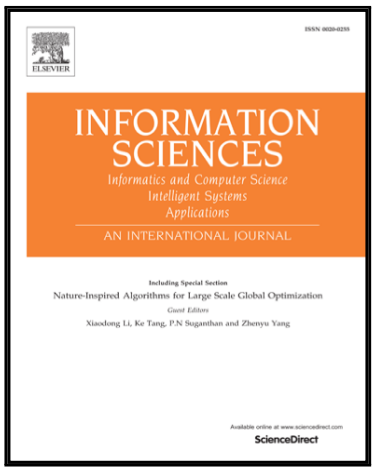

Controllability and modularity of complex networks

Peng Gang Sun

PII: S0020-0255(15)00517-4
DOI: 10.1016/j.ins.2015.07.024
Reference: INS 11670

To appear in: *Information Sciences*

Received date: 9 November 2014
Revised date: 28 June 2015
Accepted date: 4 July 2015

Please cite this article as: Peng Gang Sun , Controllability and modularity of complex networks, *Information Sciences* (2015), doi: 10.1016/j.ins.2015.07.024

Controllability and modularity of complex networks

[*]Peng Gang Sun [a,b]

[a]School of Computer Science and Technology, Xidian University, Xi'an, 710071, China

[b]Institute of Computational Bioinformatics, Xidian University, Xi'an, 710071, China

Abstract Two primary properties of complex networks, controllability and modularity not only are closely related to each other, but also play an important role in understanding the networks' characteristics. In this paper, we discuss an elastic model to enhance the control of undirected networks and study the controllability of random networks with built-in gradually varied modularity as well as real-world networks to elaborate the correlation between the networks' controllability and modularity. The results show that it is easier to control the networks with stronger modularity than that of weaker modularity, and the networks with larger size communities probably need more driver nodes to control than that of smaller size communities when we fix both the number of nodes and the number of links of the networks. In addition, the robustness analysis indicates that the model enhances the resistance of networks against link failure. This work shows that the controllability of complex networks is highly associated with the networks' degree distribution as well as the networks' modularity, which gives a new insight into the understanding of controllability and modularity of complex networks.

Keywords: controllability, modularity, minimum dominating set

1 Introduction

The study of complex networks has always been a hot topic and has attracted more attention of researchers from different fields [1-3, 5-7, 9, 12-14, 19-25]. The modularity as one primary property widely exists in most real-world networks [1, 5, 7, 13, 23-25]. The property can be described as groups of nodes, called community structures or modular structures [5, 7, 13, 21-23]. The nodes in same groups are more highly connected than that of different groups [5, 7, 13, 21-23]. Community structures often correspond to important functional units, e.g. social networks consist of communities, which often correspond to groups of people who share similar characteristics [1, 5, 7, 13, 23-25]. Biological networks are composed of communities, which often correspond to groups of genes sharing similar biological functions [1, 5, 7, 13, 23-25]. Through the study of modularity, we can get a new insight into the understanding of characteristics of complex networks [5, 7, 13]. Therefore, community detection has attracted a good deal of attention over the past several years [1-3, 5-7, 9, 12-14, 19-23,

[*] Corresponding author (sun198268@163.com Tel/Fax: 86+29+8202629) is at School of Computer Science and Technology, Xidian University, P. O. Box 163, No. 2 South Taibai Road, Xi'an, China, 710071.