[Talk 9] Reconstructing Network connectivity and weights from Noisy Dynamical Data

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At the merge of the "Big data" era with huge amount of dynamical data in many different disciplines are all waiting to be mined with novel and reliable methods of network reconstruction[1,2]. The most basic feature of a network is how the nodes are linked and how strong they are linked. This feature determines the overall behavior and affects the function of a network. However, this information of the wiring diagram of a network is often not available. Thus, a critical problem in the study of networks is how to infer the wiring diagram and reconstruct a network from measurements. In this talk, I will discuss our recent work on the challenging inverse problem of network reconstruction solely from the measurement of dynamical time-series data. We derived general mathematical results relating the adjacency matrix of the network and the time-series measurements of the nodes. Based on these results, we have developed a method that reconstructs both the links and their relative coupling strength using only the time-series measurements of node dynamics as input[3]. We demonstrate that our method can give accurate results for unweighted and weighted random and scale-free networks with linear and nonlinear dynamics. We further show why relevance networks constructed using Pearson correlation coefficient and partial correlation coefficient can have significant deviations from the actual network.

1. "Extracting connectivity from dynamics for networks with uniform bidirectional coupling", E.S.C. Ching, **Pik-Yin Lai**, and C. Y. Leung, Phys. Rev. E **88**, p.042817 (2013).
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