Inferring Network Topology via Driving the Dynamics

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We present a method to infer the complete connectivity of a network from its stable response dynamics. As a paradigmatic example, we consider networks of coupled phase oscillators and study their long-term stationary response to temporally constant driving. The response depends characteristically on both the driving signals and the underlying network connectivity [1]. Thus, for a given driving condition, measuring the phase differences and the collective frequency reveals information about how the units are interconnected. Sufficiently many repetitions for different driving conditions yield the entire network connectivity (the absence or presence of each connection) from measuring the response dynamics only [2]. For sparsely connected networks we obtain good predictions of the actual connectivity even for formally under-determined problems. We explicitely show that the method works equally well for networks with lattice and random connectivity as well as in the intermediate small-world regime.

[1] M. Timme, Europhys. Lett. 76:367 (2006).
[2] M. Timme, http://arxiv.org: cond-mat/0610188 (2006).