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QUADRATIC STABILITY AND STABILIZATION OF UNCERTAIN LINEAR DISCRETE-TIME SYSTEMS WITH STATE DELAY: A LMI APPROACH

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Abstract. This paper presents necessary and sufficient conditions for quadratic stability and stabilization of uncertain linear discrete systems with state delay. The system under consideration involves state time delay and time-varying norm-bounded parameter uncertainties appearing in all the matrices of the state-space model. The results are obtained in terms of linear matrix inequality. A robustly stabilizing state feedback controller can be constructed by using the corresponding feasible solution of the matrix inequalities. Our results can be regarded as extensions of existing results on quadratic stability and stabilization for discrete-time delay systems with uncertainties. Two examples are presented to demonstrate the effectiveness of the proposed approach.

1 Introduction

Robust stability analysis and robust stabilization of systems with parameter uncertainties are problems of recurring interest in past years [1,3,22,27]. During the last decades, considerable attention has been devoted to the problem of stability analysis and controller design for time-delay systems. Especially, in accordance with the advance of robust control theory, a number of robust stability and stabilization methods have been proposed for uncertain time-delay systems (see [8,12,16,19,23,24,26]). Less attention has been drawn to the corresponding results for discrete-time delay systems (see [5,6,9,11,14,17,18,21]). This is mainly due to the fact that such systems can be transformed into augmented systems without delay. This augmentation of the systems is, however, inappropriate for systems with unknown delays or systems with time-varying delays.

One of the most popular ways to deal with robust stability analysis and robust stabilization is the one based on the concept of quadratic stability and quadratic stabilization (see [7,10,13,25,28] for free delay and [4,15,20]