PILLAR LECTURE

přednáška držitele ocenění za výsledek vyhodnocený jako vynikající v rámci II. pilíře hodnocení

Discerning connectivity from dynamics in networks inferred from multivariate time series

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Abstract

Emergent behaviour of complex systems, consisting of many interacting elements, cannot be explained by a simple extrapolation of the laws describing the behaviour of a few elements. Studying systems of many interacting elements as complex networks is an intensively developing paradigm in which statistical physics embraced the graph theory. While studying the Internet or an airline network, the network nodes and links, or vertices and edges are known; in such complex systems as the human brain or the Earth climate the underlying structure is a part of research questions. On the other hand, dynamics of the latter systems or their components can be observed and recorded in the form of multivariate time series. A "functional" network is constructed using a measure of statistical association of pairs of time series. Such a measure can be the Pearson's correlation coefficient, however, more elaborated, nonlinear dependence measures are also used. These connectivity measures can be influenced by the dynamics (dynamical memory, autocorrelation) of the time series analyzed. Then changes in the dynamics can be erroneously interpreted as changes of network topology. Focusing on a particular problem, the climate networks are used as a mathematical abstraction of interactions of many intertwined physical processes influencing atmospheric dynamics and climate evolution. We demonstrate that an informed choice of a connectivity measure and properly inferred network links build climate networks reflecting climate phenomena such as El Niño, North Atlantic Oscillation, or external influences such as the variability of the solar activity.