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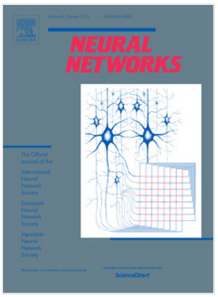

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Adaptive Exponential Synchronization of Complex-valued Cohen-Grossberg Neural Networks with Known and Unknown Parameters☆

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Abstract

The complex-valued Cohen-Grossberg neural network is a special kind of complex-valued neural network. In this paper, the synchronization problem of a class of complex-valued Cohen-Grossberg neural networks with known and unknown parameters is investigated. By using Lyapunov functionals and the adaptive control method based on parameter identification, some adaptive feedback schemes are proposed to achieve synchronization exponentially between the drive and response systems. The results obtained in this paper have extended and improved some previous works on adaptive synchronization of Cohen-Grossberg neural networks. Finally, two numerical examples are given to demonstrate the effectiveness of the theoretical results.

Keywords: complex-valued Cohen-Grossberg neural networks, exponential synchronization, adaptive control

1. Introduction

Recently, the complex-valued neural network, which has complex-valued states, connection weights and activation functions, has drawn the interest of more and more researchers. The complex-valued neural networks are well suited to handle complex-valued information and capable of solving problems that can not be solved by real-valued neural networks (see Nitta (2003)). Therefore the study of complex-valued neural networks has greatly extended the scope of the applications of neural networks in various fields, such as adaptive signal processing, communication engineering, medical imagine, constrained optimization etc. See Bohner et al. (2011), Chen and Song (2013), Duan and Song (2010), Hirose (2010), Hu and Wang (2012), Hu and Wang (2015),Liu and Chen (2015), Li et al. (2002), Rakkiyappan et al. (2015), Zhang et al. (2011), Zhou and Song (2013), Zhang et al. (2015), Zhang and Xia (2015), Zhou and Zurada (2009) and the references herein.

The complex-valued Cohen-Grossberg neural network is an extension of real-valued Cohen-Grossberg neural network proposed in 1983 (Cohen and Grossberg (1983)). It includes several famous complex-valued neural networks such as complex-valued Hopfield neural networks and complex-valued cellular neural networks as its special cases and has promising application potentials for tasks of classification, associative memory, parallel computation and nonlinear optimization problems. In complex-valued Cohen-Grossberg neural networks, the states, connection weights and activation functions as well as the amplification functions and behaved functions are all complex-valued, thus they are more complicated in dynamical properties than the real-valued counterparts and it is quite significant to study these properties. In recent years only a few papers have studied the stability and synchronization of complex-valued Cohen-Grossberg neural networks see Zhang et al. (2014) and Zhang and Yu (2015). This is far from enough. In this paper, we will investigate the adaptive synchronization problem of complex-valued Cohen-Grossberg neural networks.

Chaos synchronization, introduced by Pecora and Carrol in Pecora and Carroll (1990) and Carroll and Pecora (1991), means that two or more systems share a common dynamical behavior. It has been pointed out that neural networks can exhibit complicated dynamics and even chaotic behavior if the parameters and time delays are appropriately chosen. In the past decades, since the concept of drive-response synchronization for coupled chaotic systems was proposed in Pecora and Carroll (1990), chaos synchronization has become a hot topic and much attention has been paid to control and chaos synchronization because of its potential applications in secure communication, automatic control, biological systems, information science, etc, see Cao and Lu (2006), Gan (2012b), Guo et al. (2015), He and Cao (2008), Lu et al. (2016), Liu and Zhang (2012), Nie et al. (2015), Wu and Chen (2016),Wang et al.

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