Noise-induced pattern formation in networks of spatially-dependent neural networks | Daniele Avitabile

This talk presents a study of pattern formation in a class of high-dimensional neural networks defined on random graphs and subjected to spatio-temporal stochastic forcing. The connectivity matrices of these neural networks are randomly generated and can be excitatory or inhibitory, dense or sparse, and need not be symmetric. Under generic conditions on coupling and nodal dynamics, we prove that the network admits a rigorous mean-field limit, resembling a Wilson-Cowan neural field equation. The state variables of the limiting system are the mean and variance of neuronal activity. We select networks with tractable mean-field equations and perform a bifurcation analysis using the diffusivity strength of the afferent white noise on each neuron as the control parameter. We identify conditions for Turing-like bifurcations in a system where the cortex is modeled as a ring and provide numerical evidence of noise-induced spiral waves in models with a two-dimensional cortex. We present numerical evidence that solutions of the finite-size network converge weakly to those of the mean-field model.

The talk is based on the following preprint: https://arxiv.org/abs/2408.12540

Authors:
* Daniele Avitabile (speaker), Centre for Dynamics and Computation, Department of Mathematics, Vrije Universiteit Amsterdam.
*James MacLaurin
Department of Mathematical Sciences, New Jersey Institute of Technology,