Theoretical Neuroscientists have developed a wide range of mathematical, computational, and numerical tools for modeling and simulating sets of interacting neurons. While in most cases, with some notable exceptions, the framework of these efforts has been deterministic, drawing on the theory of dynamical systems, partial differential equations, integral or integro-differential equations, it has been felt from the early days of Hodgkin and Huxley that uncertainty has to be taken into account in the models.

Uncertainty has its source in the physics of the underlying phenomena, for example in the way the ion channels open and close, or the way in which neurotransmitters diffuse in the synaptic cleft. This is the physical uncertainty. Uncertainty also comes from the fact that many of the parameters in the models are out of reach of any of the current experimental techniques, most likely still for a long time. For example the exact values of the synaptic weights describing the way neurons influence each other at a given instant in a network will probably never be known. This second source is the intrinsic uncertainty.

Researchers are therefore in great need of stochastic models to account for these two sources in a mathematically rigorous framework allowing for quantitative descriptions and predictions.

The goal of the aforementioned special issue is to bring together the key experimental and theoretical research linking state-of-the-art knowledge about uncertainty in the Brain with current fore-front research in probability theory and statistics in the general area of stochastic nonlinear dynamical systems featuring several time scales. As a result we hope to shed some new light on the question of the role of noise in the activity of the Brain. We are certain that such an endeavor is highly timely and is presently missing, and that it will be highly attractive to a wide community of brain researchers and of mathematicians in probability and statistics.

Submission Instructions:

Before submission, authors should carefully read over the journal’s Author Guidelines, which are located at mathematical-neuroscience.com/authors/instructions. Prospective authors should submit an electronic copy of their complete manuscript through the SpringerOpen submission system at mathematical-neuroscience.com/manuscript. They should choose the correct Special Issue in the “sections” box upon submitting. In addition, they should specify the manuscript as a submission to the “Special Issue on Uncertainty and the Brain” in the cover letter. All submissions will undergo initial screening by the Guest Editors for fit to the theme of the Special Issue and prospects for successfully negotiating the review process. Every article will be published shortly after its acceptance, regardless of the peer review status of other submitted articles.

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