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POSITIVE REAL CONTROL FOR UNCERTAIN DISCRETE SINGULAR SYSTEMS WITH STATE DELAY

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Abstract. This paper is concerned with the problem of positive real control for uncertain discrete singular systems with state delay. The discrete singular system under consideration involves state time delay and unstructured time-invariant norm-bounded parameter uncertainties in both the state and input matrices. The problem we address is the design of state feedback controllers such that, for all admissible uncertainties, the resulting closed-loop system is regular, causal and stable while the closed-loop transfer function is extended strictly positive real. A sufficient condition for the existence of the desired feedback controllers is given in terms of two LMIs. When these LMIs are feasible, the expected state feedback controller can be easily constructed via convex optimization. An illustrative example is given to demonstrate the applicability of the proposed approach.
Keywords. Discrete singular systems, linear matrix inequality, parameter uncertainties, positive real control, state delay, state feedback.

1 Introduction

The concept of positive realness has played an important role in control and system theory [1, 4, 14]. In the past years, the problem of positive real control has received much attention. The objective is to design controllers such that the resulting closed-loop system is stable and the closed-loop transfer function is positive real [11]. The motivation for studying the positive real control problem stems from robust and nonlinear control, in which a well-known fact is that the positive realness of a certain loop transfer function will guarantee the overall stability of a feedback systems if uncertainty or nonlinear can be characterized by a positive real system [14]. It was shown in [13] that a solution to the positive real control problem involves solving a pair of Riccati inequalities. The results in [13] were extended to uncertain linear systems with time-invariant uncertainty in [12] and [16], respectively. The corresponding results for discrete time systems can be found in [5] and [10], respectively. It is worth pointing out that when time delay appears in