

POSTER PRESENTATION

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Coarse-grained description of the spatio-temporal dynamics of network activity from experimentally verified single-neuron models and connectivity

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We combine experimentally constrained models of neo-cortical neuron voltage dynamics [1,2] and network connectivity [3] to derive a set of equations that describe the activity at a tissue scale. The resulting equations represent a neuronal field theory in which emergent properties at a coarse-grained level can be causally linked to the physiology of cellular and sub-cellular components. The description is mathematically tractable and can be elaborated to include further biophysical details such as multiple neuronal populations to capture the structure of the component microcircuits, synaptic dynamics and filtering as well as distance-dependent delays in signal propagation. For spatially homogeneous afferent drive the steady-state firing rate can be straightforwardly calculated together with the network response to weak spatio-temporal modulation of the afferent drive via a perturbative approach. For the spatially heterogeneous non-linear regime, which the network is pushed into under stronger drive, we construct an iterative numerical scheme that rapidly converges to the network firing rate. The utility of the approach is illustrated using examples from the experimental literature.

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