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APPLICATION OF GENETIC ALGORITHM ON OBSERVER-BASED D-STABILITY CONTROL FOR DISCRETE MULTIPLE TIME-DELAY SINGULARLY PERTURBATION SYSTEMS

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Abstract. *This study proposes a Genetic Algorithm (GA) application for the observer-based controller design for discrete multiple time-delay, singularly perturbed systems. The corresponding slow and fast subsystems of the original system are first determined. The GA then derives the observer-based controllers for the D-stability of the slow and the fast subsystems, and a composite observer-based controller for the original system synthesized from the designed subsystems controllers. This study proposes a stability condition dependent upon the singular perturbation parameter* ε, *to guarantee the stability of the original system under the composite observer-based controller. This study finds the stability criteria of the original uncontrolled system by establishing the stability criteria for its corresponding slow and fast subsystems. If any of the criteria conditions is satisfied, this study uses the condition to find the upper bound* ε^* *of* ε *and can guarantee the stability of the original system by examining the stability of corresponding subsystems, if* $\varepsilon \in [0, \varepsilon^*)$. *Finally, an illustrative example demonstrates the efficiency of the proposed controller.*

Keywords: Genetic algorithm, Composite observer-based controller, Multiple time-delay singularly perturbation systems, D-stability

1. **Introduction.** The existence of small time-constants always increases the order of the dynamical system and makes the analysis and control of the system complicated. Some research techniques exist to resolve this problem. The most popular and effective is the singular perturbation method, of which characters are time-scale separation and reduction in order. For controller design by the singular perturbation method, divide the original system into two lower order subsystems called the slow and fast subsystems, and a controller then designed for each subsystem. This study obtains the full-order controller by combining the two reduced-order controllers. This simplifies the procedure of controller design and the stability of system can be inferred from the stabilities of the reduced-order subsystems (Kokotovic et al. [1], Khalil [2], Hsiao et al. [3,4]). Recently, Yao et al. explored an important class of stochastic singularly perturbed systems [5-7]. The controller design in typical singular perturbation methods applies traditional optimal control laws, and always needs to solve Riccati equations. The Riccati equations are complicated and difficult to solve and system processing is slow.