SOE 11: Networks - From Topology to Dynamics I (joint SOE/DY/BP)

Time: Wednesday 17:30–18:30 Location: GÖR 226

SOE 11.1 Wed 17:30 GÖR 226

Scaling and Fluctuation Scaling in Systems and Networks of Constant Size — •Cornelia Metzig[1] and Caroline Colijn[2] — [1]Queen Mary University of London, UK — [2]Simon Fraser University, Burnaby, Canada

We propose a preferential-attachment-type model for a system of constant size which applies to urn/ball systems and to networks. It generates a power law for the size (or degree) distribution with exponential cutoff depending on parameters. This distribution can be explained by maximization of the Gibbs-Shannon entropy for one iteration of the stochastic process. We use as constraint the information on the growth of individual urns. Alternatively it is possible to calculate the exact probabilities. Another distribution that often occurs together with power laws, a 'tent-shaped' growth rate distribution, comes out naturally from this model. We confirm our theoretical results with numerical simulations and by another method using recursively calculated exact probabilities.

SOE 11.2 Wed 17:45 GÖR 226

Inferring political spaces from retweet networks — •Eckehard Olbrich, Felix Gaisbauer, Armin Pournaki, and Sven Banisch — Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany, Leipzig,

When people analyze retweet networks from Twitter it is quite common to interpret visualizations generated by some force-directed layout algorithm as political spaces in the sense that distances between nodes are interpreted as political distances. We investigate, under which conditions this is a valid interpretation by building a statistical model for retweet networks in political spaces, i.e. where the agents have a position in a metric space and the retweet probability depends on their distance. These models can be considered as extensions of spatial random graph models for social networks, for which inference algorithms of the underlying social spaces are known [1]. We show that force-directed layout algorithms can be related to maximum likelihood estimators of theses models by using gradient decent. Finally, we propose layout algorithms that are specifically adapted to the task of embedding the graph in a political space.

[1] P. D. Hoff, A. E. Raftery, and M. S. Handcock (2002). Latent space approaches to social network analysis. Journal of the american Statistical association, 97(460), 1090-1098.

SOE 11.3 Wed 18:00 GÖR 226

Exact sampling of connected graphs with a given degree sequence — •Szabolcs Horvát and Carl Modes — Center for Systems Biology Dresden

Sampling random graphs with various constraints is an essential tool for network analysis and modelling, with the connectedness of graph being a common additional requirement. Here we present an algorithm to sample simple connected graphs with a given degree sequence. Most current methods fall into two categories, each with its specific limitations: 1. Rejection-based sampling, such as the configuration model, cannot handle dense graphs due to a very high rate of rejections. 2. Methods based on Markov-chain Monte Carlo cannot guarantee the independence of samples due to unknown mixing times. Recently, a new rejection-free class of methods was proposed that can sample with exact probabilities and generates the sampling weight together with each sample. We describe and implement a generalisation of these methods to sample from the set of connected realisations.

SOE 11.4 Wed 18:15 GÖR 226

Revealing network size from the dynamics of a single node? — •Georg Börner[1], Hauke Haehne[2], Jose Casadiego[1], and Marc Timme[1] — [1]Chair for Network Dynamics, Institute for Theoretical Physics and Center for Advancing Electronics Dresden (cfaed), TU Dresden — [2]Institute for Physics, Carl von Ossietzky University Oldenburg

Networks are ubiquitous in the natural and human-made world and their dynamics fundamentally underlie the function of a variety of systems, from gene regulation in the cell and the activity of neuronal circuits to the distribution of electric power and the transport of people and goods.

Recent work [1] introduced a method to infer the size of a network, its number of dynamical variables, from measuring times series of a fraction of its units only. Here we demonstrate that size inference is possible even from the observed time series of a single unit. We state mathematical conditions required for such inference in principle and show that, in practice, the success depends strongly on numerical constraints as well as on experimental decisions. We illustrate successful size inference for systems of $N = 18$ variables and point to ways for improving the reliability and power of the reconstruction. We briefly comment on how the success of the approach depends on the quality and quantity of collected data and formulate some general rules of thumb on how to approach the measurement of a given system.

[1] H. Haehne et al., Detecting Hidden Units and Network Size from Perceptible Dynamics Phys. Rev. Lett. 122:158301 (2019).