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H_∞ CONTROL FOR DISCRETE-TIME SINGULARLY PERTURBED SYSTEMS WITH DISTRIBUTIONAL PROPERTIES

Guoliang Wang[1,2], Qingling Zhang[1,2], Chuanxin Bian[1,2] and Victor Sreeram[3]

[1]Institute of Systems Science
[2]Key Laboratory of Integrated Automation of Process Industry, Ministry of Education
Northeastern University
Shenyang, Liaoning Province 110004, P. R. China
gliangwang@yahoo.com.cn; qlzhang@mail.neu.edu.cn; bianchuanxin@163.com

[3]Department of Electrical and Electrical, Electronic and Computer Engineering
University of Western Australia
35 Stirling Highway, Crawley, Western Australia 6009
sreeram@ee.uwa.edu.au

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Abstract. *In this paper, the H_∞ control problem for discrete-time singularly perturbed systems (DSPSs) with distributional probabilities is considered. Compared with traditional DSPSs, there are two main differences. The first is the singularly perturbation parameter in our model may be in different intervals instead of a deterministic interval. The second is the occurrence between two DSPSs is random. Via using a stochastic variable satisfying some probabilistic property with known probability distribution, for the first time, DSPSs switching stochastically are modeled into a new type of DSPSs with stochastic parameter matrices. Mean-square exponential stability condition where the bound of ϵ can be checked is presented via a new approach. Based on the derived criterion, however, an ϵ-independent switching controller satisfying H_∞ performance is given in terms of linear matrix inequalities (LMIs) with equality constraints. An effective algorithm involving LMIs is suggested to solve the matrix inequalities characterizing the controller solutions. Finally, illustrative examples are presented to show the benefits and the validity of the proposed approaches.*

Keywords: Discrete-time singularly perturbed systems, Probability distribution, H_∞ control

1. **Introduction.** Singularly perturbed systems (SPSs) known as multiple time-scale dynamic systems normally occur due to the presence of small "parasitic" parameters, typically small time constants, masses, and so on. Examples of SPSs can be found in modern control systems, such as economic models, motor control systems, power systems and magnetic-ball suspension systems. Such systems are commonly modeled with small parameters, which can lead to high dimensionality and ill-conditioned numerical issues in system analysis and controller design. In order to alleviate these issues, a great number of results on this topic were reported in literature [1-13]. One popular approach is a two-step design method where the controller could be determined without knowledge of the small singularly perturbation parameter. As we know, stability bound problem for SPSs is very important in application. Some frequency- and time-domain methods have been derived to provide the largest upper bound of ϵ in [14-17]. However, all of the aforementioned results are assumed that there is only one SPS, whose singularly perturbation parameter belongs to a deterministic small interval.