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A DELAY-DEPENDENT APPROACH TO STABILITY FOR STATIC RECURRENT NEURAL NETWORKS WITH MIXED TIME-VARYING DELAYS

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Abstract. *This paper performs a global stability analysis of a particular class of recurrent neural networks (RNN) in the static neural network models with both discrete and distributed time-varying delays. Both Lipschitz continuous activation function and monotone nondecreasing activation function are considered. Globally delay-dependent stability criteria are derived in the form of linear matrix inequalities (LMI) through the use of Leibniz-Newton formula and relaxation matrices. Moreover, the constraint that derivative of time-varying delays must be smaller than one is released for the proposed control scheme. Finally, two numerical examples are given to illustrate the effectiveness of the proposed criterion*

Keywords: Static recurrent neural networks, Linear matrix inequalities, Global asymptotic stability, Time-varying delay, Leibniz-Newton formula

1. Introduction.

Recurrent neural networks (RNN) have been extensively studied recently and involved in many different applications such as pattern recognition, image processing, associative memory and combinatorial optimization [1-3]. In these applications, stability and convergence of neural networks are prerequisites. Therefore, the stability analysis of recurrent neural networks has received much attention and many results on this topic have been reported in the literature [4-6].

In practice, due to the finite speeds of the switching and transmission of signals, time delays do exist in a working network, which may cause oscillation and instability [7-9]. It is important to ensure the global asymptotic stability of the designed network. Therefore, the problem of exponential stability analysis for RNNs with constant or time-varying delays has been studied in the past few years. Various sufficient conditions, either delay-independent or delay-dependent, have been proposed to guarantee the global asymptotic or exponential stability for the RNNs [10-15], where only the discrete delays have been handled. Moreover, on this general topic of time-delay systems from the control community, there exist already some results available in the literature. For example, in [16], the problem of designing a resilient observer-based dynamic feedback controller for a class of uncertain systems with time-varying delays against controller perturbations was investigated. In [17,18], the authors studied the problem of guaranteed cost control and