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THE BASIC PRINCIPLES OF TOPOLOGY-DYNAMICS RELATIONS IN NETWORKS: AN EMPIRICAL APPROACH

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Abstract

Inferring functional properties of a node from its topological role in the network is of utmost importance in many application fields. In this work, we try to give some hints on this issue focusing on the discovery of empirical topology/function rules located at different degrees of generalization going from a population of heterogeneous biological networks to a single wiring architecture.

Here we report a simulation approach to this problem based on the analysis of the relationship between dissipation kinetics across the network of a perturbative stimulus applied on a single node and its topological properties. The empirical character of the study prompted us to rely on real biological networks instead of ‘ideal architectures' and to adopt a statistical attitude with a relatively low number of affected nodes for each network that is much more realistic in real-world biological applications. The analysis allowed us to recognize some general topology-dynamics correlation rules variously modulated by global wiring architecture.

Keywords: Networks dynamics, perturbative methods, signal transmission, biological networks.

Introduction

As aptly pointed out by Nicosia et al.[1] ‘‘Networks are the fabric of complex systems’’. Concepts including organized complexity[2], the middle way[3], and mesoscopic systems[4] all revolve around network paradigms.