Influence of external input and relative weight of inhibitory connections on the balance of a sparsely connected network of Leaky integrate-and-fire neurons.

Introduction

It is of common knowledge that neurons in the human cortical brain show an irregular firing pattern. One explanation is that the timing of the input is synchronized enough to evoke action potentials, as there is summation of input signals (Softky & Koch, 1993). A contradictory explanation says that not the timing but the frequency of the input is relevant (Shadlen & Newsome, 1998). The average input is subthreshold and because of the stochastic input it is possible to evoke spikes even though there is no synchrony.

In order to examine the hypotheses it is very useful to perform simulations on computational models of the human cortex. In computational neuroscience there are numerous neuron and network models available, all of them having advantages and disadvantages. Mostly the consideration is based on the computational performance/ biological plausibility. People choose the simplest model which contains the minimal features in order to answer the research question.

When examining the network dynamics of the cortex, simple neuron models are preferred, as the focus is more on the behavior of the network than on the single neurons. Moreover, for the examination of cortical networks the connections are recurrent as in the human brain. A commonly used network is the sparsely connected Balanced random network (Brunel, 2000; Remme & Wadman, 2012; Yger & Harris, 2013).