DY 13: Complex Systems

Time: Monday 17:30–18:30 Location: ZEU 147

DY 13.1 Mon 17:30 ZEU 147

Sufficient conditions for the existence of solutions for two phase flow in porous media — •Pradeep Kumar, Rouven Steinle, Tillmann Kleiner, and Rudolf Hilfer — Institute for Computational Physics, University of Stuttgart, Germany

In this talk, we consider a jump-type hysteresis model for two phase flow in porous media. It is shown that, after abstract formulation of the hysteresis model into a Cauchy problem on a Hilbert space $X = L^2(0,1)$, the solutions of the corresponding model are governed by an analytic semigroup defined on X.

[1] Steinle, R. and Hilfer, R.; Transp. Porous Media, (2016) (DOI 10.1007/s11242-015-0598-2)

[2] Hilfer, R. and Steinle, R.; Eur. Phy. J., 223, (2014)

[3] Pazy, A.; Semigroups of Linear Operators and Applications to Partial Differential Equations, Springer-Verlag, (1983)

DY 13.2 Mon 17:45 ZEU 147

Eigenvalue Outliers of Sparse non-Hermitian Random Matrices — •Izaak Neri[1,2] and Fernando Metz[3] — [1]Max Planck Institute for the Physics of Complex Systems, Dresden, Germany — [2]Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany — [3]Universidade Federal de Santa Maria

Spectra of sparse non-Hermitian random matrices determine the dynamics of complex processes on graphs. Eigenvalue outliers in the spectrum are of particular interest, since they determine the stationary state and the stability of dynamical processes. We present a general and exact theory for the eigenvalue outliers of random matrices with a local tree structure. For adjacency and Laplacian matrices of oriented random graphs, we derive analytical expressions for the eigenvalue outliers, the first moments of the distribution of eigenvector elements associated with an outlier, the support of the spectral density, and the spectral gap. We show that these spectral observables obey universal expressions, which hold for a broad class of oriented random matrices.

DY 13.3 Mon 18:00 ZEU 147

An Equal Space: Data-driven Embedding of Complex Dynamics — •Felix Kemeth[1,2], Sindre W. Haugland[1,2], Yannis Kevrekidis[2,3], and Katharina Krischer[1] — [1]Physik-Department, Nonequilibrium Chemical Physics, Technische Universität München, James-Franck-Str. 1, D-85748 Garching, Germany — [2]Institute for Advanced Study - Technische Universität München, Lichtenbergstr. 2a, D-85748 Garching, Germany — [3]The Department of Chemical and Biological Engineering - Princeton University, Princeton, NJ 08544, USA

We present a way to embed nonlinear phenomena in a meaningful and low-dimensional space. In particular we apply diffusion maps, a nonlinear dimensionality reduction method, to extract useful axes from measurements or simulation data of different non-linear phenomena. Useful hereby refers to the degree of coarsening in which we want to observe our system, with this degree being specified by appropriately tuning the kernel scale in the diffusion maps approach. In addition, we demonstrate that these axes are, provided we have sufficient data, independent of the particular nature of the measurement entity. As illustrative examples, we apply our method on spatio-temporal chaotic dynamics apparent in the complex Ginzburg-Landau equation, on modulated traveling waves in the Kuramoto-Sivashinksy equation and on chimera states, states of coexisting coherence and incoherence. For the latter, we show that it is possible to extract insightful order parameters, allowing further understanding of these intricate dynamics.

DY 13.4 Mon 18:15 ZEU 147

Opinion Spreading in the Adaptive Voter Model by Zealots with Excess Degree — •Pascal Klamser[1,2], Marc Wiedermann[1,2], Jonathan Donges[2,3], and Reik Donner[2] — [1]Humboldt Universität, Berlin — [2]Potsdam Institut für Klimafolgenforschung, Potsdam — [3]Stockholm Universität, Stockholm

The (adaptive) voter model is widely studied as a benchmarking toy model for opinion formation processes on time evolving networks. Past studies on the effect of zealots only considered the voter model on a static network. Here, we extend the idea of zealotry to the case of a temporal network and investigate the opinion spreading by the zealots depending on their initial fraction and degree. Numerical simulations reveal that the spreading efficiency is strongly coupled with the fragmentation transition. An analytical representation of the model verifies the numerical findings. In order to avoid a dominance of the zealots opinion, voters must adjust their rate of rewiring as well as the number of connections with other voters, respectively.