

ModelDB

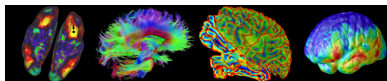
Bill Lytton, Robert McDougal, Michael Hines,
Tom Morse, Gordon Shepherd, Nicole Flokos

July 23, 2015

Modeling in context of The BRAIN initiative

Map, View, Understand

- Map the circuits of brains
- View patterns of electrical and chemical activity in their circuits
- Understand how interplay creates behavior and cognition

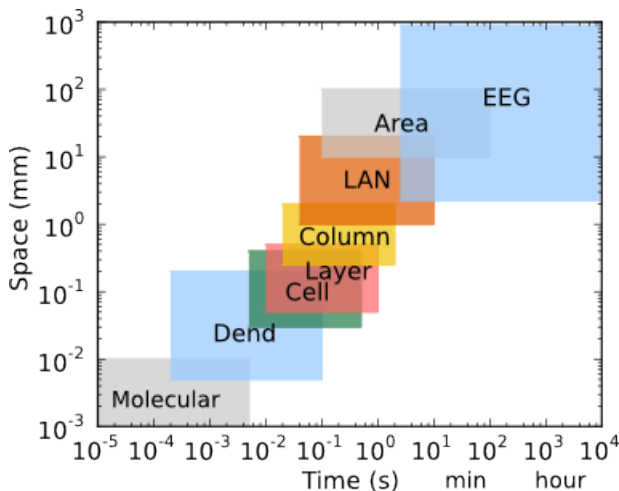


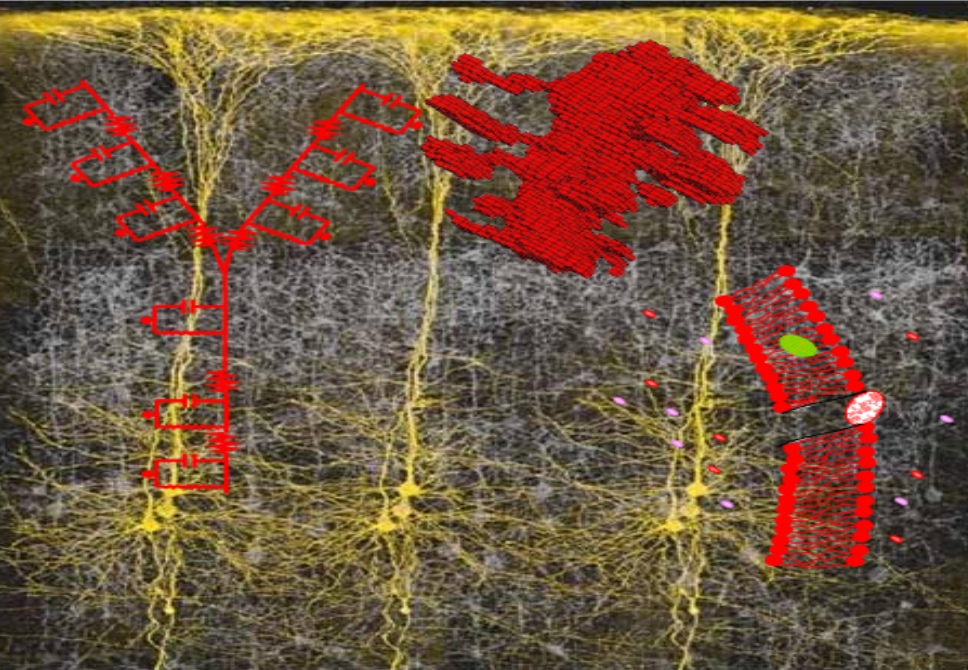
Climbing the omes

Omeomics

- Genomes (microbiome, tumorome, virome)
- “Variome” (SNPs, HVP)
- Epigenomes
- Proteome (organ-specific), interactome, metabolome
- Connectome
- Cognitome
- etceterome

Multiscale Modeling





in silico experiments are wonderfully reproducible

but only if you have the code


- typos in published equations are not uncommon
- assumptions are unreported – e.g., how trapezoids abut
- random choice of pseudorandomizer

ModelDB part of SenseLab

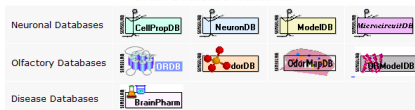


[Login](#)

The SenseLab Project is a long-term effort to build integrated, multidisciplinary models of neurons and neural systems. It was founded in 1993 as part of the original Human Brain Project, which began the development of neuroinformatics tools in support of neuroscience research. It is now part of the Neuroscience Information Framework ([NIF](#)) and the International Neuroinformatics Coordinating Facility ([INCF](#)). The SenseLab project involves novel informatics approaches to constructing databases and database tools for collecting and analyzing neuroscience information, using the olfactory system as a model, with extension to other brain systems.

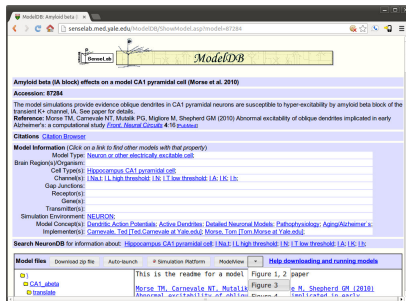
- [Overview](#)
- [Membrane Properties Resource](#)
- [Read about recent changes in SenseLab](#) 

Brain Database Research



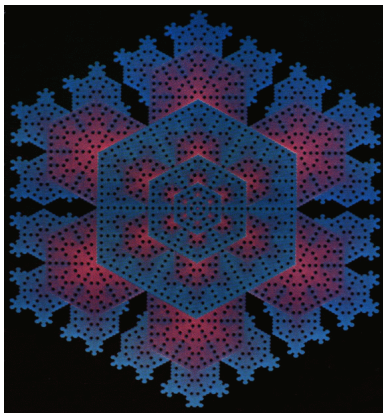
[Neuroscience Information Framework](#)

ModelDB



- ~ 1000 models
- 158 cell types
- 68 formats

Complex computer models as experimental objects



S Wolfram Computer software in science and mathematics *Sci Am* 251:188-204 1984

Initially “experiment” on someone else’s model to figure out what’s going on

- Want to make models more human-interpretable
- ModelView provides NEURON models with
 - Simulator introspection
 - Metadata from ModelDB
 - Static analysis of source code
 - Moving towards dynamic analysis (cf debuggers)

Dynamic evaluation with modelview

- Run model setup to see morphologies and data strucs
- Abbreviate a long simulation to play&poke interactively

Full txt + key-term search

Database + Full Text Search

Version 0.9 [Help](#)

Search: Computational model

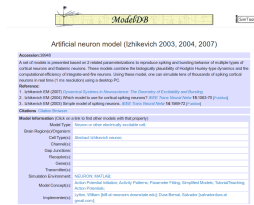
Parameters to retrieve (All <input type="checkbox"/>)	Select	Conditions
0 Id	<input type="checkbox"/>	
1 Name	<input checked="" type="checkbox"/>	
2 Notes	<input type="checkbox"/>	
3 Model Neurons	<input type="checkbox"/> Keywords	
4 More Cells	<input type="checkbox"/> Keywords	
5 Model Currents	<input type="checkbox"/> Keywords	IA
6 Model Receptors	<input type="checkbox"/> Keywords	
7 Model Type	<input type="checkbox"/> Keywords	
8 Model Concept	<input type="checkbox"/> Keywords	
9 Simulator software	<input type="checkbox"/> Keywords	
10 Gene	<input type="checkbox"/> Keywords	
11 Region Organism	<input type="checkbox"/> Keywords	
12 Gap Junctions	<input type="checkbox"/> Keywords	
13 Implemented by	<input type="checkbox"/> Keywords	
14 Model Neurotransmitters	<input type="checkbox"/> Keywords	

And

ModelDB Full Text Search:

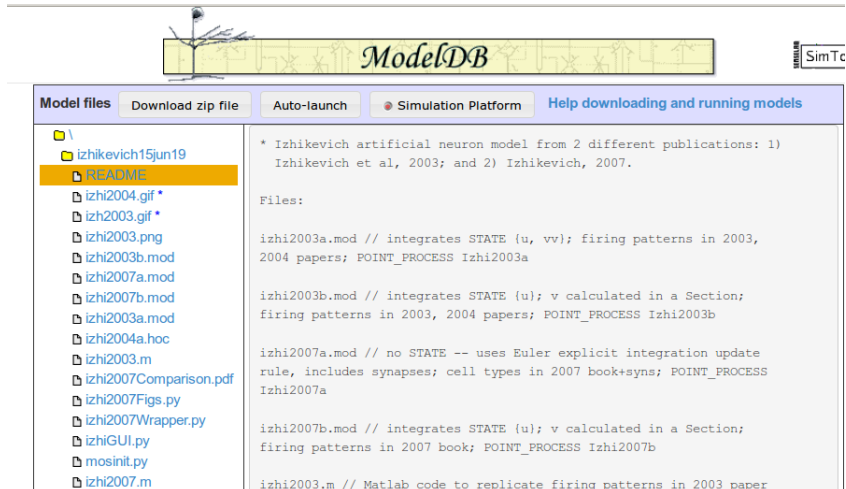
Multiple model scales

Model porting makes a great intro for rotators



- Chemical reaction-diffusion simulations (cf SBML, VCML)
- Multicompartment neurons (MCs)
- Networks of MCs
- Artificial cells and networks of ArtCells

Izhikevich model has multiple implementations



The screenshot shows the ModelDB website interface. At the top, there is a logo for ModelDB and a SimTc logo. Below the logo, there is a navigation bar with buttons for "Model files", "Download zip file", "Auto-launch", "Simulation Platform", and "Help downloading and running models". The main content area is divided into two panels. The left panel shows a file tree with the following files: "izhikevich15jun19", "README", "izhi2004.gif", "izh2003.gif", "izhi2003.png", "izhi2003b.mod", "izhi2007a.mod", "izhi2007b.mod", "izhi2003a.mod", "izhi2004a.hoc", "izhi2003.m", "izhi2007Comparison.pdf", "izhi2007Figs.py", "izhi2007Wrapper.py", "izhiGUI.py", "mosinit.py", and "izhi2007.m". The right panel contains a description of the model and a list of files. The description states: "Izhikevich artificial neuron model from 2 different publications: 1) Izhikevich et al, 2003; and 2) Izhikevich, 2007." The list of files includes: "izhi2003a.mod // integrates STATE {u, vv}; firing patterns in 2003, 2004 papers; POINT_PROCESS Izhi2003a", "izhi2003b.mod // integrates STATE {u}; v calculated in a Section; firing patterns in 2003, 2004 papers; POINT_PROCESS Izhi2003b", "izhi2007a.mod // no STATE -- uses Euler explicit integration update rule, includes synapses; cell types in 2007 book+syns; POINT_PROCESS Izhi2007a", "izhi2007b.mod // integrates STATE {u}; v calculated in a Section; firing patterns in 2007 book; POINT_PROCESS Izhi2007b", and "izhi2003.m // Matlab code to replicate firing patterns in 2003 paper".

ModelDB SimTc

Model files [Download zip file](#) [Auto-launch](#) [Simulation Platform](#) [Help downloading and running models](#)

Files:

- * Izhikevich artificial neuron model from 2 different publications: 1) Izhikevich et al, 2003; and 2) Izhikevich, 2007.

Files:

- izhi2003a.mod // integrates STATE {u, vv}; firing patterns in 2003, 2004 papers; POINT_PROCESS Izhi2003a
- izhi2003b.mod // integrates STATE {u}; v calculated in a Section; firing patterns in 2003, 2004 papers; POINT_PROCESS Izhi2003b
- izhi2007a.mod // no STATE -- uses Euler explicit integration update rule, includes synapses; cell types in 2007 book+syns; POINT_PROCESS Izhi2007a
- izhi2007b.mod // integrates STATE {u}; v calculated in a Section; firing patterns in 2007 book; POINT_PROCESS Izhi2007b
- izhi2003.m // Matlab code to replicate firing patterns in 2003 paper

Replicates figures from a paper

requires paper publication for submission



ModelDB

ModelDB
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Model files Download zip file Auto-launch Download the displayed file

Simulation Platform Help downloading and running models

- \
- izhikevich15jun19
 - README
 - izhi2004.gif *
 - izhi2003.gif *
 - izhi2003.png
 - izhi2003b.mod
 - izhi2007a.mod
 - izhi2007b.mod
 - izhi2003a.mod
 - izhi2004a.hoc
 - izhi2003.m
 - izhi2007Comparison.pdf
 - izhi2007Figs.py
 - izhi2007Wrapper.py
 - izhiGUI.py
 - mosinit.py
 - izhi2007.m

(A) tonic spiking

(B) phasic spiking

(C) tonic bursting

(D) phasic bursting

(E) mixed mode

(F) spike frequency adaptation

(G) Class 1 excitable

(H) Class 2 excitable

(I) spike latency

(J) subthreshold oscillations

(K) resonator

(L) integrator

View code directly from the browser



ModelDB

- izhikevich15jun19
 - README
 - izhi2004.gif *
 - izh2003.gif *
 - izhi2003.png
 - izhi2003b.mod
 - izhi2007a.mod
 - izhi2007b.mod
 - izhi2003a.mod
 - izhi2004a.hoc
 - izhi2003.m
 - izhi2007Comparison.pdf
 - izhi2007Figs.py
 - izhi2007Wrapper.py
 - izhiGUI.py
 - mosinit.py

```
'''Usage:
import simple
h.run()
simple.show()

Sets up 5 models using default parameters in the .mod files
2 versions of 2003/2004 parameterization: freestanding (3a); in section (3b)
3 versions of 2007/2008 parameterization: freestanding (7a); in section (7b); in sec using v
can graph u, v for any model
simple.show('v3a','v3b') # compare voltage output for the 2 versions of the 2003/2004 param
simple.show('v7a','v7b','v7bw') # compare voltage output for 3 versions of the 2007 paramete
'''

from neuron import h, gui
import numpy as np
import izhi2007Wrapper as izh07
import pylab as plt
```