*International Journal of Innovative Computing, Information and Control*
Volume **3**, Number **6(B)**, December **2007**

ICIC International ©2007 ISSN 1349-4198
pp. **1549–1556**

# NEW ROBUST STABILITY OF CELLULAR NEURAL NETWORKS WITH TIME-VARYING DISCRETE AND DISTRIBUTE DELAYS

Yiming Chen and Weiwei Su

College of Science
Yanshan University
Qinhuangdao, Hebei 066004, P. R. China
chenym@ysu.edu.cn; weiweisu20@sina.com

Received November 2006; revised April 2007

Abstract. *Delay-dependent robust stability of cellular neural networks with time-varying discrete and distributed delays is considered in this paper. Based on Lyapunov stability theory and linear matrix inequality (LMI), stability criteria are derived in terms of LMIs avoiding bounding certain cross terms which often leads to conservatism. And the restriction of derivative of time-varying delay is removed. Numerical examples are given to indicate significant improvements over some existing results.*
**Keywords:** Cellular neural networks, Delay-dependent robust stability, Time-varying discrete and distributed delay, Norm-bounded uncertainties

1. **Introduction.** Different classes of neural networks such as Hopfield neural networks, cellular neural networks, Cohen-Grossberg neural networks, and bi-directional associative memory neural networks have been extensively studied [1-4]. In our paper, we discuss the cellular neural networks with time-varying delays. The cellular neural networks (CNN) are introduced in [1], and the CNN with a delay (DCNN) is first reported in [2].

It is well known that time delays may occur in neural processing and signal transmission, which can cause instability and oscillations in system. And uncertainties are unavoidable in modeling neural networks due to modeling errors and parameter fluctuations during their implementation, which also result in instability and poor performance. Among the dynamical behaviors of various neural networks, stability is the most important. So in the past few years, the stability analysis of neural networks with time delays and uncertainties has been a subject of great practical importance that has attracted a great deal of research interest. Existing criteria for asymptotic stability of time-delay neural networks can be classified into two types: that is, delay-independent stability [5-10] and delay-dependent stability [11-13]. It's noticed that most works on delayed neural networks have dealt with the stability problem for neural networks with discrete time delays.

On the other hand, neural networks usually have a spatial extent due to the presence of a multitude of parallel pathways with a variety of axon sizes and lengths, and hence there is a distribution of propagation delays over a period of time. So it is often the case that the neural networks model possesses both discrete and distributed delays. Very recently, there have been some initial studies on the stability analysis for various neural networks with distributed delays [14-16]. In [14], the author discusses robust global stability analysis for generalized neural networks with both discrete and distributed delays. The parameter