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STABILIZATION AND SWITCHED CONTROL FOR A CLASS OF SWITCHED FUZZY SYSTEMS

Hong Yang[1,2], Ximing Sun[1] and Xiaodong Liu[1]

[1]Research Center of Information and Control
Dalian University of Technology
2 Linggong Road, Ganjingzi District, Dalian, 116024, P. R. China
{ cherryyh; wrsxm }@126.com; xdliuros@dlut.edu.cn

[2]School of Information Engineering
Shenyang University
21 Wanghua South Street, Dadong District, Shenyang, 110044, P. R. China

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Abstract. *This paper considers the quadratic stability problem for a class of switched fuzzy (SF) systems. A new method based on a switching technique is presented to solve this problem. A switched fuzzy system, which differs from existing ones, is firstly employed to describe a nonlinear system, and then some new concepts about the innovated SF system are introduced. Usually, this class of systems can precisely describe continuous and discrete dynamics as well as their interactions in the complex real-world systems. Next, the switched state feedback controllers for the proposed SF systems are built to ensure that the relevant closed-loop system is quadratically stable. Finally, switching laws of the state-dependent form achieving system quadratic stability of the SF system are given. The main conditions are given in terms of convex combination and linear matrix inequalities (LMIs), hence they are easily solvable. The comparison of the elaborated example is conducted to demonstrate the effectiveness of the proposed control design approach. All results illustrate good control performances as desired.*
Keywords: Switched system, Fuzzy system, Switching law, Quadratic stability, Global model

1. **Introduction.** In recent years, considerable attention has been paid to switched systems [1-5]. Switched systems are one of important kinds of hybrid systems. A switched system consists of a number of subsystems, both continuous-time or discrete-time dynamic systems, and a switching law which orchestrates the switching between the subsystems. The applications in computer disc drives, some robot control systems, and other engineering systems indicate that switched systems have extensive practice background. Therefore, it has both theoretical significance and practical value to study switched systems.

From the middle of the 1980s, there have appeared a number of analysis problems about T-S fuzzy systems [6-11]. And recently, switched systems have been extended further to encompass fuzzy systems too. For, it is well known the switching by an ideal relay controller is in fact a time optimal control law [3,11]. Also, the extension towards fuzzy systems has emanated out of the remarkable developments in theory, applications, and the industrial implementations of fuzzy control systems have mentioned in [7,12-14]. Very notably, the stabilizability conditions and smoothness conditions for fuzzy switching control systems were reported. For the continuous-time case, a combination of hybrid systems and fuzzy multiple model systems was described and an idea of the fuzzy switched hybrid control was put forward [15]. Based on the T-S fuzzy systems, Tanaka [8,16,17] introduced new switching fuzzy systems for more complicated real systems such as multiple