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DELAY-DEPENDENT H_∞ CONTROL FOR DISCRETE-TIME UNCERTAIN RECURRENT NEURAL NETWORKS WITH INTRERVAL TIME-VARYING DELAY

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Abstract. *This paper deals with the problem of delay-dependent robust H_∞ control for discrete-time recurrent neural networks (DRNNs) with norm-bounded parameter uncertainties and interval time-varying delay. The activation functions are assumed to be globally Lipschitz continuous. For the robust stabilization problem, a state feedback controller is designed to ensure global robust stability of the closed-loop system about its equilibrium point for all admissible uncertainties, while for the robust H_∞ control problem, attention is focused on the design of a state feedback controller such that in addition to the requirement of the global robust stability, a prescribed H_∞ performance level for all delays to satisfy both the lower bound and upper bound of the interval time-varying delay is also required to be achieved. A linear matrix inequality approach is developed to solve these problems. It is shown that the desired state feedback controller can be constructed by solving certain LMIs. A numerical example is provided to demonstrate the effectiveness and applicability of the proposed results.*
Keywords: Interval time-varying delay, Linear matrix inequality, Robust H_∞ control, Stability, Discrete-time recurrent neural network

1. Introduction.

In recent years, the study of delayed recurrent neural networks has attracted considerable attention due to the fact that delayed recurrent neural networks can be applied in patterns recognition, associative memories and optimization solvers, etc. Some of these applications have been reported on the existence, uniqueness, and global asymptotic or exponential stability of the equilibrium point for recurrent neural networks with constant delays or time-varying delays. Especially, the problem of stability analysis of delayed recurrent neural networks has been an important topic for researcher [1-6].

Up to now, most works on recurrent neural networks have been focused on acting in a continuous-time manner. However, when it comes to the implementation of continuous-time networks for the sake of computer-based simulation, experimentation or computation, generally speaking, it is usual to discretize the continuous-time networks. Accordingly, discrete-time neural networks have already been applied in a wide range of areas, such as image processing [7], time series analysis [8], quadratic optimization problems [9] and system identification [10], etc. In an ideal case, the discrete-time analogues should be produced in a way to reflect the dynamics of their continuous-time counterparts. Specifically, the discrete-time analogue should inherit the dynamical characteristics of the continuous-time networks under mild or no restriction on the discretization step-size, and also maintain functional similarity to the continuous-time system and any physical or biological reality that the continuous-time network has [11]. Unfortunately, as pointed out in [12],