Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **12 (2005)** 701-715

Exponential Stability of Singularly Perturbed Stochastic Systems with Delay

Wu-Hua Chen[1], Zhi-Hong Guan[2], Xiaomei Lu[2] and Yuedong Xu[2]

[1]College of Mathematics and Information Science
Guangxi University, Nanning, 530004, Guangxi, P. R. China
[2]Department of Control Science and Engineering
Huazhong University of Science and Technology, Wuhan, Hubei, 430074, P. R. China

Abstract. This paper is concerned with exponential stability and stabilization in mean square for a class of singularly perturbed stochastic systems with delay. Through constructing an appropriate Lyapunov functional based on a descriptor model transformation, a delay-dependent exponential stability in mean square criterion for all small enough values of singular perturbation parameter ε, expressed in terms of linear matrix inequalities (LMIs), is derived by using Moon's inequality for bounding cross terms. We also obtain delay-independent stability conditions. Moreover, a memoryless ε-independent state feedback stabilizing controller is presented, which can be obtained by solving LMI problems. Numerical examples are employed to demonstrate the effectiveness of the proposed techniques.

Keywords. Stochastic systems, singular perturbation, time-delay systems, exponential stability, linear matrix inequality.

1 Introduction

The singular perturbation representation can model systems subject to various forms of disturbances, particularly ones where both slow and fast dynamics coexist. The stability problem in singularly perturbed systems has attracted the attentions of many researchers. For singularly perturbed deterministic systems, the reader is referred to [14-15] and the reference cited therein; for singularly perturbed stochastic systems, see [6-9]. On the other hand, time-delays occur frequently in many practical systems, such as manufacturing systems, telecommunication and economic systems, etc., often times causing instability and poor performance. The stability of singularly perturbed deterministic systems with delays has been studied in [1-5]. However, to the best of the author's knowledge, the stability and stabilization for singularly perturbed stochastic systems with delay have not been developed. In this paper, our aim is to study the exponentially stability and stabilization of a class of singularly perturbed stochastic systems with delay. Using the descriptor system approach (see [3], [10-12]), a new type of Lyapunov functional is constructed by transforming the singularly perturbed stochastic