Seminar Zavoda za Teorijsku Fiziku Institute Rudjer Boskovic 11:00 hours Monday 18.05.2015
Lecture room of the first wing

Inferring the mesoscale structure of layered, edge-valued and time-varying networks

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The structural properties of large-scale complex networks are often a result of unknown generative processes that cannot be directly observed, and need to be inferred only from their final outcome. Of particular importance are the so-called large or mesoscale structures, often represented by modules --- groups of nodes with similar topological patterns --- for which general formative mechanisms (or even unified descriptions) have not yet been fully identified. More recently, it has been increasingly recognized that most network systems are in fact composed of different types of interactions (represented as layers or attributes on the edges) and change in time, and that these features cannot be neglected when attempting to identify mechanisms of network formation. Since these elaborations increase the effective dimension of the network description, they are a double-edged sword: On one hand, the inclusion of layered or temporal structure can reveal important patterns that are otherwise obscured, while on the other hand the uncontrolled incorporation of many uncorrelated variables can in fact hide patterns which would otherwise be detected. In this talk, I propose a robust and principled method to tackle this problem, by defining general generative models of modular network structure, incorporating layered, attributed and time-varying properties, together with alternative generative processes incorporating hierarchical structure, degree correction and overlapping groups, as well as a Bayesian methodology to infer the parameters from data and select between model variants. I show that the method is capable of revealing hidden structure in layered, edge-valued and time-varying networks, and that the most appropriate level of granularity with respect to the added dimensions can be reliably identified. I illustrate our approach on a variety of empirical systems, including a social network of physicians, the voting correlations of deputies in the Brazilian national congress, the global airport network, and a proximity network of high-school students.

[1] Tiago P. Peixoto, "Inferring the mesoscale structure of layered, edge-valued and time-varying networks", arxiv:1504.02381

[2] Tiago P. Peixoto, "Model selection and hypothesis testing for large-scale network models with overlapping groups", Phys. Rev. X 5, 011033 (2015)

[3] Tiago P. Peixoto, "Hierarchical block structures and high-resolution model selection in large networks", Phys. Rev. X 4, 011047 (2014)

[4] Tiago P. Peixoto, "Parsimonious Module Inference in Large Networks", Phys. Rev. Lett. 110 14 148701 (2013)