International Journal of Innovative
Computing, Information and Control
Volume **5**, Number **8**, August **2009**

 ISSN 1349-4198
pp. **2257–2265**

NON-FRAGILE H_∞ FILTERING FOR UNCERTAIN STOCHASTIC TIME-DELAY SYSTEMS

Bo Song, Shengyuan Xu and Yun Zou

School of Automation
Nanjing University of Science and Technology
Nanjing 210094, P. R. China
{joecole1980; syxu02}@yahoo.com.cn; zouyun@vip.163.com

Received January 2008; revised June 2008

Abstract. *This paper deals with the problem of non-fragile H_∞ filtering for stochastic time-delay systems with norm-bounded parameter uncertainties. The problem to be addressed is to design a filter which is subject to gain variations, such that the filtering error system is robustly exponentially stable in the mean square with a prescribed H_∞ norm bound. A delay-dependent sufficient condition for the solvability of this problem is obtained. An example is provided to demonstrate the effectiveness of the proposed approach.*

Keywords: Delay systems, Fragility, H_∞ filtering, Stochastic systems, Uncertainties

1. **Introduction.** The H_∞ filtering problem has attracted many researchers' attention during the past years [10, 11, 15]. Since stochastic systems have come to play an important role in many branches of science and engineering applications, stochastic systems have been investigated in the literature [1, 2, 3, 6, 13, 17, 18]. Results on the H_∞ filtering for stochastic systems can be found in [4, 12, 14].

Note that all the above H_∞ filtering results are based on an implicit assumption that the filters are implemented exactly. However, the filters in practice do have a certain degree of variations; such variations can be due to finite word length in any digital systems, the imprecision inherent in analog systems [5]. Hence, it is considered beneficial that the designed filters should be capable of tolerating some level of filters gain variations. This has motivated the study of non-fragile filtering problem. For example, for linear continuous-time systems, the non-fragile filtering problems were investigated in [7, 16], while the issue of non-fragile $L_2 - L_\infty$ filter design for time-delay systems was studied in [8]. However, it should be pointed out that all the above non-fragile filtering results are derived in the context of the deterministic systems.

In this paper, we investigate the problem of non-fragile H_∞ filtering for uncertain stochastic systems with time delays. The problem we address is the design of a filter, which is subject to gain variations, such that the filtering error system is robustly exponentially stable in the mean square with a prescribed H_∞ norm bound. A delay-dependent sufficient condition for the solvability of the problem is obtained. A desired filter can be constructed by solving an LMI. An example is given to demonstrate the effectiveness of the proposed approach.

Notation: Throughout this paper, $\mathbb{R}^n$ and $\mathbb{R}^{n\times m}$ denote, respectively, the n dimensional Euclidean space and the set of all $n \times m$ real matrices. The superscript "T" represents the transpose. The notation $X \geq Y$ (respectively, $X > Y$) where X and Y are real symmetric matrices, means that the matrix $X - Y$ is positive semi-definite (respectively, positive definite). I is the identity matrix with appropriate dimensions. $\mathcal{L}_2[0, \infty)$