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DATA-DRIVEN IDENTIFICATION OF MACROSCOPIC DYNAMICS IN NEURAL NETWORK MODELS

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Realistic models of brain structures often comprise a large number of ordinary differential equations describing the dynamics of single neurons. A macroscopic network analysis of such models can reveal important information about pathological conditions and their respective treatments. We consider microscopic models of neural systems with only the detailed microscopic description available, whereas there are no equations given for the macroscopic dynamics. In this talk, a data-driven framework to derive macroscopic models for such systems will be discussed. An implicit equation-free approach [2] makes the pointwise estimation of the macroscopic vector field at selected points in phase space possible, allowing the construction of a model for the macroscopic dynamics using Gaussian process regression [1]. The obtained macroscopic models can be used to study high-dimensional neural systems on a macroscopic scale, for example by performing a bifurcation analysis. As a test example, a high-dimensional neural system of integrate-and-fire neurons is investigated, including a discussion about the application to realistic models of the basal ganglia network [3].

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