# Analysis of functional connectivity in large-scale network models

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Numerous methods exist in the literature for assessing the functional connectivity of small networks of neurons. Among others, there are methods based on Granger causality [1], maximum-likelihood estimates over stochastic spiking processes [2], and nonlinear optimization of deterministic spiking models [3]. However, these methods have generally been validated by applying them to very small networks where the activity of all the neurons is observed. This scenario is drastically different from that seen in cortical recordings where population of observed neurons is embedded in a much larger network of unobservable units. To investigate the ability of several functional connectivity algorithms [1-3] to capture the network dynamics in a scenario much more similar to that observed in recordings from awake, behaving animals, we have created a model network of O(10,000) neurons. The parameters of the model network have been taken from the physiological literature. In this simulation environment, we treat a small, O(10) network as the observable units and the remainder of the network is unobserved.

We compare the efficacy of functional connectivity algorithms. The dynamical equivalence of the “functional” and “real” networks is demonstrated. Another potential difficulty in measuring functional connectivity in real cortical networks is that the properties of the real network may be nonstationary. Properties like the mean firing rate, amount of correlation in the network, and the patterns of connectivity are systematically examined, and the utility of the various algorithms under changes in these properties is quantified.

**References**

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