AGSOE 18: Networks: From Topology to Dynamics III

Time: Thursday 14:00–16:00 Location: BAR 205

AGSOE 18.1 Thu 14:00 BAR 205

Synchronization in complex networks — •Albert Diaz-Guilera — Universitat de Barcelona — Potsdam University

Synchronization processes in populations of locally interacting elements are in the focus of intense research in physical, biological, chemical, technological and social systems. The many efforts devoted to understand synchronization phenomena in natural systems take now advantage of the recent theory of complex networks. We report the advances in the comprehension of synchronization phenomena when oscillating elements are constrained to interact in a complex network topology. We also overview the new emergent features coming out from the interplay between the structure and the function of the underlying pattern of connections. Extensive numerical work as well as analytical approaches to the problem are presented. Finally, we review several applications of synchronization in complex networks to different disciplines: biological systems and neuroscience, engineering and computer science, and economy and social sciences.

AGSOE 18.2 Thu 14:30 BAR 205

Extracting Dynamics from System Topology by Generalized Modeling — •Thilo Gross — Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Str. 38, 01187 Dresden

In several disciplines, ranging from biology to sociology and psychology, the topology of the network of interactions between system components is often either clear or suspected. By contrast the dynamical laws governing the interplay between these components are hard to derive, prohibiting a detailed mathematical analysis. For instance in ecology it is often known who-eats-who, but it is difficult to restrict these interactions to specific mathematical functions and parameter values. Therefore the term model is often used to refer to a diagrammatic representation of a system rather than a set of equations. In this talk I will show how generalized modeling can be used to investigate the local dynamics around all steady states of all potential systems of differential equations that are consistent with a given diagrammatic representations. In this way we can: identify important parameters for the local dynamical stability of the system; identify bifurcation points at which the stability is lost; and draw further conclusions on local and global dynamics from bifurcation analysis. The numerical performance of generalized models is so favorable that it can be used to statistically explore systems with thousands of unknown parameters. The approach will be illustrated by several examples from psychology and sociology.

AGSOE 18.3 Thu 15:00 BAR 205

Tour de Sys: The traveler's view of a network — •Christian Thiemann[1,2], Daniel Grady[1], and Dirk Brockmann[1] — [1]Northwestern University, Evanston IL, USA — [2]Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany

The plight of the Flatlander is imperfect information about a high-dimensional object. Yet even so, the clever inhabitant of a low-dimensional world can gain a great deal of information about such an object by examining it from many perspectives. We analyze complex transportation networks by using shortest-path trees to measure universal network properties from different locations. Furthermore, by defining a measure of a node's geographical access area we give a more realistic characterization of the centrality or remoteness of a location. The network topology indicates a clear distinction between the center and edge of a network, but we find that examining the weights of links is crucial, as the distinction in the weighted network for some quantities is even more pronounced. Often prior research has not focused on the weightedness of transportation networks, in spite of the fact that this property has an obvious bearing on how the networks are actually used. We show that measuring networks with weighted edges significantly affects their statistics. Our analysis indicates dynamical processes occurring on these networks should behave in a manner very different than what is predicted by considering topology alone.

AGSOE 18.4 Thu 15:30 BAR 205

A novel approach in the filtering of information from complex systems: The overlapping Tree Network — •Antonios Garas and Panos Argyrakis — Department of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki Greece.

We present a novel filtering technique that is able to extract information from various complex systems. To use this technique we first map the complex system into a network by representing its elements with nodes and the interactions among its elements with links connecting the nodes. Then we make use of the established Minimum Spanning Tree technique, in such a way that it allows us to create a subgraph that retains the strongest links of the original complex network, but it has considerably smaller amount of total links. The resulting subgraph is not a tree, and therefore it can contain loops. This way we are able to extract more information for the investigated system, in comparison to the information we can extract by direct implementation of the Minimum Spanning Tree technique. We apply this method into various different networks, and we discuss the results.