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Oscillations in neuronal network models

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Starting from the mathematical model of a single neuron, dynamical models of neuronal populations are presented. The well-known integrate and fire model is extended with the adaptation of the neurons. The behaviour of the whole population can be described by the rate model, where the dynamic variables are the firing rates of certain populations of neurons and the quantity characterizing the adaptation. The model consisting of an excitatory and an inhibitory population together with adaptation has been shown recently to describe several phenomena observed in experimental studies. The model is introduced in the talk and some important features of its qualitative behavior is dealt with. The fold and Hopf bifurcation curves can be determined analytically. The existence of periodic orbits is studied numerically, by exploiting the fact that the system is piece-wise linear, hence an implicit formula can be derived for the Poincaré map. It is shown that two stable limit cycles may coexist with a stable steady state. The more detailed investigation of the model is presented in the talk given by Anita Windisch.