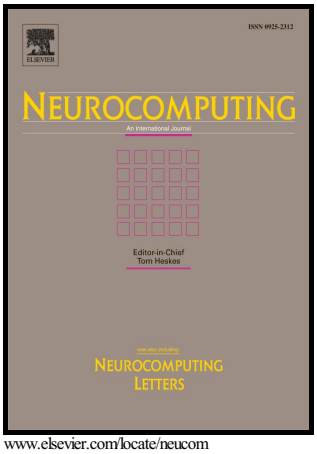

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Synchronization of Complex Dynamical Networks on Time Scales via Wirtinger-Based Inequality ⋆

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Abstract

A new Wirtinger-based inequality on time scales which can unify the continuous and discrete ones is studied in this paper. By using the new inequality, a new approach to synchronization of complex dynamical networks with discrete time delays on time scales is given. To illustrate the effectiveness of our results, an example is given.

Key words: Synchronization, Complex dynamical networks, Wirtinger-based inequality, Time scale.

1 Introduction

As one of the most significant and attractive dynamical phenomenon in complex networks, the synchronization phenomenon has attracted considerable attention over the past years. This phenomenon appears in many fields, such as communication, neural networks, internet, etc. In [1], the authors presented a framework for analysis of synchronization of linearly coupled map lattices (LCMLs) and obtained criteria for both local and global synchronization. The problem of stochastic synchronization analysis was investigated for a new array of coupled discrete time stochastic complex networks with randomly occurred nonlinearities (RONs) and time delays in [2]. In [3], a novel pinning synchronization scheme for an array of neural networks with hybrid coupling was investigated. The problem of exponential synchronization and state estimation for singularly perturbed complex networks (SPCNs) with coupling delay under sampled-data control technique was dealt with in [4]. In [5], proper adaptive controllers were proposed for the stabilization and function matrix projective synchronization of a class of non-diffusively coupled complex networks consisting of nodes of different dimensions.

It's meaningful to study both continuous and discrete network systems under the same framework because the interaction among agents can happen at both continuous-time and discrete-time simultaneously. The theory of time scales, which was introduced by Stefan Hilger, not only can unify continuous and discrete analysis, but also has a tremendous potential for applications [6–8]. In [9], some sufficient conditions were derived to ensure the global exponential stability of the delayed bi-directional associative memory (BAM) neural network on time scales. Several sufficient conditions were derived for reaching the globally exponential consensus of multi-agent system with distributed control on time scales in [10]. In [11], some new sufficient conditions ensuring the existence and global exponential stability of the almost periodic solutions for a class of neutral-type neural networks with distributed leakage delays on time scales were derived. In [12], the authors came up with an interesting unified framework on time scales to combine both continuous complex networks and discrete cases, and derived several sufficient criteria to ensure the global exponential synchronization for the considered networks.

In this paper, we give a new Wirtinger-based inequality on time scales. This new inequality can unify both continuous one [16] and discrete ones [17, 19], and based on this new inequality, we can directly construct a appropriate Lyapunov function for deriving a new synchronization criteria for complex networks on time scales. Moreover, compared with the existing results in [12], which may need $\frac{N(N-1)}{2}$ inequalities to verify, our results need only one, thus, the computational complexity by using the new inequality in this paper is reduced greatly.

The paper is organized as follows. Section 2 recalls some preliminary results. In Section 3, we give a new Wirtinger-based inequality on time scales. By using

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