FROM THE TOPOLOGY TO THE DYNAMICS OF COMPLEX NETWORKS

Abstract

by

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Understanding the mechanisms governing the behavior of complex networks is a prerequisite for characterizing complex systems. Frequently, networks are modelled as unweighted graphs in which each link has the same strength. However, for many real networks appearing in biological, technological and economic systems, each link has a specific weight, as nodes interact with each other with different strengths. In order to extend our understanding of network architecture to such systems, we introduce several weighted network models and investigate their scaling properties. In some real systems each node has a fixed geographical location, forcing some nodes to be connected by physical links of considerable length, such as routers connected by wires on the Internet. In such systems, we find that the physical layout of the underlying network strongly impacts the large-scale properties of the network. By combining data from several empirical databases and results from numerical simulations, we uncover the existence of three universal mechanisms which significantly affect the network's global properties. As an application of complex network theory, we also study the large-scale properties of four yeast-protein interaction databases, finding quantitative evidence of strong correlations between the underlying network's structure and pro-

tein classes and function. To move beyond the topological properties of networks, we investigate the dynamics of a diffusive system driven by multiplicative noise, uncovering the relationship between the fluctuations of the incoming fluxes and the underlying network topology.