Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **15 (2008)** 269-281
 http://www.watam.org

RELIABLE GUARANTEED COST CONTROL OF NONLINEAR DISCRETE-TIME SYSTEMS WITH TIME-VARYING STATE DELAY AND ACTUATOR FAILURE

Nan Xie

College of Computer Science and Technology
Shandong University of Technology, Zibo 255049, P. R. China

Abstract. This paper concerns the reliable guaranteed cost control problem of nonlinear discrete-time systems with time-varying state delay and actuator failures for a given quadratic cost function. The problem is to design a reliable guaranteed cost state feedback control law which can tolerate actuator failures, such that the closed-loop cost function value is guaranteed to be no more than a specified upper bound. Based on the linear matrix inequality (LMI) approach, a sufficient condition for the existence of reliable guaranteed cost controllers is derived. Furthermore, a convex optimization problem with LMI constraints is formulated to design the optimal reliable guaranteed cost controller which minimizes the upper bound of the closed-loop system cost. A numerical example is given to illustrate the proposed method.

Keywords. Reliable control; Guaranteed cost control; Nonlinear systems; Actuator failure; LMI

1 Introduction

The problem of designing robust controllers for systems with parameter uncertainties has drawn considerable attention in recent control system literatures [1-4]. It is also desirable to design a control system which is not only stable but also guarantees an adequate level of performance. One approach to this problem is the so-called guaranteed cost control approach first introduced by Chang and Peng [5]. This approach has the advantage of providing an upper bound on a given performance index and thus the system performance degradation incurred by the uncertainties is guaranteed to be less than this bound. Based on this idea, some significant results have been proposed for the continuous-time case [6] and for the discrete-time case [7].

In practical application, actuators are very important in transforming the controller output to the plant. Actuator failures may be encountered sometimes. Furthermore, how to preserve the closed-loop system performance in the case of actuator failures will be tougher and more meaningful. This motivates the development of the so-called reliable control theory. Veillette et