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FAULT-TOLERANT H_∞ FILTER DESIGN OF A CLASS OF SWITCHED SYSTEMS WITH SENSOR FAILURES

Shuhui Shi[1,2], Zhonghu Yuan[3] and Qingling Zhang[1,2]

[1]Institute of Systems Science
P. O. Box 325, Northeastern University, Shenyang 110004, P. R. China

[2]Key Laboratory of Integrated Automation of Process Industry, Ministry of Education
Northeastern University
Shenyang 110004, P. R. China
shishuhuishuxue@163.com; qlzhang@mail.neu.edu.cn

[3]School of Information Engineering
Shenyang University
Shenyang 110044, P. R. China
tiger445765@sina.com

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Abstract. *The fault-tolerant H_∞ filter design problem is proposed for a class of switched systems with sensor failures. A new idea that transforming a switching fault matrix into a class of dynamic interval matrix is adopted in order to enlarge the admissible range of sensor failures and reduce computational cost. Under arbitrary switching, a fault-tolerant H_∞ filter is designed for switched systems composed of stable subsystems based on common Lyapunov function technique. For switched systems composed of unstable subsystems, by constructing appropriate switching strategy, a fault-tolerant H_∞ filter is established by multiple Lyapunov functions technique. The fault-tolerant filter against sensor failures can make the filtering error system asymptotically stable while ensuring H_∞ norm bound γ. A simulation example illustrates the advantage of our method.*
Keywords: Switched systems, Fault-tolerant H_∞ filter, Sensor failure, Common Lyapunov function, Multiple Lyapunov functions

1. **Introduction.** In recent years, the filter design problem has been extensively investigated in [1-11]. [9] studied the problem of robust filtering for a class of jumping systems. [10] designed the optimal filter for the systems with multiple state and observation delays, which are allowed to be different from each other. The $L_2 - L_\infty$ filtering problem of a class of fuzzy systems is investigated in [11]. A common assumption in many filter designs is that the sensors can provide constant level of signals. However, contingent failures are possible for all sensors in a system, which may cause filtering performance degradation and even hazard. Thus it is quite necessary to design such a filter that could tolerate sensor failures while retaining desired properties.

A switched system is an important class of hybrid dynamical system, and it is composed of a family of continuous-time or discrete-time subsystems and a rule orchestrating the switching among them. Owing to frequent switching among multiple subsystems, actuator or sensor failures usually occur. Hence, designing a filter with fault-tolerant capability for switched systems ought to be paid to much attention. However, to our best knowledge, the fault-tolerant filter design problem of switched systems has not yet been investigated. This motivates our research. By introducing additional instrumental matrix variables, [6] designed H_∞ filters for a class of switched systems. Based on a μ-dependent approach, [7] investigated the exponential H_∞ filtering for uncertain discrete-time switched systems.