

## **Magnus Richardson**

### *Dynamics of populations and networks of neurons with voltage-activated and calcium-activated currents*

A current goal of theoretical neuroscience is the development of a framework that allows for predictions about the emergent states of neuronal networks from the biophysical properties of constituent neurons. Population-based modelling, using the Fokker-Planck formalism, is one promising approach. However, the form of the Fokker-Planck equation for neurons with biophysically reasonable properties rapidly becomes awkward or impossible to solve. Here a rather efficient Threshold Integration scheme is demonstrated for solving the network FP equation. This method greatly simplifies the calculation of many quantities central to the analysis of populations and recurrent networks of neurons such as the steady-state rate, spike-train spectrum, first-passage-time density and the dynamical response to patterned synaptic conductance modulation. The method works equally well for non-linear integrate-and-fire models, such as the experimentally verified exponential model. The method generalizes to networks comprised of many neuronal classes with distinct expression patterns of gated currents and so promises to allow for the modelling of emergent states in neural tissue at significantly increased levels of detail.