STATISTICAL PHYSICS SEMINAR

April 18th, 2018.
Wednesday, 11.00

ELTE TTK Northern Building 2.54

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A coarse-grained finite-time description of open flows, with an introduction to the conceptof Lagrangian flow networks

In fluid flows, or in the phase space of any dynamical system, the time evolution of the trajectories can be regarded as a transport phenomenon, described by the Perron–Frobenius operator. Its discretized version gives the amount of (phase space) volume transported from one box of the domain to another. The recognition that this discretized operator can be considered to be the connectivity matrix of a weighted directed network, a Lagrangian flow network, led to particularly successful applications of this coarse-grained description. Beyond identifying relationships between traditional quantifiers of chaos and network characteristics, techniques developed for the investigation of networks, like community detection, have proven to be remarkably useful from a dynamical systems point of view, like for the identification of coherent regions.

The focus has so far been almost exclusively on volume-preserving closed flows. In one of our research directions, we study how characteristics of open flows can be defined in a coarse-grained finite-time description. In particular, we consider the escape rate and the fractal dimension beyond the finite-time largest Lyapunov exponent, and illustrate numerically that the Kantz–Grassberger relation, linking these quantities on infinitesimally small spatial scales for asymptotically long times, is approximately satisfied by the coarse-grained finite-time counterparts of these quantities. What is interesting is that these quantities have a spread throughout the domain of the flow, but such that the Kantz-Grassberger relation is approximately fulfilled.

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