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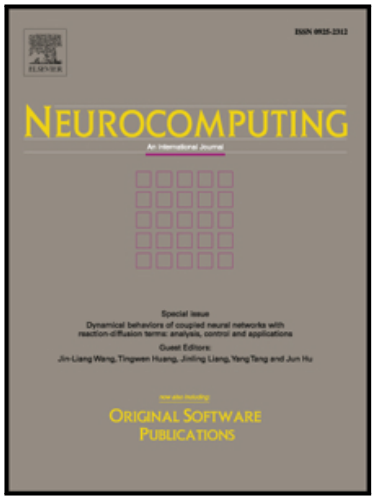

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Synchronization of stochastic complex networks with time delay via feedback control based on discrete-time state observations

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Abstract

In this paper, synchronization of stochastic complex networks (SCNs) with time delay is researched. A feedback control method is introduced to drive such SCNs to achieve inner synchronization in mean square. Different from previous researches, the feedback control we designed is based on discrete-time state observations. Moreover, by exploiting Lyapunov method and Kirchhoff's Matrix Tree Theorem in graph theory, some sufficient criteria are obtained to guarantee synchronization in mean square and asymptotical synchronization in mean square of SCNs. What is more, we make use of the theoretical results to analyze asymptotical synchronization in mean square of second-order Kuramoto oscillators with time delay and stochastic disturbances and get a sufficient criterion. At the end of this paper, a numerical example is provided to validate the effectiveness and feasibility of our theoretical results.

Keywords: asymptotical synchronization; stochastic complex networks; time delay; feedback control; discrete-time state observations

1. Introduction

In the past few decades, complex networks have been widely researched by many scholars because they can describe many systems in real world, such as social networks, Internet, the World Wide Web and so on [1, 2, 3, 4, 5, 6]. In fact, complex networks are made up of some interconnected nodes and edges, in which each node represents a subnetwork and each edge represents the interactions between two subnetworks. And the complexity of complex networks is determined by the diversity of topological structure and rich node dynamics, which are closely related [7]. Meanwhile, among the dynamical properties of complex networks, including stability, periodicity, synchronization and so on, synchronization is an interesting topic which mainly focuses on the topological structure and node dynamics of complex networks. Generally, synchronization includes out synchronization and inner synchronization. In fact, outer synchronization means that synchronization occurs among the corresponding nodes of two or more coupled networks, regardless of synchronization among the nodes in the same network. However, inner synchronization is that two or more nodes achieve a common behaviour by adjusting some properties of their movements. To achieve this purpose, the nodes in complex networks need to exchange their information with each other, which is very critical in complex networks. In this way, investigating synchronization of complex networks has important significance and some studies have been developed [8, 9, 10, 11, 12, 13, 14].

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