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STABILITY ANALYSIS OF IMPULSIVE TAKAGI-SUGENO SYSTEMS

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Abstract. *In this paper the Lyapunov stability of impulsive Takagi-Sugeno(T-S) fuzzy systems is considered. The sufficient conditions of stability for impulsive fuzzy systems are derived based on the Lyapunov's direct method. They can be expressed easily as a set of Linear Matrix Inequalities(LMIs). An example of impulsive fuzzy control for ecological predator– prey community is given to illustrate the theory.*
Keywords: Impulsive fuzzy system, Linear matrix inequalities, Asymptotic stability

1. **Introduction.** During the last few decades the stability analysis and controller synthesis of nonlinear T-S fuzzy models have been widely studied [1-7] because the T-S fuzzy models can approximate a wide class of complex, uncertain, ill-defined and nonlinear systems that cannot be exactly modeled.

In recent years the T-S fuzzy models were extended to the nonlinear systems with time delay and uncertainty and the most results have been obtained by state feedback and observer scheme [1,5,8-14]. The control approaches based on T-S model are usually used PDC technique [15] which is widely applied in the fuzzy control design. It is well known that there exist the systems that cannot endure the continuous effects of control inputs. In this case the most control approaches based on PDC technique couldn't efficiently deal with them. But the impulsive control which instantly changes the system's state is an effective way to solve stability problem for such systems. Therefore the theory of differential equations with impulsive effect has been the subject of many investigations (see [16-20] and the references therein). It should be noted that in [18,19] stability conditions have been obtained which allow to investigate the case when continuous and discrete components of impulsive system are unstable. The impulsive control has been also used to stabilize and synchronize chaotic systems [21,22].

Though there are only some papers(the authors know only [23]) which considered impulsive control of systems using the T-S fuzzy models. In [23] the stability conditions of impulsive fuzzy systems are derived by employing comparison method [16,27]. In spite of their success, their conditions are not easy to verify in general, specifically as the number of fuzzy rule is increased or/when than control matrices are not diagonal.

In this paper the stability of impulsive fuzzy systems is investigated by constructing a Lyapunov function of special form. The sufficient conditions for stability of such systems in the sense of Lyapunov are derived in the form of Linear Matrix Inequalities. The obtained results are applicable to a wider class of systems than in [23].

The paper is organized as follows. In Section 2 the configuration of impulsive T-S fuzzy system and some preliminaries are discussed. Next, in Section 3 the sufficient conditions are derived to guarantee the asymptotical and globally asymptotical stability of impulsive