Available online at www.sciencedirect.com

SciVerse ScienceDirect

Mathematics and Computers in Simulation 82 (2012) 2199–2214

MATHEMATICS AND COMPUTERS IN SIMULATION

www.elsevier.com/locate/matcom

Original article

Attracting and invariant sets of non-autonomous reaction-diffusion neural networks with time-varying delays

Shujun Long [a,b,*], Xiaohu Wang [b], Dingshi Li [b]

[a] *College of Mathematics and Information Science, Leshan Normal University, Leshan 614004, PR China*
[b] *Yangtze Center of Mathematics, Sichuan University, Chengdu 610064, PR China*

Received 10 March 2011; received in revised form 21 February 2012; accepted 15 May 2012
Available online 19 June 2012

Abstract

In this paper, a class of non-autonomous reaction-diffusion neural networks with time-varying delays is investigated. By establishing a new differential inequality and employing the properties of spectral radius of nonnegative matrix and diffusion operator, the global attracting and positive invariant sets and exponential stability of non-autonomous reaction-diffusion neural networks with time-varying delays are obtained. Our results do not require the conditions of boundedness of the coefficient of neural networks. One example is given to illustrate the effectiveness of our conclusion.

Keywords: Attracting and invariant sets; Non-autonomous; Reaction-diffusion neural networks; Differential inequality; Delays

1. Introduction

Recently, various neural network models have been extensively investigated and successfully applied to image processing, signal processing, pattern classification, optimization problem, etc. In implementation of neural networks, time delays are unavoidable due to finite switching speeds of the amplifiers and communications. The existence of time delays may destroy a stable network and cause sustained oscillations, bifurcation or chaos and thus could be harmful. Therefore, the stability of neural networks with delay have been studied widely (see Refs. [6,9,11,12,15,22,21,27,29]). However, strictly speaking, diffusion effects cannot be avoided in the neural networks when electrons are moving in asymmetric electromagnetic fields. For example, as it is well known, the multi-layer cellular neural networks are arrays of nonlinear and simple computing elements characterized by local interactions between cells, therefore the multi-layer cellular neural networks paradigm are well suited to describe locally interconnected simple dynamical systems showing a lattice-like structure (see Refs. [2,3]). In other words, the whole structure and dynamic behavior of multi-layer cellular neural networks are seriously dependent on the evolution time of each variable and its position (space), but also intensively dependent on its interactions deriving from the space-distributed structure of the whole networks. So, we must consider that the activations vary in space as well as in time. In recent years, various interesting results on the stability and other behaviors of autonomous neural networks with reaction-diffusion terms have been reported (see Refs. [14,18,19,23,31,32]).

* Corresponding author at: College of Mathematics and Information Science, Leshan Normal University, Leshan 614004, PR China.
E-mail address: longer207@yahoo.com.cn (S. Long).

0378-4754/$36.00
http://dx.doi.org/10.1016/j.matcom.2012.05.018