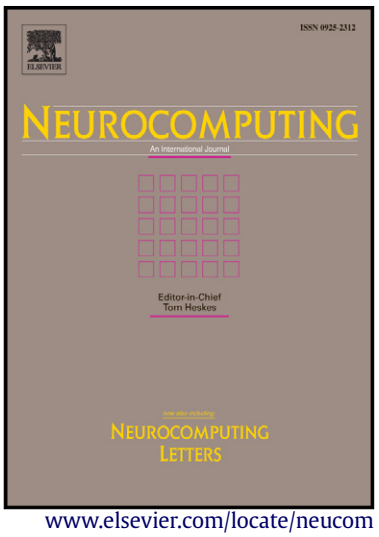

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Adaptive exponential synchronization in mean square for Markovian jumping neutral-type coupled neural networks with time-varying delays by pinning control

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Abstract

In this paper, the adaptive exponential synchronization problem of neutral-type coupled neural networks with Markovian switching parameters is investigated. The switching parameters are modeled as a continuous time, finite state Markov chain. Based on Lyapunov stability theory, stochastic analysis and matrix theory, some sufficient conditions for exponential synchronization in mean square are derived. The adaptive controllers are added to part of nodes, and the adaptive laws are depend on Markov chain and error states. Two numerical examples are exhibited to illustrate the validity of the theoretical results. Through the comparison of average value of synchronization control cost and synchronization time, we verify that control different nodes may be more effectively to achieve synchronization than control fixed nodes when the network topology is switching by a Markov chain.

Keywords: Synchronization, neutral-type, neural networks, Markovian switching, adaptive pinning control.

1. Introduction

The neural networks (NNs) has been extensively investigated over the last decades for its practical applications in many areas including image processing and signal, automatic control, associative memories, combinatorial optimization, and so on (see. [1, 2, 3, 4]). In NNs, one of the most interesting phenomena is synchronization, such as drive-response synchronization of neural networks, synchronization of biological neural networks, and so on. Motivated by both the basic science and the technological practice, the study of synchronization problems among an array of coupled neural networks has become an active research topic in the past few years (see. [5, 6, 7]).

In the case where the coupled network cannot synchronize by itself, therefore many control techniques have been developed to drive the network to achieve synchronize, such as linear state feedback control [8], sampled data control [9], impulsive control [10] and adaptive control [11]. All of them have a common feature that the controller needs to be added to each node. But in practice, it is too difficult to add controllers to all nodes in a large-scale coupled network. To reduce the number of controlled nodes, pinning control is introduced, in which controllers are only applied to partial nodes. This case of control techniques has been earlier reported in paper [12, 13, 14, 15]. In addition, the adaptive pinning control method, which is utilized to get the appropriate control gains effectively, has received considerable research attention. An adaptive pinning control method is proposed in [16] to synchronize for a delayed complex dynamical network with free coupling matrix. Besides these, there are many literatures to study adaptive pinning control problems of networks [17, 18, 19].

On the other hand, time delays commonly exist in in various system [20, 21, 22, 23], because of the finite switching speeds of amplifiers and traffic congestions in signal transmission processes, which become one of the main sources for causing instability and poor performance of neural networks. So far, much efforts have been paid for analyzing synchronization behaviors of NNs with various types of time delays, such as constant time delays, time-varying delays, discrete and distributed delays. Neutral-type NNs is a special type of time delayed NNs, in which the time-delays occur not only in the system states but also in the derivatives of system states [24, 25, 26, 27]. Meanwhile, many NNs can happen abrupt changes in their structure and parameters, which can be described by a continuous time, finite state Markov chain [28, 29]. It is called Markovian jumping neutral neural networks when the neural network with neutral-type delays and Markovian jumping parameters. These kinds of systems are widely studied by many scholars. In [30], the stochastic stability problem of neutral-type neural networks with Markovian jumping parameters is considered. By using the adaptive control approach, the drive-response synchronization of neutral-type delayed neural networks is investigated in [31]. In [32], by using adaptive control method, the exponential synchronization of coupled neutral-type complex dynamical networks is considered, in which the

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