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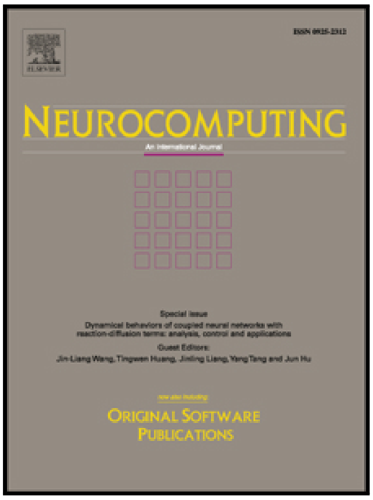

Double almost periodicity for high-order Hopfield neural networks with slight vibration in time variables

Chao Wang, Sakthivel Rathinasamy

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Double almost periodicity for high-order Hopfield neural networks with slight vibration in time variables *

Chao Wang[a], Sakthivel Rathinasamy[b,c†]
[a]Department of Mathematics, Yunnan University,
Kunming, Yunnan 650091,
People's Republic of China
[b]Department of Mathematics, Bharathiar University,
Coimbatore 641 046, India
[c]Department of Mathematics, Sungkyunkwan University,
Suwon 440-746, South Korea

Abstract

In this paper, based on almost periodic time scales, we propose the concept of double almost periodicity of neural networks and analyze almost periodic hybrid dynamics for a new type of Hopfield neural networks that is with slight vibration in time variables. Not only can this new type of neural networks unify discrete, continuous and q-difference analysis, but also it initiates an original idea of slight vibration in time variables of neural networks to precisely describe the double almost periodicity for the status of neural networks. Moreover, a new timescale functional is established and some new Lyapunov functional on time scales are constructed to obtain some sufficient conditions for the existence and ψ-exponential stability of almost periodic solutions for this new type of high-order Hopfield neural networks with variable delays. Finally, several numerical examples with simulation are provided to illustrate the effectiveness and feasibility of our results.

Keywords: Neural networks; Slight vibration; Double almost periodic solutions; Existence; ψ-exponential stability; Time scales.

1 Introduction

In recent years, considerable attention has been paid to recurrent neural networks due to their successful applications such as classification, parallel computation, associative memory, combinatorial optimization, pattern recognition, image processing, etc.(see [1, 2, 3, 4, 5, 6, 7, 8]). Due to the fact that high-order neural networks have a stronger approximation property, faster convergence rate, greater storage capacity and higher fault tolerance than low-order neural networks, high order neural networks have been the object of intensive analysis by numerous authors in recent years. In particular, there have been extensive results on the existence and stability of equilibrium points and periodic solutions of high–order Hopfield neural networks (HHNNs) (see [9, 10, 11, 12, 13] and the references cited therein). However, in celestial mechanics, almost periodic solutions and stable solutions to differential equations or difference equations are intimately related. In fact, almost periodicity is a property of dynamical systems that appear to retrace their paths through phase space, but not precisely. An example would be a planetary system, with planets in orbits moving with periods that are not commensurable (i.e., with a period vector that is not proportional to a vector of integers). A

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†Corresponding authors-Email: krsakthivel@yahoo.com; chaowang@ynu.edu.cn