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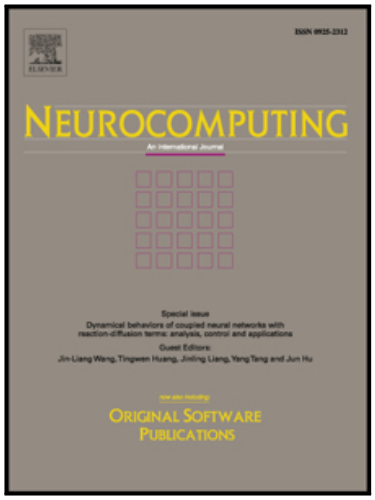

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Finite-Time Synchronization of Time-Delayed Neural Networks with Unknown Parameters via Adaptive Control

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Abstract

In this paper, the problem of finite-time adaptive synchronization is investigated for two different delayed neural networks with unknown parameters. Two adaptive control approaches are designed in order to synchronize the neural networks in finite time. The first controller fully involves the information of time-varying delay and the second one is delay-independent under the case that time-varying delay is unknown. By utilizing the Lyapunov stability theory, sufficient conditions are proposed to guarantee the finite-time synchronization of the addressed neural networks. In addition, the settling time for synchronization is estimated. Finally, two numerical simulations are used to illustrate the correctness and effectiveness of the proposed methods.

Key words: Finite-time synchronization, delayed neural networks, adaptive control, unknown parameters.

1 Introduction

In recent years, the neural networks have been widely used in different areas, such as combinatorial optimization, signal processing, machine learning, image encryption and so on [1,2]. Particularly, the synchronization of neural networks, as a typical collective dynamical behavior, has also received massive attention due to its potential applications in engineering, such as synchronization-based secret communication [3,4].

It is well known that the time delay cannot be avoided during the hardware implementation of neural networks because of the finite switching speed of the neuron amplifiers and the finite signal propagation speed. Moreover, the time delay may also be the source of instability, oscillation or other undesirable dynamical performance [5–9]. Note that the neural networks with time delays can exhibit complicated dynamics and even chaotic behaviors. Therefore, there have been an increasing research interest concerning on the synchronization of time-delayed neural networks in recent years [10]. For example, the global synchronization has been discussed in [11] for multiple recurrent neural networks with time delays. In [12,13], the synchronization problems have been studied for the memristive neural networks with time-varying delays. The adaptive synchronization issues of Cohen-Crossberg neural networks with mixed time-varying delays have been studied in [14] and the exponential synchronization of chaotic neural networks with delays has been investigated in [15,16].

It is worth mentioning that most of existing results including those mentioned above are focused on the asymptotic or exponential synchronization of time-delayed neural networks, which means that the state trajectories of the response system can keep track of those of the drive system over an infinite time interval. In reality, a requirement is for more precise time specifications of the synchronization in practical process of engineering. Therefore, the finite-time synchronization for various types of neural networks has been attracted