Abstract

Neurons communicate by action potentials. This process can be described by very detailed biochemical models of neuronal membrane and its channels, or by simpler phenomenological models of membrane potential (integrate-and-fire models) or even by very abstract models when only time of spikes are considered.

We took one particular description — stochastic leaky integrate-and-fire model — and compared it with recorded *in-vivo* intracellular activity of the neuron. We estimated parameters of this model, compared how the model simulation corresponds with a real neuron. It can be concluded that the data are generally consistent with the model.

At a more abstract level of description, the spike trains are analyzed without considering exact membrane voltage and one asks how the external stimulus is encoded in the spike train emitted by neurons. There are many neuronal codes described in literature and we focused on the open problem of neural code responsible for spatial hearing in mammals. Several theories explaining the experimental findings have been proposed and we suggest a specific variant of so called slope-encoding model. Neuronal circuit mimicking auditory pathway up to the first binaural neuron was constructed and experimental results were reproduced. Finally, we estimated the minimal number of such parallel circuits needed to reproduce results obtained in psychoacoustic experiments and it is sufficient for estimated number of fibers entering the centers for spatial hearing.

Keywords: binaural hearing in mammals, integrate-and-fire model, neural coding