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H_∞ FILTERING FOR LINEAR SINGULARLY PERTURBED DESCRIPTOR SYSTEMS

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Abstract. The H_∞ filtering problem for singularly perturbed descriptor system is investigated in this paper. Firstly, an ε-independent sufficient condition is obtained such that the filtering error system is admissible and satisfies the prescribed H_∞ performance. Then, LMI-based design approaches are presented by linearizing transformation techniques. The approaches presented in this paper are independent of the perturbed parameter and can avoid the numerical stiff problem. Finally, the effectiveness of the approach is illustrated by a numerical example.

Keywords. H_∞ filter; Singularly perturbed systems; Descriptor systems, Linear matrix inequality

AMS (MOS) subject classification: 93C05; 93E11.

1 Introduction

Singularly perturbed systems are commonly encountered in engineering due to the presence of small parasitic parameters such as small time constants and moments of inertia which are often the source of the increased order and stiffness of systems [8]. The main purpose of the singular perturbation approach is to alleviate the high dimensionality and ill-condition resulting from the interaction of slow and fast dynamic modes. The details on the recent development of the theory and application of singularly perturbed systems can be seen from [10] and [13] and the references therein.

On the other hand, there has been a growing interest in descriptor systems for their extensive applications in control theory, circuits, economics, mechanical systems and other areas, see [5, 12, 15]. More recently, a great deal of attention has been devoted to the filtering problem for descriptor systems. The stochastic shuffle algorithm was used in [14] to solve the Kalman filtering problem for descriptor systems. The full-order and reduced-order H_∞ filtering problems for descriptor systems were investigated in [16, 17], respectively. Necessary and sufficient conditions for the solvability of the problem were obtained in terms of LMIs and the desired H_∞ filter are constructed by solving several certain LMIs. Robust H_∞ filtering problem for discrete-time descriptor systems with norm-bounded uncertainties was considered in [9], in which a normal transformation was applied to obtain normal