International Journal of Innovative
Computing, Information and Control
Volume **6**, Number **12**, December **2010**

 ISSN 1349-4198
pp. 5527–5538

ROBUST H_∞ FILTERING FOR NONLINEAR SYSTEMS WITH INTERVAL TIME-VARYING DELAYS

Zhihong Deng[1], Peng Shi[2,3], Hongjiu Yang[1] and Yuanqing Xia[1]

[1]School of Automation
Beijing Institute of Technology
Beijing 100081, P. R. China
{ dzh_deng; xia_yuanqing }@bit.edu.cn; yanghongjiu@gmail.com

[2]Faculty of Advanced Technology
University of Glamorgan
Pontypridd, CF37 1DL, United Kingdom
pshi@glam.ac.uk

[3]School of Engineering and Science
Victoria University
PO Box 14428, Melbourne, VIC 8001 Australia

Received August 2009; revised December 2009

Abstract. *In this paper, robust H_∞ filtering problem for a class of linear fractional uncertain continuous-time nonlinear systems with interval time-varying delays is investigated. The delay factor is assumed to be time-varying and belongs to a given interval, which means that the lower and upper bounds of the interval time-varying delays are available. Furthermore, the derivative of the time-varying delay function can be larger than one. Based on Lyapunov-Krasovskii functional, a new sufficient condition for the solvability of this problem is presented in terms of linear matrix inequalities (LMIs). When these LMIs are feasible, an expression of a desired H_∞ filter is given. A numerical example is given to illustrate the effectiveness of the developed techniques.*
Keywords: Continuous-time systems, Nonlinear systems, Robust filter, H_∞ filter, Time delay, Linear matrix inequality (LMI), Linear fractional uncertainties

1. **Introduction.** Since time delays may lead to instability and oscillation of system models, the issue on the stability analysis of systems with time delays has received more and more attention. It is well known that delay-dependent criteria type is less conservative than delay-independent one, for example [1, 2, 3, 4, 5, 6, 7, 8, 22]. In recent years, a special type of time delay in practical engineering systems, interval time-varying delay, was investigated [9, 10, 11, 12, 13]. Interval time-varying delay is a time delay that varies in an interval. The system with interval time varying delays means that the lower bound of time-delay which guarantees the stability of system is not restricted to zero. He et al. [9] investigated H_∞ filter design for systems with interval time-varying delays. A typical example of dynamic systems with interval time-varying delays is networked control systems [10]. It is well known that there are systems that are stable with some nonzero delay, but are unstable without delay [11]. Therefore, it is of great significance to consider the stability of systems with interval time-varying delay if there is time-varying perturbation on the nonzero delay. [12] investigated the delay-dependent robust stability for uncertain stochastic systems with interval time-varying delay, respectively. The delay-dependent robust stability of uncertain neutral systems with interval time-varying delays was studied in Kwon et al. [13].