Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **12 (2005)** 151-164

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AN LMI BASED DESIGN FOR TIME-DELAYED SYSTEMS WITH ACTUATOR FAILURES

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Abstract. The design of a reliable state feedback control is considered for a class of uncertain systems with actuator failures as well as delays in control inputs. The model uncertainties are unknown but bounded. By applying the Lyapunov stability criteria, state feedback controllers are designed for the systems with control delays in the framework of Linear Matrix Inequality (LMI). It shows that the design can be directly applied to the delay-free systems as a special case. The results for stability are delay-dependent, which are less conservative than delay-independent ones. The obtained controller can guarantee the robust stability of the system for both normal operation and actuator failure cases. In addition to the system stability, the failure induced disturbance attenuation is achieved. An example is given to illustrate the proposed method.

Keywords. State feedback, robustness, LMI, Lyapunov stability, time delay, actuator failure.

1 Introduction

The control systems designed using conventional techniques may not be able to maintain good performance in the presence of component failures. In some cases, even the closed-loop system stability may be in jeopardy. The many challenging issues in the control system design by taking into account the component failures have ignited enormous research activities recently, in search for a new design methodology, which can be called fault tolerant control [1]-[3].

In fault tolerant control systems, redundancy is considered to be essential for the enhancement of the system reliability. When the system possesses hardware redundancies, such as spare actuators and sensors, it naturally has a MIMO representation. In this case, design of a controller that is 'robust' to a presumed set of component failures is possible, because of the inherent design degree of freedom of the multivariable systems. It is known that in these systems, when there are failures in some loops, the interaction among the remaining loops may result in the reduction of the system stability margins. Such a problem was referred to as system integrity in the literature [4][5]. A multivariable feedback system is said to have high integrity if it remains stable under all likely failures. This problem has been tackled by many