BP 23: Networks, From Topology to Dynamics (joint with SOE and DY)

Time: Wednesday 15:45–17:00 Location: H37

BP 23.1 Wed 15:45 H37

Eigenvector centrality as a measure of influence in dynamics on networks — •Konstantin Klemm[1], M. Angeles Serrano[2], Victor M. Eguiluz[3], Maxi San Miguel[3], and Fakhteh Ghanbarnejad[4] — [1]Bioinformatics, Institute for Computer Science, Leipzig University, Germany — [2]Fisica Fonamental, University of Barcelona, Spain — [3]Institute for Cross-Disciplinary Physics and Complex Systems, Palma de Mallorca, Spain — [4]MPI for Physics of Complex Systems, Dresden, Germany

Definitions of centrality aim at quantifying the importance of a node in a given graph. Among many others, the degree, the betweenness and the closeness are examples of frequently used measures of centrality. Here we ask which notion of centrality is best suited for predicting the influence a node has on dynamics. The concept of dynamical influence is made rigorous for a class of dynamical rules that asymptotically lead the system to a stationary state $y(\infty)$ from any initial condition $y(0)$. Then the influence of node v is the dependence of the asymptotic state on the initial condition $y_v(0)$ at node v. We find that the principal eigenvector of the coupling matrix is an accurate predictor of influence for various kinds of dynamics [1,2], including critical epidemic and Ising models, Boolean networks, the voter model as well as Kuramoto and Rössler oscillators.

[1] Klemm et al., Scientific Reports 2, 292 (2012).
[2] Ghanbarnejad and Klemm, EPL 99:58006 (2012).

BP 23.2 Wed 16:00 H37

A macroscopic view on temporal networks — •Hartmut Lentz[1,2], Thomas Selhorst[1], and Igor M Sokolov[2] — [1]Friedrich-Loeffler-Institute, Federal Research Institute for Animal Health, 16868 Wusterhausen, Germany — [2]Humboldt-University of Berlin, 12489 Berlin, Germany

The concept of accessibility graphs can be extended to temporal networks. An accessibility graph (transitive closure) of a network contains a link, wherever there is a path of arbitrary length between node pairs. Building an accessibility graph by consecutively adding paths of growing length ("unfolding") yields information about the distribution of shortest path durations and reveals characteristic time-scales in temporal networks. Accessibility contributes a key element for a theoretical framework for the macroscopic analysis of temporal networks, because it maps the whole causal path structure of the system onto a single mathematical object. In addition, we define a causal fidelity, measuring the goodness of the static representation of a temporal network. The methods provided here can be implemented efficiently and their capability is demonstrated in applications, as shown by our discussion of three temporal network data sets, namely social contacts, livestock trade and sexual contacts.

Reference: Unfolding accessibility provides a macroscopic approach to temporal networks, arXiv:1210.2283.

BP 23.3 Wed 16:15 H37

Clustering coefficient of temporal networks — •Vitaly Belik[1,2], Igor M Sokolov[3], and Hartmut Lentz[3,4] — [1]Max Planck Institute for Dynamics and Self-Organization, Göttingen — [2]Massachusetts Institute of Technology, Cambridge, USA — [3]Humboldt-University of Berlin — [4]Friedrich-Loeffler-Institute, Wusterhausen

The science of complex networks has experienced a tremendous development in recent years. Most of the research was devoted to static networks where interactions between nodes are aggregated over time. However with increasing availability of empirical data of high temporal resolution, the dynamics of networks becomes the focus of research. In the present study we generalize the concept of clustering coefficient to temporal networks allowing for arbitrary durations of triangles fulfilling the requirement of causality. In contrast to many algorithmic approaches, we build up on the current advances in the mesoscopic description of temporal networks [1]. We apply our approach to various empirical datasets, in particular a conference contact network and a mobile phone dataset, as well as to their randomized counterparts.

[1] Unfolding accessibility provides a macroscopic approach to temporal networks, H Lentz, T Selhorst, I M Sokolov, arXiv:1210.2283

BP 23.4 Wed 16:30 H37

Devil's Staircases, Crackling Noise and Phase Transitions in Percolation — •Jan Nagler — Max Planck Inst. f. Dyn. & Self-Organization

We identify and study certain phenomena in percolation that can subvert predictability and controllability in networked systems. We establish devil's staircase phase transitions, non-self-averaging, and power-law fluctuations in percolation. We provide exact conditions for percolation that exhibits multiple discontinuous jumps in the order parameter where the position and magnitude of the jumps are randomly distributed - characteristic of crackling noise. The framework is linked to fragmentation processes, where groups or particles repeatedly split up, to susceptible-infected type dynamics, and also to effects in ferromagnetic materials.

BP 23.5 Wed 16:45 H37

Resilience to Leaking - Dynamic Systems Modeling of Information Security — •Kay Hamacher — Department of Computer Science, Department of Physics & Department of Biology, Technische Universitaet Darmstadt, Germany

Leaking of confidential material is a major threat to information security. This insight become popular wisdom since Wikileaks, which hopes to attack 'unjust' systems or 'conspiracies'.

Eventually, such threats to information security rely on a biologistic argument on the benefits and drawbacks that uncontrolled leaking might pose for 'just' and 'unjust' entities. Such biological metaphors are almost exclusively based on the economic advantage of participants.

Here, I introduce a mathematical model of the complex systems dynamics implied by leaking. The complex interactions of adversaries are modeled by coupled logistic equations including network effects of econo-communication networks.

Situations might arise where leaking can strengthen the 'conspiracy'. The only impact leaking can have on an organization originates in the exploitation of leaks by a competing entity. We conclude that leaks can be used as a 'tactical mean' in direct adversary relations, but do not necessarily increase public benefit.

Within the model exploiting the competition between entities seems to be a more promising approach to control malicious organizations: divide-et-impera policies triumph here.

[1] K. Hamacher, "Resilience to Leaking - Dynamic Systems Modeling of Information Security", PLoS One, 2012, accepted