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ROBUST OPTIMAL STABILIZING OBSERVER-BASED CONTROL DESIGN OF DECENTRALIZED STOCHASTIC SINGULARLY-PERTURBED COMPUTER CONTROLLED SYSTEMS WITH MULTIPLE TIME-VARYING DELAYS

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Abstract. *The control algorithm of a controller-observer scheme for robust optimal stabilizing control of a decentralized stochastic singularly-perturbed computer controlled systems 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 observer-based controller is designed to have control of the dominant poles in an approximated reduced-order system model for robust optimal control performances. Applying the time separation principle that is concerned with each delay moment, the problem of multiple time-varying delays is solved. Finally, a composite model is presented to show the close-loop control of deploying this robust optimal stabilizing observer-based controller.*

Keywords: Observer-based controller, Decentralized, Stochastic, Singularly-perturbed, Multiple time-varying delays

1. **Introduction.** Singularly perturbed systems often occur naturally because of the presence of small parameters, typically small-time constants, and mass. 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 that the state variables are available. It will therefore be necessary to rebuild the missing variables. The state observation problem centers on forming an auxiliary dynamic system, known as a state estimator or observer, driven by the available inputs and outputs. Once state variables can be measured, state feedback controllers can be applied and perform the optimal control. This is also the reason many researchers are trying to construct an observer which can estimate state variables precisely; also, they can use an observer and a state feedback controller to build an observer and controller synthesis such as an observer-based controller.

An important issue of singularly perturbed systems theory is the qualitative behavior of singularly perturbed systems when the small parameter is neglected, since that is where 'singularity' could occur. The results of [5-7] show the 'singularity' is absent under some extra conditions of the fast system. Actually, in such cases, a singularly perturbed system converges to the slow system in the graph topology as the small parameter tends to zero.