BP 35: Networks: From Topology to Dynamics II (Joint Session SOE/DY/BP)

Time: Tuesday 15:00–15:45 Location: H36

BP 35.1 Tue 15:00 H36

Collective Failure due to Multistability in Oscillator Networks and Power Grid — •Debsankha Manik[1], Dirk Witthaut[2], and Marc Timme[1] — [1]Network Dynamics Group, Max Planck Institute for Dynamics anf self-Organization, 37077 Göttingen — [2]Forschungszentrum Jülich, Institute of Energy and Climate Research Systems Analysis and Technology Evaluation (IEK-STE), 52425 Jülich

Networks of phase oscillators model the collective dynamics of various interacting physical and biological systems, ranging from electric power grid operation to neuronal rhythms. Here we show that the number of stable steady states in phase oscillator systems scales with the length of the topological cycles in the network such that for non-global coupling, multistable steady states may emerge. The clustering of similar natural frequencies favour fewer stable states, whereas homogeneous frequency distributions favour more. Intriguingly, multistability prevails even under conditions for which stable states have been claimed to be unique. This multistability may have significant impact on the collective dynamics of such networks: for example, in power grids where the transmission lines have structural limitations on the maximum load they can safely carry, perturbations may induce switching to different steady states, strongly alter the flow patterns, and in turn yield a collective failure of the grid.

Supported by the BMBF under grant no. 03SF0472E.

BP 35.2 Tue 15:15 H36

Geometric organization of real multiplex networks — •Kaj Kolja Kleineberg[1], Marian Boguna[1], M. Angeles Serrano[1], and Fragkiskos Papadopoulos[2] — [1]Departament de Fisica Fonamental, Universitat de Barcelona, Marti i Franques 1, 08028 Barcelona, Spain — [2]Department of Electrical Engineering, Computer Engineering and Informatics, Cyprus University of Technology

Real complex networks are organized to perform certain functions, among which targeted transport is important in a broad range of real systems, such as the Internet, social networks, or transportation networks. In reality, networks are not isolated entities but instead form interacting parts of larger and more complex systems. These systems are not a random combination of single networks, but instead are organized in a certain way. We investigate the geometric organization of multilayer networks and its implications. We find significant metric correlations between different layers. These correlations are key to answer many important questions concerning real multilayer systems. Metric correlations allow for inter-layer link prediction and the definition and detection of multidimensional communities. Metric correlations improve mutual greedy routing, that is targeted navigation in the whole multilayer system. Interestingly, only in the presence of metric correlations does the whole system outperform its single layers. We find that optimal correlations make multilayer systems perfectly navigable. Finally, we show how correlations present in the real Internet multiplex help navigating the digital world. Our findings have important implications for the design of real multilayer systems.

BP 35.3 Tue 15:30 H36

Interplay of shape and degree distribution in complex networks — •Robin de Regt and Christian von Ferber — Applied Mathematics Research Centre, Coventry University, UK

Complex networks are often described without geometry. Here, we explore possibilities of how an embedding of such networks in real space (e.g. 2D or 3D) may reveal interesting correlations between standard measures such as degree distributions and the shapes these structures may attain when embedded in a given space.