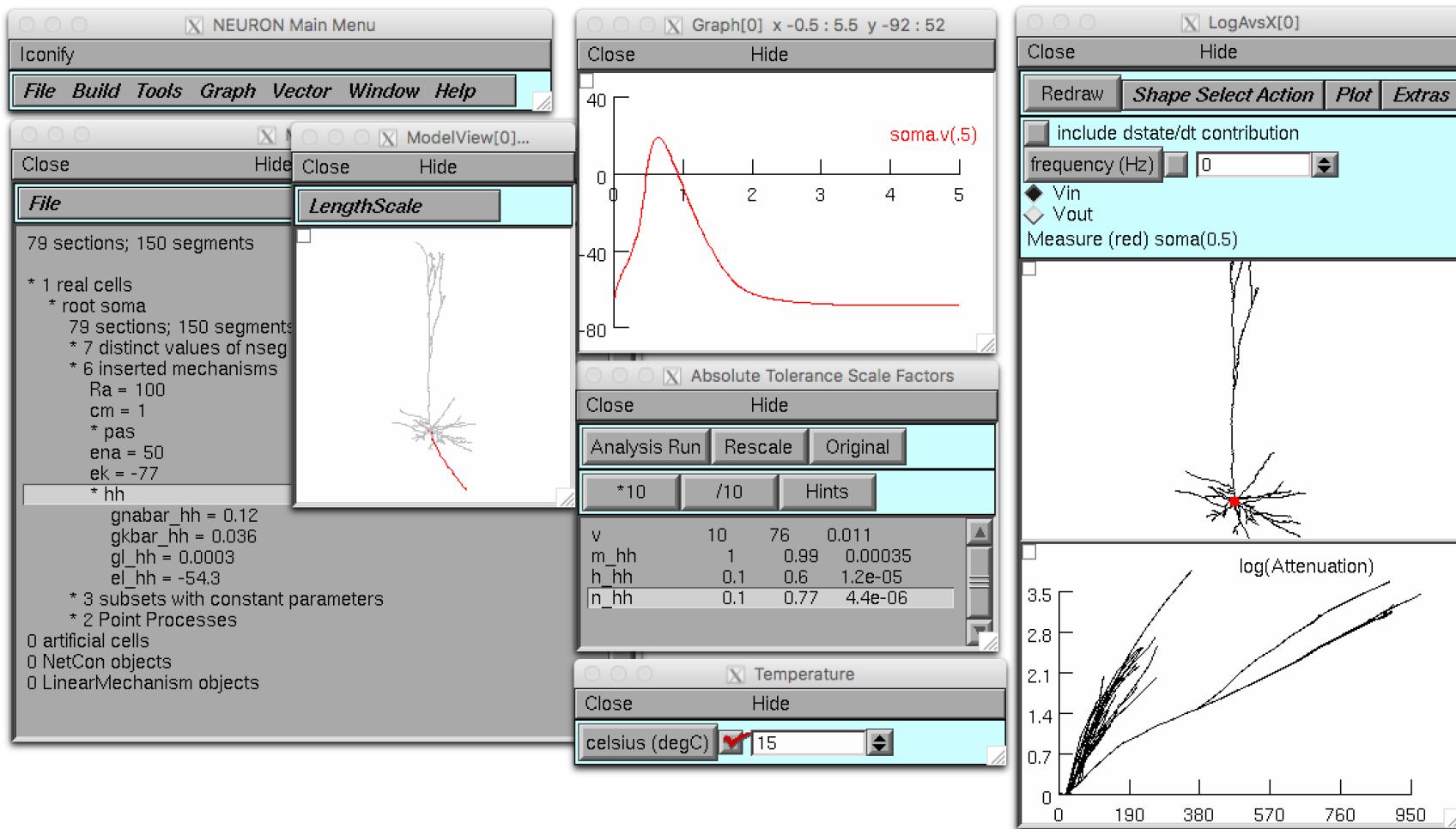


# NEURON

<http://neuron.yale.edu>

NEURON is a tool for *developing, simulating, and analysing* empirically-based models of neurons and networks of neurons. NEURON supports all classes of spiking models and runs on both desktops and supercomputers.



Powerful GUI tools • Fully Python scriptable • Large networks and single cells • Morphologically and biophysically detailed cells, integrate-and-fire cells, and anything in between • Run on a single core or on 128,000 processors.

# Plans and in development

## Features

- Standards support: NeuroML, SBML.
- Extracellular reaction-diffusion (rxn).
- Stochastic rxn simulations.
- 3D intracellular rxn simulation.

## Performance enhancements

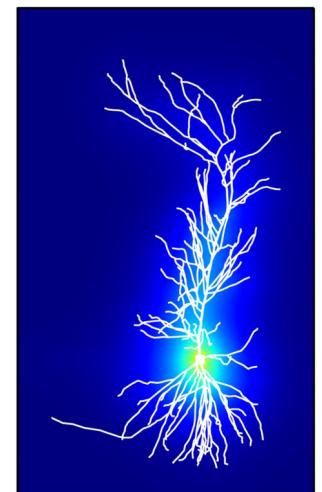
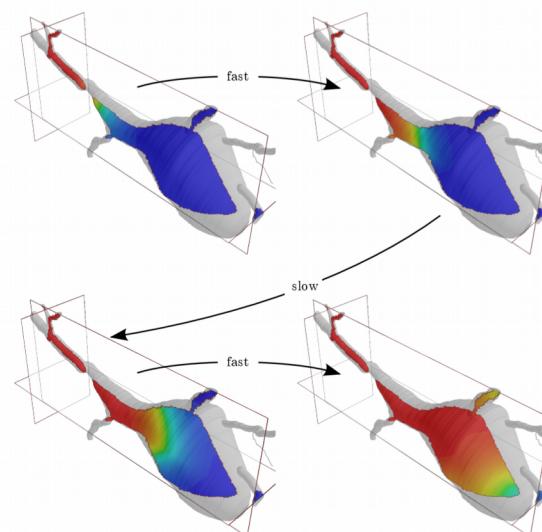
- GPU support.
- Faster reaction-diffusion.

## Better documentation

- Recently released Python programmer's reference.



Migliore et al 2014. Olfactory bulb network model. Up to 69,000 cells. [modeldb.yale.edu/151681](http://modeldb.yale.edu/151681)



3D intra- (left) and extracellular (right) reaction-diffusion simulations.

# More NEURON Resources

**API documentation** (both Python and HOC):

[https://neuron.yale.edu/neuron/static/py\\_doc/index.html](https://neuron.yale.edu/neuron/static/py_doc/index.html)

**ModelDB** (over 575 NEURON models):

<http://modeldb.yale.edu>

**NEURON forum** (over 14,000 posts):

<https://neuron.yale.edu/phpBB/>

**Tutorials:**

<http://neuron.yale.edu/neuron/docs>

**NEURON courses:**

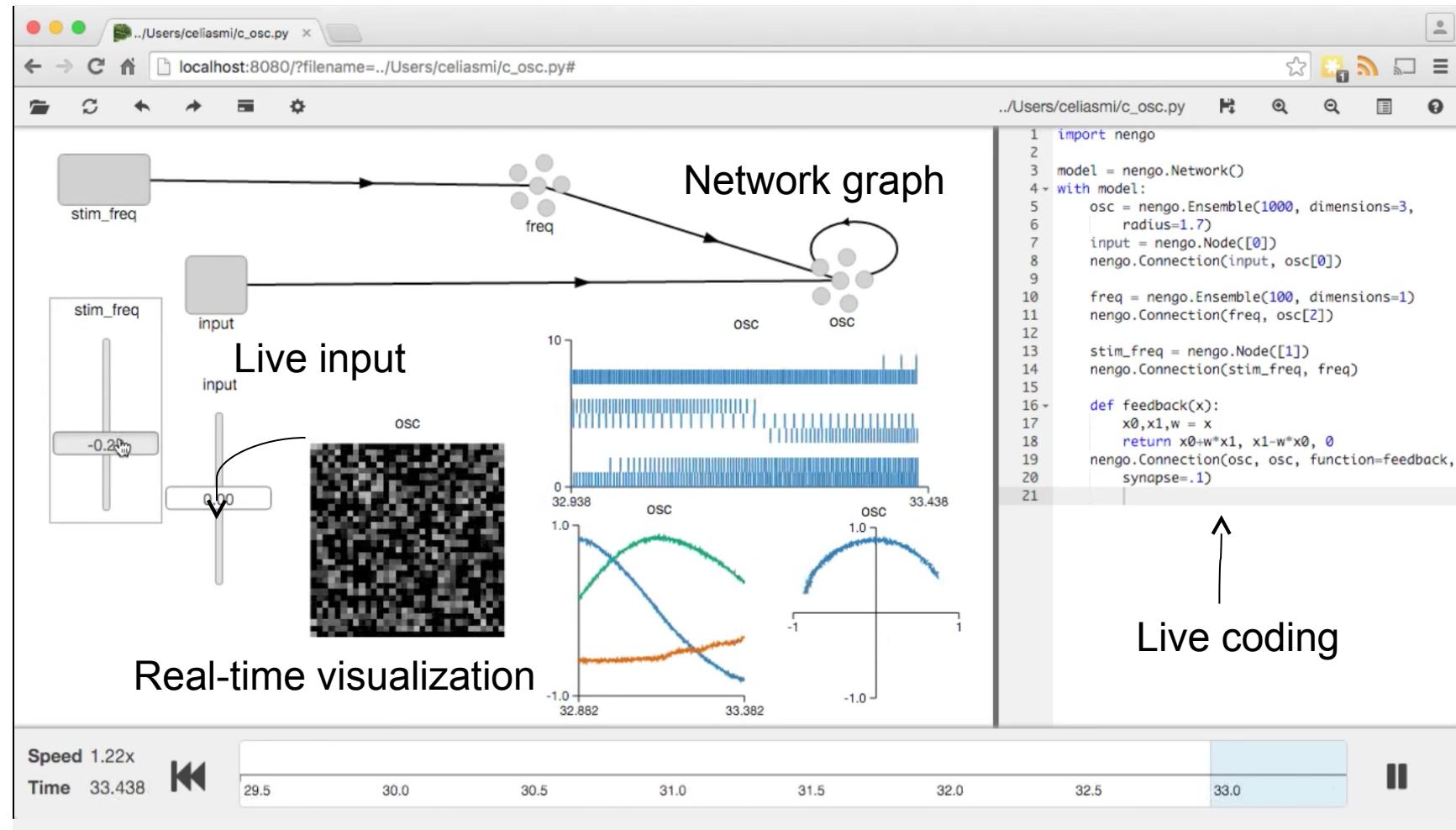
Week-long NEURON course every summer.

Day-long NEURON course before each Society for Neuroscience conference.

# Nengo 2.0

<http://nengo.github.io>

Nengo is a graphical and scripting based software package for simulating large-scale spiking and non-spiking neural systems. It supports CPUs, GPUs (single and multi), MPI, and neuromorphic chips.

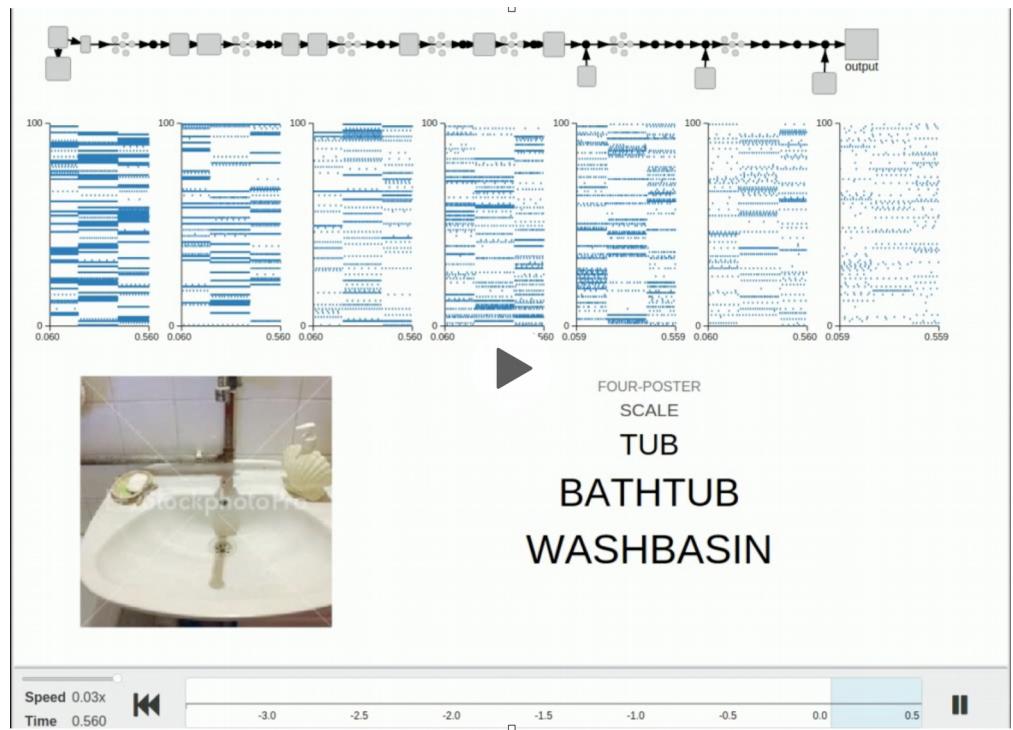


**Documentation** -- Usage and API documentation is at:  
<https://pythonhosted.org/nengo/>

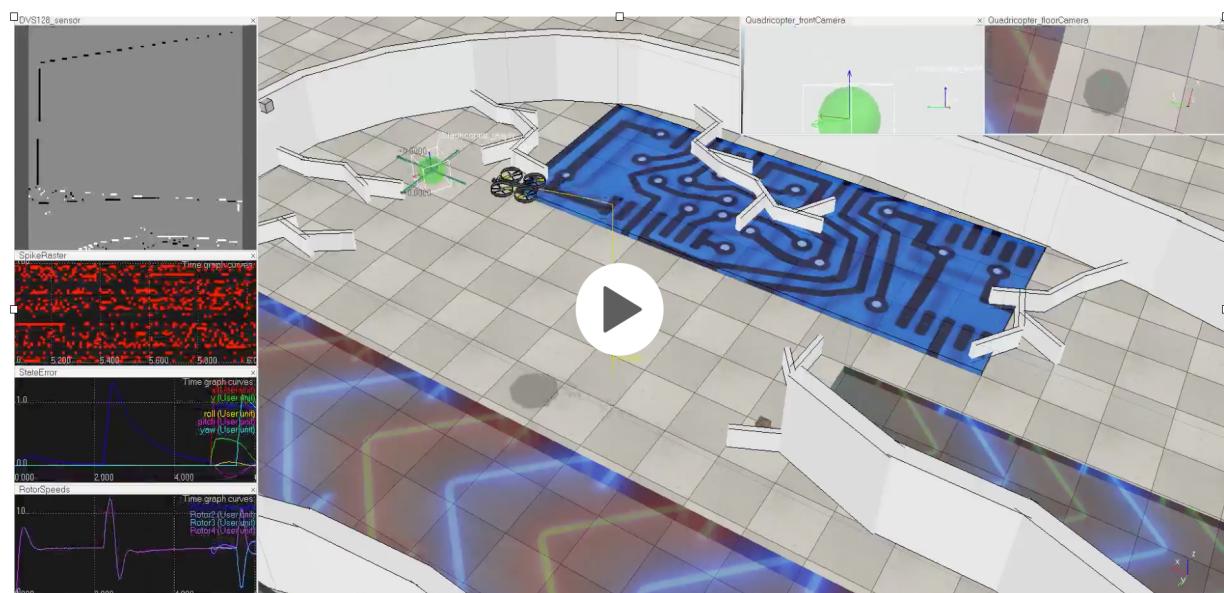
**Getting Help** -- Nengo forum at:  
<https://forum.nengo.ai>

## **Application Highlights**

- Used to develop large-scale spiking deep networks
- Integration with robot simulators & platforms
- 6 DOF nonlinear adaptive control on neuromorphic hardware for 30x power savings
- Spun large-scale neuro-cognitive model published in *Science*



**Spiking ImageNet in Nengo**  
<https://youtu.be/7R5F4mNURGc>



**Nengo adaptive quadcopter control in VREP**  
<https://youtu.be/KBwBX7bzohA>

# More Nengo Resources

## In Development

- More complete NEURON integration
- Fully featured Semantic Pointer Architecture (SPA) library for cognitive modeling
- Additional tools for TensorFlow integration (Nengo DL)
- Additional backends for FPGAs, neuromorphic ASICs, etc.

## Online Tutorials & Examples (in addition to documentation)

- Covering NEF and SPA methods in Nengo GUI

[https://github.com/nengo/nengo\\_gui/tree/master/nengo\\_gui/examples/tutorial](https://github.com/nengo/nengo_gui/tree/master/nengo_gui/examples/tutorial)

- >40 Jupyter notebook examples covering core Nengo usage

<https://pythonhosted.org/nengo/examples.html>

- To accompany the book How to Build a Brain (2013)

[https://github.com/nengo/nengo\\_gui/tree/master/nengo\\_gui/examples/hbb\\_tutorials](https://github.com/nengo/nengo_gui/tree/master/nengo_gui/examples/hbb_tutorials)

## Additional resources

- Annual Nengo Summer School

<http://nengo.ca/summerschool>

- Information for current or prospective developers can be found at

<https://nengo.github.io/contributing.html>