Network trajectories

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Temporal networks (TNs) are graphs whose topology changes in time. They are minimal mathematical models that encapsulate how the interaction architecture of elements in a complex system changes dynamically. TNs have been successfully used in a variety of areas ranging from epidemic spreading or air transport to neuroscience to cite a few, and it has been shown that important dynamical processes running on networks display qualitatively different emergent patterns when the substrate is a TN, compared to the case of a static network. These effects are particularly relevant when the timescale of the dynamics running on the graph is comparable to that of the intrinsic evolution of the network, i.e., when there is no manifest separation of timescales. Relatively lesser work has, however, considered the intrinsic dynamics of the network from a principled point of view.
In this talk I will briefly overview a research programme on network trajectories [1,2], in which TNs are to be interpreted as the trajectories of a latent graph dynamical system. I will discuss how to extend concepts from dynamical systems and time series analysis -such as autocorrelation function or Lyapunov exponents- to characterize network trajectories, thereby describing phenomena such as network pulsation [1], network memory [1,3] or the onset of chaotic network trajectories [2]. Applications to different areas will also be considered.

[1] *Lucas Lacasa, Jorge P. Rodriguez, Victor M Eguiluz,* Correlations of network trajectories, **Physical Review Research** 4, L042008 (2022)
[2] *Annalisa Caligiuri, Victor M. Eguiluz, Leonardo Di Gaetano, Tobias Galla, Lucas Lacasa* Lyapunov Exponents for Temporal Networks, **Physical Review E** 107, 4 (2023)
[3] *Oliver E. Williams, Lucas Lacasa, Ana P. Millan, Vito Latora,* The shape of memory in temporal networks, **Nature Communications** 13, 499 (2022)