Neural System Prediction and Identification Challenge

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Two main paradigms in neuroscience

1. Observation and analysis of neural activity while animals perform a sensory, motor or cognitive task.
2. Building models of brain function based on observed neural activity using methods from mathematics, physics, engineering and computer science.

The first approach assumes that recording the activity – and other properties – of more and more neurons under a variety of conditions will suffice to reveal the brain's working principles. The second approach aims at integrating experimental findings in order to identify basic computational principles that the brain might be using.

The problem

Despite decades of effort our understanding of brain processes has remained limited. **This makes one wonder if these approaches are indeed suitable to understand brain function.**

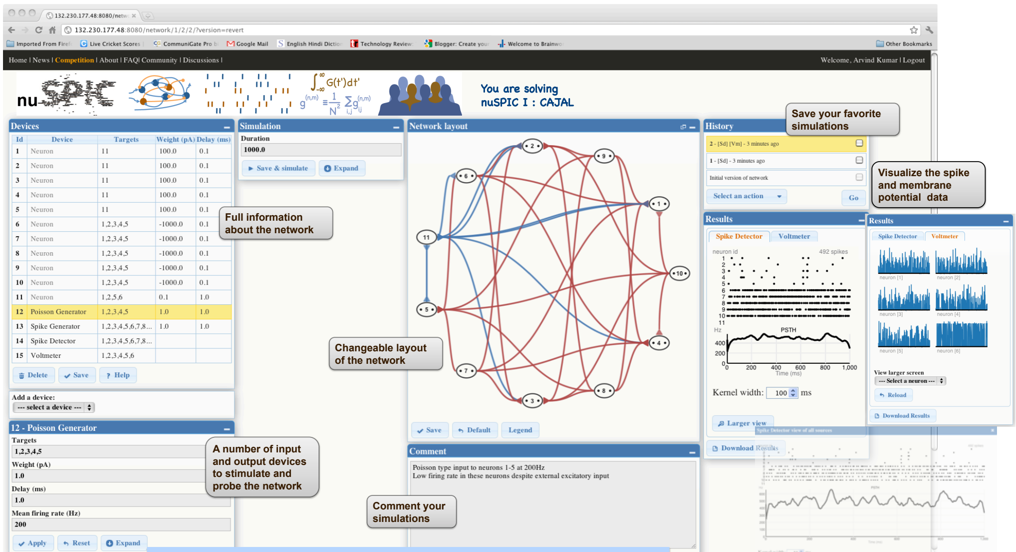
A decade and a half ago, Hopfield and Tank (Science 1986) argued that it is not sufficient to know all details of neurons and their connectivity to extract the function of a neural network. With growing computer power and the advancement of experimental methods that allow for increasing high-density sampling of neural activity, it seems that Hopfield and Tank's message has been lost.

The challenge of predicting function of neural systems from its activity

nuSPIC-I: Discover the function of spiking neural network (SNN)

A particular function - [bio] logical, mathematical - is implemented in an SNN. Perform experiments and discover that function. All necessary information about neural properties and the connectivity matrix is provided.

nuSPIC-II: Implement a given function using a finite number of spiking neurons



Web interface for the NEST to work towards these challenges.

Target audience

Neuroscientists
Physicists
Engineers
Computer Scientists
Hackers
Brain enthusiasts
Students
You

Features

- Known network connectivity, neuron and synapses properties
- Multiple devices to stimulate neurons
- Record spiking activity and membrane potential
- Save your previous simulation and offers a possibility to return to older simulations
- Simulation data can be downloaded as ascii files
- Basic data analysis tool. More sophisticated analysis can be provided on demand

Goals

1. To determine if it is possible to extract a function from a small neural network given full knowledge of neural activity and connectivity. Which classes of networks can be easily extracted and which are rather difficult or even impossible, in principle, to handle?
2. To determine the specific strategies that users apply to extract the function of a network and to use the successful strategies for better experimental designs.
3. To determine the technical and theoretical constraints in the implementation of mathematical functions using a neural network of spiking neurons.

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