International Journal of Innovative Computing, Information and Control
Volume **5**, Number **12(A)**, December **2009**

ICIC International ©2009 ISSN 1349-4198
pp. 4407–4414

ROBUST OUTPUT FEEDBACK CONTROL DESIGN OF DECENTRALIZED STOCHASTIC SINGULARLY-PERTURBED COMPUTER CONTROLLED SYSTEMS WITH MULTIPLE TIME-VARYING DELAYS

Kai-Chao Yao, Chien-Yu Lu, Wen-Jye Shyr and Der-Fa Chen

Department of Industrial Education and Technology
National Chung-Hua University of Education
No. 2 Shi-Da Road, Changhua City, Taiwan
kcyao@cc.ncue.edu.tw

Received July 2008; revised December 2008

Abstract. *The control algorithm of an output feedback control scheme for robust optimal stabilizing control of a decentralized stochastic singularly-perturbed computer controlled system with multiple time-varying delays is designed. The technique is based on singular perturbation methodology, computer control theory, stochastic control theory, and the time separation principle. The output feedback controller is designed to control the dominant poles in an approximated reduced-order system model for robust optimal control performances. Applying the proposed time separation principle concerned with each delay moment, the problem of multiple time-varying delays is also solved.*
Keywords: Output feedback, Control design, Decentralized, Stochastic, Singularly-perturbed, Multiple time-varying delays

1. **Introduction.** Stochastic singularly perturbed systems with multiple time-varying delays often occur naturally because of the presence of small parameters, disturbing noises and bitty transmission time of signals. Examples of such systems abound and include communication systems [1], nuclear systems [2], flight control systems [3], and power systems [4]. Such large-scale and complex multivariable systems rarely satisfy the assumption the state variables are available. It will therefore be necessary to rebuild the missing variables. The output feedback control problem attracted the attention of researchers from the field of singular perturbations in the 1980's [5,6]. It is well known singularly perturbed systems belong to the class of systems with ill-conditioned dynamics making corresponding numerical problems stiff. [7] developed the recursive algorithm for solving the algebraic equations comprising the solution of the optimal static output feedback control problem of singularly perturbed linear systems.

Stability is the most important issue in control design. The decentralized singularly-perturbed system may also be stabilized by optimal output feedback control. Savkin and Petersen [8] examined the stability of continuous time full-order linear systems by decentralized output feedback control. They only used the input-output information and applying the linear quadratic regulator. Calise and Moerder provide a technique of finding optimal static output feedback gain for reduced-order systems with the stability constraint of high frequency dynamics; this reduced order process could effectively reduce the calculation load. Further, [9] examined a two-time-scale approximation to the linear quadratic optimal output feedback regulator problem. It is verified optimal gains for the two-time-scale problem provide a second-order approximation to optimal closed-loop performance in the unperturbed system.