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Research Article

Cluster Synchronization of Nonlinearly Coupled Complex Networks via Pinning Control

Jianwen Feng,[1] Jingyi Wang,[1] Chen Xu,[1] and Francis Austin[2]

[1] *College of Mathematics and Computational Science, Shenzhen University, Shenzhen 518060, China*
[2] *Department of Applied Mathematics, The Hong Kong Polytechnic University, Hong Kong*

Correspondence should be addressed to Jianwen Feng, fengjw@szu.edu.cn

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We consider a method for driving general complex networks into prescribed cluster synchronization patterns by using pinning control. The coupling between the vertices of the network is nonlinear, and sufficient conditions are derived analytically for the attainment of cluster synchronization. We also propose an effective way of adapting the coupling strengths of complex networks. In addition, the critical combination of the control strength, the number of pinned nodes and coupling strength in each cluster are given by detailed analysis cluster synchronization of a special topological structure complex network. Our theoretical results are illustrated by numerical simulations.

1. Introduction

Complex networks synchronization is an important phenomenon in both mathematical and physical sciences because of its myriad applications to diverse problems such as communications security, seismology, parallel image processing as well as many others [1–7]. Loosely speaking, synchronization is the process in which two (or more) dynamical systems seek to adjust a certain prescribed property of their motion to a common behavior in the limit as time tends to infinity either by virtue of coupling or by forcing [8]. Some common synchronization patterns that have been widely studied are complete synchronization [9], lag synchronization [10], cluster synchronization [11], phase synchronization [12], and partial synchronization [13, 14].

Since Pecora and Carroll [15] found the chaos synchronization in 1990, synchronization has been widely studied because of its potential application in many different areas. Rulkov et al. [16] explored generalized synchronization of chaos in directionally coupled