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Title:

Equation Free Computations on Neuronal Networks: From Neuronal Interactions To Emergent Brain Dynamics.

Abstract

In the first part of my presentation, I will demonstrate how the Equation-Free Method (EFM) [1] for mutliscale computations can be exploited to extract, in a computational systematic way the emergent dynamical attributes, from detailed large-scale microscopic stochastic models, of neurons that interact on complex networks [2, 3, 4]. In particular I will present, how bifurcation, stability and rare events analysis can be derived bypassing the need for obtaining analytical approximations, providing an "on-demand" model reduction with respect to the underlying connectivity of the network [3, 4].

In the second part I will present you a biophysical network model that is used to study the neurodegenerative effects on the performance of subjects with schizophrenia during a cognitive task (antisaccade task) [5]. Following the EFM, the values of the biophysical parameters of the model, (i.e. conductances of the ionic currents, network connectivity in the Prefrontal cortex (PFC)) were computed by wrapping around the simulator an optimization algorithm that minimized the differences between simulations and experimental behavioral data. Our results imply that the model approximates remarkably well the effects of dopamine modulation on the distribution of the antisaccade reaction times (aSRT), as well as the changes of the connectivity in the PFC that have been observed in neuroimaging studies.

References

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