Simulating Physiological and Morphological Properties of Neurons with SNNAP (Simulator for Neural Networks and Action Potentials)

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Introduction

Computer simulations are useful tools for teaching neurophysiological principles as well as for research. To make the tools of computational neuroscience more readily available, we previously developed a Simulator for Neural Networks and Action Potentials (SNNAP). With SNNAP, all aspects of developing and running simulations are mediated via a user-friendly graphical interface and no programming skills are necessary.

SNNAP was designed as a tool for rapidly developing and simulating realistic models of single neurons and small neural networks. The electrical properties of individual neurons are described with Hodgkin-Huxley type ionic currents. The connections among neurons can be electrical, modulatory or chemical, and they can express many forms of plasticity. SNNAP also includes descriptions of intracellular second messengers and ions, which, in turn, can modulate ionic conductances or synaptic transmission. SNNAP also simulates current flow in multicompartamental models of neurons.

The specific details of the first version of SNNAP were described in Ziv et al. (1994). This poster describes a new version (JAVA Ver. 5.1d) of SNNAP, which is now available.

What Are Some Features SNNAP Ver. 5.1d?

- SNNAP can simulate networks of up to 100 cells and 300 electrical, chemical and modulatory synaptic connections.
- Descriptions for the synthesis of second messengers include serial interactions as well as converging and diverging interactions. For example, both a modulatory transmitter and the levels of intracellular Ca2+ can regulate the synthesis of cAMP.
- Descriptions for chemical synaptic connections can include a voltage-dependent component.
- Chemical synaptic connections can include descriptions for a pool of transmitter that is regulated by depletion and mobilization and modulated by intracellular ions and second messengers.
- To simulate multicompartamental cells more accurately, SNNAP incorporates tools that allow users to develop models based on morphological parameters, such as the diameter of a cell body or the width and length of a neuronal process.
- SNNAP includes a batch mode of operation, which allows the user to assign any series of values to any given parameter or combination of parameters. A new batch editor was developed for the most recent version of SNNAP to facilitate the exploration of parameter space.
- For flexible virtual experiments, cells can be injected with currents that have either step-like or user-defined waveforms.
- SNNAP runs in the JAVA environment, and thus can run on virtually any computer or operating system.

How Do I Get SNNAP?

It's simple. SNNAP is available free of charge. Just visit the SNNAP web site and download the files.

http://snnap.uth.tmc.edu

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