Introduction

madSim - a software tool for simulating biological neuronal networks - was developed since most of the tools for modeling neuronal networks either have their main focus on the properties of single neurons and synaptic transmission or on the interaction of large clusters of neurons. madSim is based on BIOSIM (Bergdoll & Koch, 1995; Neurocomputing 8: 93-112), a simulation environment for neuronal networks, originally designed for UNIX operating systems. It combines both, the ability to handle single neuron properties and the possibility to model and alter synaptic transmission of large networks. BIOSIM is incompatible with modern UNIX platforms since its user interface critically depends on outdated MOTIF libraries. An existing PC-version is inappropriate for research purposes due to substantial restrictions such as limited simulation time and voltage range. We thus converted and adapted the BIOSIM UNIX kernel to WINDOWS and developed a new graphical user interface with extended functions.

Features

- madSim improves this type of synapse by giving the option to pass both, de- and hyperpolarizing currents.
- Most neuronal networks require both de- and hyperpolarizing electrical synapses. We thus compared identical networks with electrical synapses that either pass only depolarizing currents (BIOSIM synapse) or de- and hyperpolarizing currents (madSim synapse).

Testing

To test the functionality of madSim, we compared the results of a simple network simulation in madSim and BIOSIM.

Conclusions

1) We successfully converted the BIOSIM simulator core to Windows PC.
2) The graphical user interface madSim extends the BIOSIM functions and allows standard Windows editing.
3) madSim improves the functionality of the BIOSIM electrical synapses.
4) madSim is capable of handling large networks with individually different neurons.
5) Application: We are currently modeling resisting and assisting reflexes in the femur-tibia control system of the stick insect.

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