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DELAY-DEPENDENT ROBUST STABILITY AND STABILIZATION OF TWO-DIMENSIONAL STATE-DELAYED SYSTEMS

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Abstract. For uncertain two-dimensional (2-D) discrete systems subject to delays in both horizontal and vertical directions, this paper proposes a new delay-dependent stability condition, and uses the condition to develop a robust stabilization method via linear state feedback control. The linear matrix inequality (LMI) approach is adopted, so all results can be applied conveniently. Also, the results may be reduced and utilized in the 1-D case. An example is given to illustrate the application of the proposed stabilization method.

Keywords. 2-D system, delay, linear matrix inequality, robust stability, state feedback.

AMS (MOS) subject classification: 93D09, 93D15, 93D05.

1 Introduction

The 2-D discrete systems are often seen in the fields like multi-dimensional digital filtering, linear image processing, partial difference equations, and so on [12]. Thus the stability analysis and feedback stabilization problems of these systems have attracted much attention for quite some time [5, 7, 10, 12, 13, 17, 23]. Recently, the robust stabilization problem of uncertain 2-D discrete systems is considered by [5] using the LMI [1] approach. Most of the results regarding this topic focus on the 2-D systems without any delay.

However, there are many practical examples of 2-D systems containing delay effects, including the material rolling process [22], and models described by the delayed lattice differential equation [11] and partial difference equations [24]. As is well known, delays are often a source of instability and poor performance. Therefore, the robust stability analysis and control for the 2-D state-delayed system become worthwhile investigation issues.

In the one-dimensional (1-D) case, the robust stability conditions and robust stabilization methods for delay systems can be classified into two types: the delay-independent and the delay-dependent ones. In general, the delay-dependent results are less conservative than the delay-independent counterparts, especially when it is known beforehand that the delay involved is small.