

## CONTROLLER FAILURE ANALYSIS FOR T–S FUZZY SYSTEMS WITH TIME-VARYING DELAY VIA A SWITCHED APPROACH

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Received September 2008; revised February 2009

**ABSTRACT.** *This paper deals with the problem of controller failure analysis for T–S fuzzy systems with time-varying delays. The T–S fuzzy systems can be stabilized by a pre-designed state feedback controller. Our objective is to establish conditions concerning controller failure time and frequency, under which the systems still keep exponentially stable. For this purpose, the systems with controller failures are first formulated as a class of switched delay systems. Next, based on piecewise Lyapunov functional method, exponential stability of such systems is guaranteed by restricting unavailable rate and failure frequency of the controllers. All the results are presented in terms of linear matrix inequalities (LMIs). An example is provided to demonstrate the effectiveness of the proposed approach.*

**Keywords:** Controller failure, Interval time-varying delay, Switched delay system, Exponential stability

**1. Introduction.** Controller failures are frequently encountered in practical control systems due to various factors. One of the reasons lies in that the data is not transmitted smoothly over the unreliable links such as packets dropout in networked control systems. Other reasons are that we suspend the controller purposefully in a positive way. Controller failure problems of linear time-invariant systems [1, 2] and time-delay systems are considered [3]. In [1], a controller failure time analysis problem for linear time-invariant (LTI) systems with a pre-designed stabilizing state feedback is considered. Sufficient conditions for the solvability of such problems are established. In [2], the results of [1] are extended to LTI symmetric systems with a pre-designed symmetric static output feedback. Furthermore, we extended the consideration to the systems with interval time-varying delays in [3].

It is well known that a complex nonlinear system can be represented by using a T–S fuzzy model [4] such that the nonlinear system can be analyzed and synthesized by using modern control theory. Consequently, T–S fuzzy systems have attracted considerable attention. The controller design problems for T–S fuzzy systems have been investigated in the past decades (see, for instance, [5, 6, 7, 8, 9, 10] and the references therein). The mentioned results are obtained based on the assumption that the controllers are always available, which is not true in many real systems. On the other hand, time delays reside in various practical systems and constitute a main source for system performance degradation or