaxation but also ensure better H_∞ performances. Finally, the validity and applicability of the proposed results are successfully demonstrated through two numerical examples.*
Keywords: Discrete T-S fuzzy systems, Nonquadratic Lyapunov functions, Non-PDC control laws, Stabilization, H_∞ control

1. **Introduction.** It is well known that most plants in the industry have significant nonlinearities, which usually make the analysis and controller design difficult. In order to overcome this kind of difficulties, various schemes have been developed in the past two decades, among which a successful approach is the fuzzy control. In recent years, it becomes quite popular to adopt the so-called T-S fuzzy models [1] to represent or approximate a nonlinear system, and there have been many successful applications [2,3]. For now, for stability analysis and systematic design of T-S fuzzy systems, many researchers have presented a quadratic Lyapunov function approach to find a constant positive definite matrix utilized a parallel distributed compensation (PDC) control law [2-11]. So-called relaxed stabilization conditions were proposed in [4,5], and the proposed conditions were used to design fuzzy controllers for T-S fuzzy systems. In [6,8], the quadratic stabilization conditions were proposed in the form of linear matrix inequalities (LMIs) and reported to release the conservatism of the conditions of [4,5] by collecting the interactions in a single matrix. In [9], a new stabilization condition was shown to be less conservative than some relaxed quadratic stabilization conditions published in the literature [4-6,8]. Recently, in order to find more relaxed stabilization conditions, the nonquadratic Lyapunov function approach has been introduced which utilized a fuzzy blending of multiple quadratic Lyapunov functions [12-15]. In [12,13], nonquadratic stabilization conditions were proposed by using PDC control laws and [14,15] effectively applied nonquadratic Lyapunov functions and non-PDC control laws.