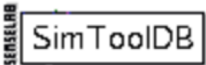


Computational Neuroscience Tools

Computational Lab 6

Model DB is a database of computation neuroscience models



Submit Model

ModelDB provides an accessible location for storing and efficiently retrieving computational neuroscience models. A ModelDB entry contains a model's source code, concise description, and a citation of the article that published it. The source code can be in any language for any environment, can be viewed before downloading, and optionally can be auto-launched on download. For further information, see [model sharing in general](#) and [ModelDB in particular](#).

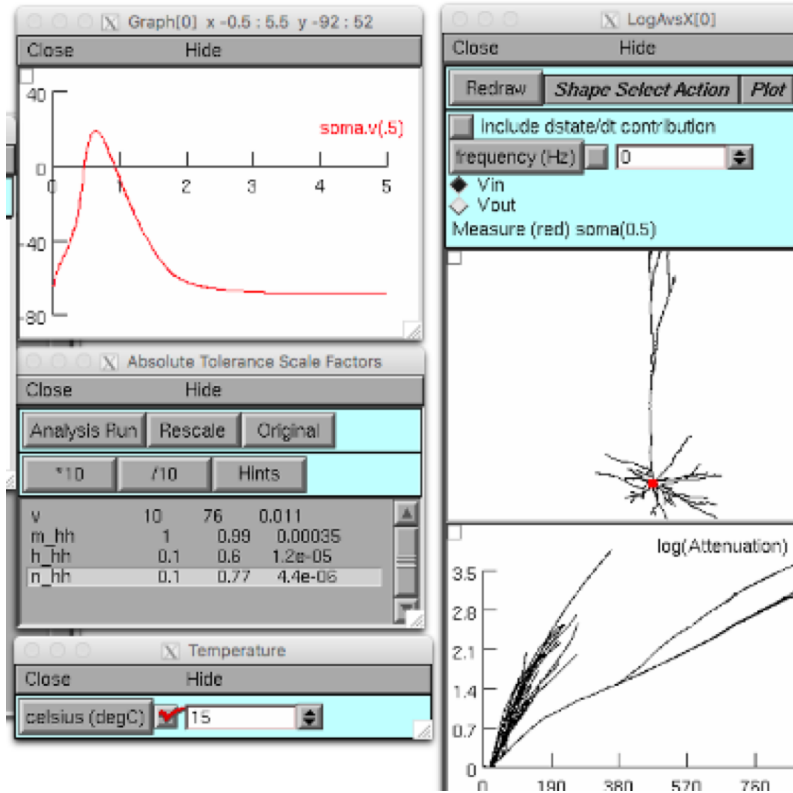
ModelDB is tightly coupled with [NeuronDB](#), a database of neuronal properties that are used to constrain models based on experimental observations.

Browse or search through over [1480 models](#) using the navigation on the left bar or in the menu button on a mobile device. To search papers instead of models, go [here](#); this may be used to identify models whose paper cites or is cited by a given paper.

Both NEURON and BRIAN work with Python!

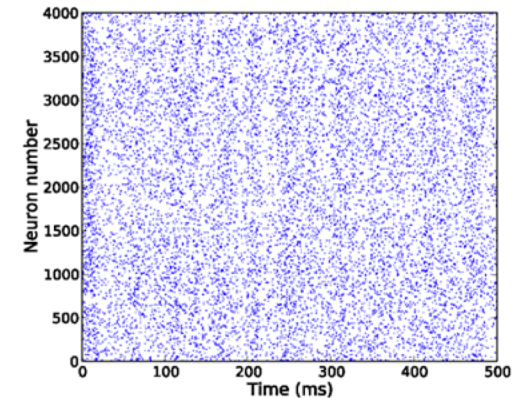
NEURON

BRIAN

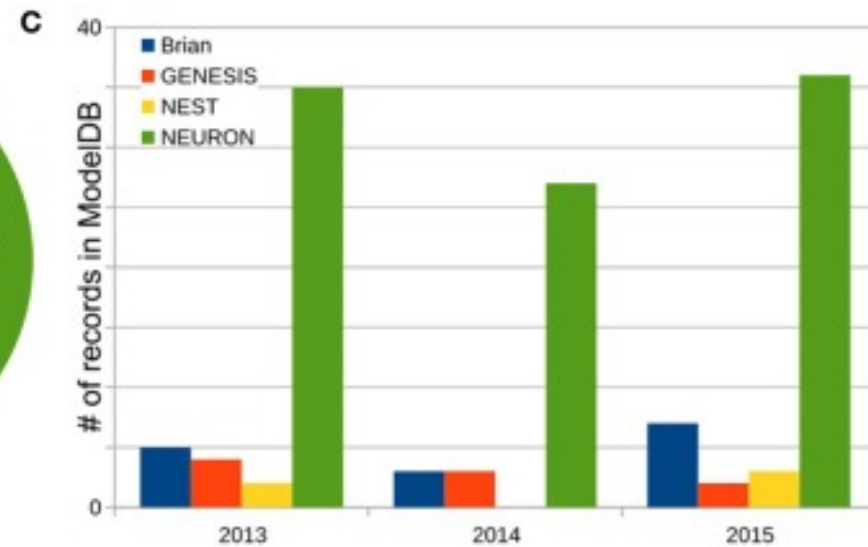
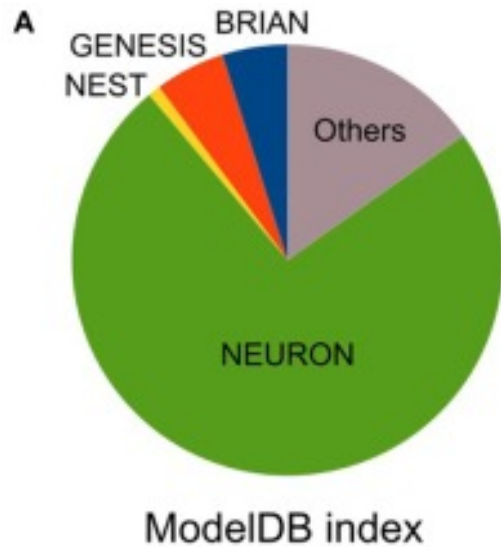


```
from brian import *
eqs = '''
dV/dt = (ge+gi-(V+49*mV))/(20*ms) : volt
dge/dt = -ge/(5*ms) : volt
dgi/dt = -gi/(10*ms) : volt
'''
P = NeuronGroup(4000, model=eqs,
                threshold=-50*mV, reset=-60*mV)
Pe = P.subgroup(3200)
Pi = P.subgroup(800)
Ce = Connection(Pe, P, 'ge')
Ci = Connection(Pi, P, 'gi')
Ce.connect_random(Pe, P, p=0.02,
                  weight=1.62*mV)
Ci.connect_random(Pi, P, p=0.02,
                  weight=-9*mV)
M = SpikeMonitor(P)
P.V = -60*mV+10*mV*rand(len(P))
run(.5*second)
raster_plot(M)
show()
```

$$\tau_m \frac{dV}{dt} = -(V - E_L) + g_e + g_i$$
$$\tau_e \frac{dg_e}{dt} = -g_e$$
$$\tau_i \frac{dg_i}{dt} = -g_i$$



More models use NEURON than Brian



Both can simulate everything from class and more

	NEURON	NEST	BRIAN
Neuron model without dynamics	M	M	Y
Neuron model with simplified and discontinuous dynamics <i>Examples: <u>Leaky Integrate-and-Fire (LIF)</u>, <u>Izhikevich or Quadratic LIF</u>; <u>Exponent Leaky Integrate-and-Fire (eLIF)</u></i>	M	M	Y
Neuron model with simplified and continuous dynamics <i>Examples: <u>FitzHugh–Nagumo</u>, <u>Morris–Lecar</u></i>	M	M	Y
Single compartment, conductance-based model—temporal integration (point neuron) <i>Examples: <u>Single-Compartment Hodgkin–Huxley model</u></i>	YG	M	Y
Can conductance-based descriptions of ion channels be added to the neuron model? <i>Example: <u>h-channel</u></i>	YG/M	m	Y
Neuron model with simplified morphology (2-compartment model) <i>Example: <u>Pinsky–Rinzel model</u></i>	YG	M	Y
Full spatial reconstruction of individual neuron morphology cable property spatial-temporal integration (multicompartment model) <i>Example: <u>Mainen–Sejnowski model</u></i>	YG	M:E	Y
Extracellular/intracellular chemical kinetics <i>Example: <u>Ca²⁺ dynamics</u></i>	M	m	Y
Can new ion be added to existing model	YG/M	m	Y
Radial diffusion	M	M:E	Y
Longitudinal diffusion	M	M:E	N
Currents in external medium <i>Examples: <u>to model transcranial magnetic stimulation or deep brain stimulation</u></i>	M	N	Y:E
New model of chemical synapse	M	m	Y

YG can be done in GUI without programming; Y can be done in script without writing modules; N cannot be done; M can be implemented through external modules; Y:E or M:E can be implemented in script or through external modules but requires extensive additional knowledge outside of the presumed user ability, such as numerical methods, physics, and partial differential equations (in some sense Y:E ≈ M:E ≈ N); and m cannot be implemented as an independent module but may be done through code modification.

NEURON Instructions

- Download and install:

https://www.neuron.yale.edu/neuron/download/compilestd_osx

- Go through intro with python and tutorials:

<https://neuron.yale.edu/neuron/docs/scripting-neuron-basics>

BRIAN Instructions

- Download and install:

<https://brian2.readthedocs.io/en/stable/introduction/install.html>

- Go through intro tutorials:

<https://brian2.readthedocs.io/en/stable/resources/tutorials/index.html>