

539f Emergence of Hierarchy in Foodwebs: a Paradigm for Efficient Transportation Networks

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The study of complex networks has been found to be a powerful tool in the analysis of complex systems like metabolic, transport and social networks [1]. In most cases the analysis involves directed links, with the corresponding appearance of hierarchies and different network navigability compared to undirected links [2]. Hierarchies appear in ecological networks [3], organizational networks [4] and transportation networks like river flow networks and vascular networks [5]. An understanding of the properties of, and ability to generate, hierarchical networks would have significant consequences in the design of optimal networks for transfer of material, energy and information.

In this work, the authors present a simple model, based on the efficiency of energy transfer among successive predators in an ecological food web, to generate hierarchical networks. The model encapsulates optimization between such conflicting requirements as individual energy supply maximization and interspecies competition minimization. The networks generated showed striking similarity to real food webs with regards to their topology, suggesting an underlying principle of organization.

The hierarchical structure, in the form of a spanning tree, is considered to the heart of the transport system; with additional links providing stability under structural damage while having little effect on efficiency of resource transfer [6]. Identification of the hierarchical structure of a network would be useful in identifying potential flow bottlenecks [3] and understanding of distributed problem solving systems [4, 7]. In addition, tools developed in this analysis may be used in other transport networks like airport, railway and metabolic networks.

References

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