May 22nd, 11:00 AM - 11:30 AM

Symmetries constrain dynamics in a family of balanced neural networks

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Abstract Title: Symmetries constrain dynamics in a family of balanced neural networks

Abstract:
Biological neural circuits display both spontaneous asynchronous activity, and complex, yet ordered activity while actively responding to input. Recently, researchers have demonstrated this capability in large, recurrently connected neural networks, or “echo-state” networks. In this talk, we address the question of how network connectivity structure affects the behavior of echo-state networks.

We examine a family of balanced firing-rate networks in which we enforce the neurobiological constraint of Dale's Law --- each neuron makes either excitatory or inhibitory connections onto its post-synaptic targets. We find that this constrained system may be described as a perturbation from a system with non-trivial symmetries. We analyze the symmetric system using the tools of equivariant bifurcation theory, and demonstrate that the symmetry-implied structures remain evident in the perturbed system. In comparison, spectral characteristics of the network coupling matrix are relatively uninformative about the behavior of the constrained system.