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LINEAR QUADRATIC CONTROL FOR SINGULARLY PERTURBED SYSTEMS

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Abstract. This paper proposes a new methodology to design a sub-optimal control for singularly perturbed systems. The controller is given in terms of the solution of a set of inequalities. An algorithm is given to solve those inequalities through LMI (Linear Matrix Inequality) formulation. An example exhibits that the results are very close to the exact optimal solutions. The main features of this approach are that it takes advantage of LMI to deal with singularly perturbed systems with less conservativeness and can be extended to other robust and multi-objective control problems for singularly perturbed systems. In addition, it is fit for both standard and nonstandard singularly perturbed systems.
Keywords. Singularly perturbed systems; LQ control; LMI.

1 Introduction

Systems with slow and fast dynamics, described mathematically by singular perturbations, are studied extensively in numerous papers and books, see for examples [3,4,5,7,10]. For robust control of singularly perturbed systems, the controller is usually derived through indirect mathematical programming approaches (e.g. solving Riccati equations), which encounter serious (numerical) problem linked with the stiffness of the equations involved in the design. To avoid this difficulty, several approaches [7,9,10] have been developed to transform the original problem into ϵ-independent sub-problems, among which, the time-scale decomposition [7] is commonly adopted.

As an alternative to Riccati equation solution, LMI formulation has been attracting more and more attention of robust control researchers. However, up to the present, it is nearly an open area on solving robust control problems for singularly perturbed systems through LMI approach. Garcia *et al.* [4] extended the results of [8] and proposed a solution to the infinite time near optimal regulator problem for singularly perturbed systems through an LMI formulation. A time-scale decomposition was employed on the overall system as well. But the solution must be under the condition that the initial