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H_∞ CONTROL FOR MULTI-TIME-DELAY UNCERTAIN DISCRETE SYSTEMS

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Abstract. *This paper studies the problems of quadratic stabilization and H_∞ control for a class of multi-time-delay uncertain discrete systems. Suppose that the time-varying uncertain parameters are norm-bounded, but not required to satisfy strict matched conditions, state and input for the system are both with multi-time-delay. New sufficient conditions of quadratic stabilization and H_∞ control are given for the system by generalized Lyapunov function and linear matrix inequalities. In terms of linear matrix inequalities, H_∞ controller can be obtained and a prescribed H_∞ performance lever of the closed-loop system has an upper bound for all admissible parameters uncertainties. Furthermore, the optimal H_∞ robust control law can be obtained by solving some convex optimization problems. A numerical example is offered to show the potential of the proposed techniques.*
Keywords: Discrete system, Multi-time-delay, Uncertain parameters, H_∞ control

1. **Introduction.** Time-delay often appears in many dynamic systems, such as hydraulic systems, rolling mills, biological systems, chemical systems, etc [1-2]. Just like most physical systems, time-delay often possesses parameter uncertainties, which class of systems have been investigated [3-4]. A time-delay is frequently a source of instability and poor performance in a system. In recent decades, quadratic stabilization and H_∞ control for uncertain systems with time-delay have received considerable attention and obtained many important results [5-8]. However, little attention has been paid to the discrete systems with delays. Different methods have been used to deal with uncertain discrete systems with time-delay. For example, the discrete time-delay systems can be changed into discrete systems without delays by adding state dimension. However, when time-delay is unknown, this approach can not be used [9]. Riccati equation approach is applied to H_∞ performance analysis and synthesis [10,11]. But, when solving the Riccati equation, we need to modulate some parameters and matrices so that the calculation is complicated, and literatures [10,11] require the uncertain parameters satisfying a strict matched condition. Recently, H_∞ controllers which are designed for uncertain discrete time-delay systems by LMI approach have been drawn more and more attention. We can transform uncertain discrete time-delay systems into certain discrete time-delay systems by parametrization and design H_∞ controllers in terms of LMI approach [12-16]. But the uncertain parameters are required to satisfy a strict matched condition in literatures [12-16]. It is difficult to satisfy the condition in actual systems. In recent years, literature [17] described the problem of H_∞ state feedback control for a class of time-varying uncertain discrete systems with both state and input delays, the time-varying uncertain parameters