

## Robust $H_\infty$ Control for Discrete Singular Systems with State Delay and Parameter Uncertainty

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**Abstract.** This paper addresses the problems of robust stabilization and robust  $H_\infty$  control for uncertain discrete singular systems with state delay and parameter uncertainties. The discrete singular delay system under consideration is not necessarily regular. The parameter uncertainties are assumed to be time invariant but norm-bounded. The purpose of the robust stabilization problem is the design of state feedback controllers such that, for all admissible uncertainties, the closed-loop system is regular, causal and stable, while for the robust  $H_\infty$  control problem, in addition to the above requirements, a prescribed  $H_\infty$  norm bound constraint is required to be enforced. In terms of non-strict LMIs, sufficient conditions for the solvability of the above problems are presented, and expressions of the desired state feedback controllers are also given. A numerical example is given to demonstrate the application of the proposed method.

**Keywords.** Discrete singular systems, linear matrix inequality (LMI), parameter uncertainty, robust  $H_\infty$  control, robust stabilization, state delay.

## 1 Introduction

During the past years, the problems of robust stabilization and robust  $H_\infty$  control for state-space systems with parameter uncertainties have attracted a lot of attention and significant advances have been made on these two topics; see, e.g. [1, 8], and the references cited therein. Recently, much attention has been focused on the extensions of these results to time-delay systems with parameter uncertainties since time delays as well as parameter uncertainties are often the causes for instability and poor performance of control systems; For example, in the context of continuous time-delay systems, the concept of *quadratic stabilizability* in [1, 6] was extended in [11], and a sufficient condition for the existence of stabilizing state feedback controllers was given in terms of a linear algebraic Riccati equation. While in [3] and [7] the robust  $H_\infty$  control problem for uncertain delay systems was considered, and state feedback-based controllers and observer-based controllers, which stabilize the uncertain system and guarantee an  $H_\infty$  norm bound constraint on