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DELAY-DEPENDENT STATE ESTIMATION FOR TIME-VARYING DELAYED NEURAL NETWORKS

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Abstract. *A delay-dependent state estimation problem for a class of neural networks with time-varying delays is addressed in this paper. By using both the lower bound and the upper bound of the time-varying delay of the delayed networks, a Lyapunov function is constructed. Based on this new Lyapunov function, a delay dependent condition is established in terms of linear matrix inequality (LMI) to guarantee the dynamics of the estimation error being globally asymptotically stable. A numerical example is provided to demonstrate the effectiveness of the proposed design method.*
Keywords: Lyapunov function, Neural networks, Stability, State estimation, Time-varying delays

1. **Introduction.** Neural networks(NNs), have been widely studied over the past years and have found a large amount of successful applications such as signal processing, image processing, pattern recognition, solving nonlinear algebraic equations, and other areas [2]-[5], [8], [18]. Such applications heavily depend on the dynamical behaviors. As is well known, stability of the dynamics is one of the most important issues on the analysis of the dynamical behavior. The study of the stability problem of neural networks has received much attention in recent years. However, time delays are unavoidably in practical applications for many reasons. For example, the finite switch speed of amplifiers in electronic NNs and the finite signal propagation time in biological NNs. By far, the stability analysis for delayed neural networks (DNNs) has received much attention, and a lot of results have been reported in the literature (see, e.g. [1], [11]-[19]).

In fact, the neuron states are not often fully available in the network outputs in many applications. Therefore, the state estimation problem of DNNs is also very important for many applications. In recent years, the state estimator of the neural network has attracted some attention and many results, for example, [6]-[7], [9], are obtained. The criterion derived in [6] is not in the form of LMI, which would limit the applications. In [9], the author researched the exponential state estimation problem for the neural networks with constant delay. Only the upper bound was considered in the proof of the theorem in [7].

Motivated by the above mentioned works, the state estimation problem for the neural networks with time-varying delays will be investigated in this paper. We will use both