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ROBUST DISTURBANCE ATTENUATION OF A CLASS OF NONLINEAR SINGULARLY PERTURBED SYSTEMS

Roya Amjadifard[1] and Mohammad T. H. Beheshti[2]

[1]Department of Computer Engineering, Faculty of Engineering
Tarbiat Moallem University
Tehran, Iran
amjadifard@tmu.ac.ir

[2]Department of Electrical and Computer Engineering, Faculty of Engineering
Tarbiat Modarres University
Tehran, Iran

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Abstract. *The problem of disturbance attenuation with internal stability for a class of nonlinear singularly perturbed systems is considered. Using H_∞ approach, a state feedback controller is designed for the reduced order system such that L_2 gain of this system to the relative disturbance input is made less than or equal to a prescribed value. In this paper, we propose a new theorem to show that the maximum difference between the performance index of the closed-loop singularly perturbed system with the designed slow controller, and the one related to the closed-loop reduced system, will be of order of ε. The results have been verified both analytically and through simulations.*
Keywords: Nonlinear systems, Singular perturbation, Disturbance attenuation

1. **Introduction.** The problem of disturbance attenuation with local internal stability, via state feedback is to find, if possible, a feedback law such that the corresponding closed-loop system has a locally asymptotically stable equilibrium and an L_2 gain from the input disturbance to the regulated output, less than or equal to a prescribed value γ, as is discussed in [1-5].

An approach to the problem of disturbance attenuation for the singularly perturbed systems is introduced in [6-8]. In these references, the problem of robust disturbance attenuation with internal stability via H_∞ controller for a class of singularly perturbed systems has been investigated. In [7] the mentioned problem has been solved by considering the related Hamilton-Jacobi-Isaac inequality, defining reduced Hamiltonian system, fast ε-independent PDE, and then constructing the H_∞ composite controller. On the other hand, in [6] a new algorithm for the problem of robust regulation for linear singularly perturbed systems via treating the fast modes of system as uncertainty using the small gain theorem is introduced. Also, authors in [8] extended the method introduced in [6] to a class of nonlinear affine systems and authors in [9] applied this method to an experimental inverted pendulum system. In [10] the writers have shown that computing the reduced order system and closing the feedback loop, commute, i.e. the closed loop reduced-order system is unambiguously determined. The writers have shown then, if the reduced order system associated with the original system is stabilizable or has uncertainties matched with the input, then the closed loop reduced-order system has the same property.

Recently, fuzzy logic has evolved into a well structure system of concepts and techniques and a widening array of application. In the area of singularly perturbed systems