

BIOLOGICAL COUNTERPART OF A MULTISTATE NEURON MATRIX SYNAPSE

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ABSTRACT

The simplest formal neuron is the binary McCulloch & Pitts neuron; the coding properties of recurrent network of such neurons receiving external stable inputs are well understood from an analytical point of view [1]. Such an analytical approach allows (1) the resolution of 'inverse problems', i.e. the building of a network whose dynamics follows a pre-defined spatio-temporal binary sequence, (2) the formal quantitative generation of spatio-temporal patterns reproducing experimental recordings (olfactory codes at the glomerular level) with a Hodgkin-Huxley neuron network built using the skeleton of the McCulloch & Pitts neuron network [2]. We study here an extension of that approach, introducing a third possible state in each simple formal neuron. The three states of such a neuron can be considered as the formal counterparts of the silent state, the firing state and the bursting state. In that case, the synaptic relationship between two ternary neurons is a space transformation represented by a matrix replacing the scalar synapse between two binary neurons. The question we tackle here is: how can we build a set of synaptic contacts between two Hodgkin-Huxley neurons in order to observe an equivalence of a formal 'matrix synapse'.

Keywords: Ternary formal neurons, Hodgkin-Huxley neurons, Synapses

References

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