SOE 18: Networks - From Topology to Dynamics II (joint SOE/DY/BP)

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

SOE 18.1 Thu 17:30 GÖR 226

Exact Ising partition function computed on networks of low tree-width — •Konstantin Klemm — IFISC (CSIC-UIB), Campus Universitat de les Illes Balears, Palma de Mallorca, Spain

Tree-like approximation is a method commonly used in computing dynamic properties of quenched finite network realizations, including empirical networks. Such properties include expected percolation cluster sizes, epidemic thresholds, and Ising/Potts partition functions. That method is exact only when the network is a tree: removal of one node leaves the network disconnected and this separation recursively holds on the connected components obtained, until reaching the base case of a component with two nodes only. A generalization of this recursive separation is called tree-decompsition of width k, allowing a set of up to k nodes as a separator in each step. In this talk, we show the use of tree-decompositions to obtain exact equilibrium properties for the Ising model and other stochastic processes with detailed balance. On empirical networks of up to 1000 edges, it takes a few seconds to compute the exact value of the Ising/Potts partition function at a given temperature. Computation time is proven linear in size for networks grown by attachment to cliques, such as the Klemm-Eguíluz model [PRE, 2002] and the simplest scale-free network [Dorogovtsev et al, PRE, 2001]. Next to these results, we discuss possibilities and obstacles in generalizing the concept to non-equilibrium processes.

SOE 18.2 Thu 17:45 GÖR 226

Evolution and Transformation of Knowledge over the Sphaera Corpus: A Network Study — •Maryam Zamani[1], Alejandro Tejedor[1], Matteo Valleriani[2], Florian Kräutli[2], Malte Vogl[2], and Holger Kantz[1] — [1]Max Planck Institute for the Physics of Complex Systems — [2]Max Planck Institute for the History of Science

The present work investigates the process of developing knowledge during early modern period by using complex networks method. The research is based on semantic, content-related data extracted from a corpus of 359 printed editions, mainly of textbooks used to teach cosmology at European universities between 1472 and 1650. A directed, multi-layer network is constructed in five layers whose structures are defined specifically for the research question at hand. The network is analysed, by making use of the aggregated graph, which accounts for the connectivity between books when any of the potential semantic relations are indistinctly considered. We assess the influence of the different books in the corpus by measuring the normalised node out-degree, as well as disruption factor. Results reveal the emergence of different communities in the aggregated graph that are compared based on different aspects, such as book's format, place of publication, etc. Further analysis demonstrates the time period when knowledge is converged and show its divergence afterwards.

SOE 18.3 Thu 18:00 GÖR 226

Complexified Kuramoto model I – synchrony in the asynchronous regime — Sheshagopal Marehalli Srinivas, Marc Timme, and •Moritz Thümler — Center for Advancing Electronics Dresden Chair for Network Dynamics 01062 Dresden Germany

The Kuramoto model constitutes a paradigmatic model for the emergence of temporal patterns – foremost synchrony – in coupled oscillator systems. Here we extend the Kuramoto model to complex dynamical variables and demonstrate a transition from traditional synchrony emerging for sufficiently large coupling strengths to a second type of synchrony that exists in the weak coupling regime, i.e. below the coupling required for the real model to synchronize, and that is commonly known from systems that are not dissipative but conservative, like the harmonic oscillator, see also [1,2].

[1] D. Witthaut and M Timme, Phys. Rev. E 90:032917 (2014) [2] D. Witthaut et al., Nature Comm. 8:14829 (2017)

SOE 18.4 Thu 18:15 GÖR 226

Complexified Kuramoto model II – abnormal network synchronization — •Moritz Thümler, Malte Schröder, Sheshagobal Marehalli Srinivas, and Marc Timme — Center for Advancing Electronics Dresden Chair for Network Dynamics 01062 Dresden Germany

Networks of Kuramoto oscillators commonly synchronize in the regime of sufficient coupling strengths. Extending the Kuramoto model to complex dynamical variables, and our previous contribution [1] to networks we here show under which choices of parameters we can expect synchrony. In particular we show the transition between the traditional real valued Kuramoto modell and its complex extension. Furthermore we are discussing the lack of a well defined order parameter in the comlex regime.

[1] Shesha et al., Complexified Kuramoto model I – synchrony in the asynchronous regime, DPG abstracts, above (2020)