

Don't reinvent the brain

Using ModelDB and other archives for your research

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11 November 2016

What is ModelDB?

- ModelDB Help
- User account
- Login
- Register
- Find models by
- Model name
- First author
- Each author
- Region(circuit)
- Find models for
- Cell type
- Current
- Receptor
- Gene
- Transmitters
- Topic
- Simulations
- Methods
- Find models of
- Realistic Networks
- Neurons
- Electrical synapses (gap junctions)
- Chemical synapses
- Ion channels
- Neuroanatomical (morphology)

Amyloid beta (IA block) effects on a model CA1 pyramidal cell (Morse et al. 2010)

Download zip file Auto-launch
Help downloading and running models

Model Information

Accession:87284

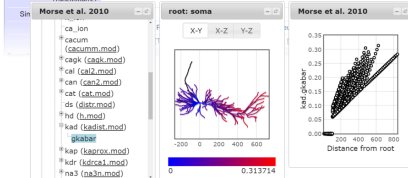
The model simulations provide evidence oblique dendrites in CA1 pyramidal neurons are susceptible to hyper-excitability by amyloid beta block of the channel, IA. See paper for details.

Reference:

1. Morse TM, Carnevale NT, Mitalik PG, Migliore M, Shepherd GM (2010) Abnormal excitability of oblique dendrites implicated in early Alzheimer's computational study *Front. Neural Circuits* 4:16 [PubMed]

Model Information (Click on a link to find other models with that property)

Model Type:	Neuron or other electrically excitable cell;
Brain Region(s)/Organism:	
Cell Type(s):	Hippocampus CA1 pyramidal cell;
Channel(s):	I Na; I L high threshold; I N; I T low threshold; I A; I K; I h;
Gap Junctions:	
Receptor(s):	
Gene(s):	
Transmitter(s):	



Alzheimer's;

```
from neuron import h, rxd
import neuron.rxd.node as node
from matplotlib import pyplot
import time
```

```
h.load_file('stdrun.hoc')
```

```
soma = h.Section()
soma.L = 10
soma.diam = 10
soma.nseg = 11
dend = h.Section()
dend.connect(soma)
dend.L = 50
dend.diam = 2
dend.nseg = 51

def print_nodes():
    print ', '.join(str(v) for v in node._states)

print 'defining rxd'
region = rxd.Region(h.allsec(), nrn_region='i')
ca = rxd.Species(region, name='ca', ds1, charge=2, initial=
reaction = rxd.Rate(ca, -ca * (1 - ca) * (0.3 - ca))

print 'initializing'
h.finitialize()

print 'before:'
print_nodes()
print
```

Morse TM, Carnevale NT, Mitalik PG, Migliore M, Shepherd GM (2010) Abnormal excitability of oblique dendrites implicated in early Alzheimer's: a computational study *Front. Neural Circuits* 4:16 [PubMed]

References and models cited by this paper

Acker CD, White JA (2007) Roles of (IA) and morphology in action potential propagation in CA1 pyramidal cell dendrites. *J Comput Neurosci* 23(2):201-16 [Journal] [PubMed]

• Roles of (IA) and morphology in AP prop. in CA1 pyramidal cell dendrites (Acker and White 2007) [Model]

Anderton BH, Calkahan L, Coleman P, Davies P, Flood D, Jicha GA, Chen T, Weaver JC (1996) Dendritic changes in Alzheimer's disease and factors that may underlie these changes. *Prog Neurobiol* 55:495-500 [PubMed]

Andrzejak RJ, Makara JK, Johnstone D, Magaz JC (2006) Altered synaptic and non-synaptic properties of CA1 pyramidal neurons in the AD mouse model. *J Neurosci* 26:11111-11121 [PubMed]

References and models that cite this paper

Gulmone V, Migliore M (2012) Progressive effect of beta amyloid peptides accumulation on CA1 pyramidal neurons: a model study suggesting possible treatments *Front Comput Neurosci* 6:52 [Journal] [PubMed]

• CA1 pyramidal neurons: effects of Alzheimer (Gulmone and Migliore 2012) [Model]

McDougal RA, Morse TM, Hines ML, Shepherd GM (2015) ModelView for ModelDB: online presentation of model structure *Neuroinformatics* 13(4):459-70 [Journal] [PubMed]

• ModelView: online structural analysis of computational models (McDougal et al. 2015) [Model]

Twenty years of ModelDB and beyond: building essential modeling tools for the future of neuroscience

Robert A. McDougal¹ · Thomas M. Morse¹ · Ted Carnevale¹ · Luis Marengo^{1,2,3} · Rixin Wang^{3,4} · Michele Migliore^{1,5} · Perry L. Miller^{2,3,4} · Gordon M. Shepherd¹ · Michael L. Hines¹

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Abstract Neuron modeling may be said to have originated with the Hodgkin and Huxley action potential model in 1952 and Rall's models of integrative activity of dendrites in 1964.

groups (Allen Brain Institute, EU Human Brain Project, etc.) are emerging that collect data across multiple scales and integrate that data into many complex models, presenting new

Why use ModelDB?

On reproducibility

“Non-reproducible single occurrences are of no significance to science.”

– Karl Popper in *The logic of scientific discovery*, 1959.

What is needed for a model to be reproducible?

Model

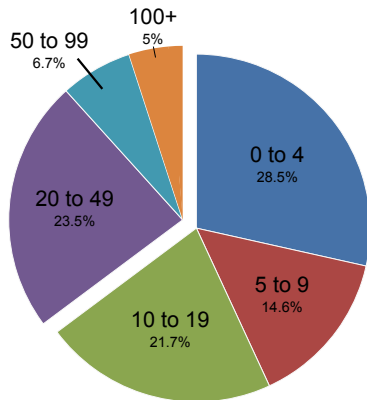
- an approximation of the system of interest
e.g. a model organism or a complete statement of the properties of the model in mathematical or computable form

Experimental protocol

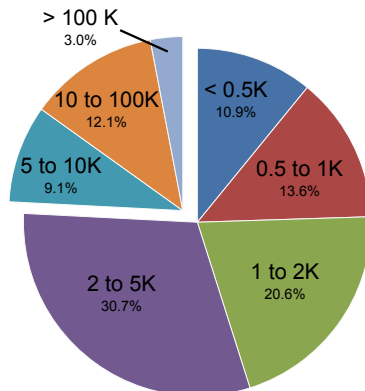
- what was done with the model to produce the data

Science builds upon previous work; in order to do that, the previous work needs to be reproducible.

Models are complicated



Files per Model



File Size

- **38.5%** of ModelDB models have **over 20 files**; **24.2%** of files are **over 5K**.
- It is often hard to fully describe this complexity in a paper.
- Any bugs, typos, errors, or omissions might completely change the dynamics.

Model sharing helps, but only reuse what you understand

The easiest way to replicate someone else's results – a first step toward building on them – is to get their model code from a repository such as ModelDB.

But beware:

- They may be solving a different problem than you (with respect to species, temperature, age, etc).
- Their code may have bugs.

To reduce the risk of problems:

- **Read** the associated paper.
- **Compare** the model and results to other similar models.
- **Examine** the model with ModelView and/or psection.
- **Test** ion channels individually.
- **Collaborate** with an experimentalist.

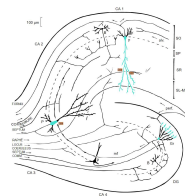
Reproducibility in Computational Neuroscience Models and Simulations

Robert A. McDougal, Anna S. Bulanova, William W. Lytton

Abstract—Objective: Like all scientific research, computational neuroscience research must be reproducible. Big data science, including simulation research, cannot depend exclusively on journal articles as the method to provide the sharing and transparency required for reproducibility.

build novel theoretical frameworks. A century ago, work by Lapicque led to the development of integrate-and-fire models [4]. A half century later, Hodgkin and Huxley provided a detailed multiscale biophysical model of the squid axon [2],

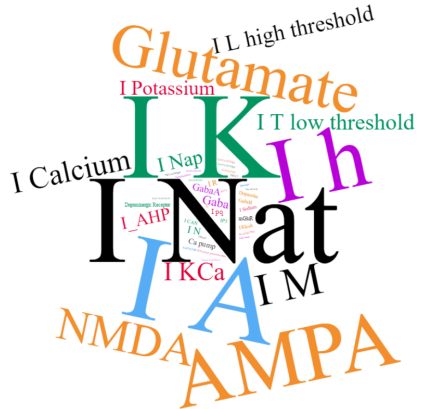
- Simulators (NEURON, MCell, XPPAUT, NEST, etc)
- Multi-simulator interoperability (NeuroML, SWC, PyNN, NeuroConstruct, etc)
- Shared resources (Neuroscience Gateway, Simulation Platform)
- Sharing resources (ModelDB, OpenSourceBrain, NeuroMorpho.Org, etc)
- More: NSDF, NeuroLex, NIF, MIASE, licensing, etc



ModelDB is a place to see what has been modeled in a cell type.

Not only can you get code, but by comparing models, you can see what mechanisms are considered critical by the community.

Metadata associated with
CA1 Pyramidal Cell Models ($n = 71$)



How to use ModelDB

Finding models

The screenshot shows the ModelDB search interface. At the top left, there is a search box containing the text 'hin' and a magnifying glass icon. Below the search box, a dropdown menu lists suggestions: 'hin', 'hinf', 'hinf-h', 'hines', 'hinton.hoc', 'hint', 'Authors', 'Hines ML', 'Hines M', 'Cell Type', 'Entorhinal cortex stellate cell', 'Region', 'Entorhinal cortex', 'Transmitter', 'Norepinephrine', 'Ephinephrine', 'Dynorphin', 'Receptor', 'Dynorphin', 'Concept', and 'Tutorial/Teaching'. To the right of the search box, a list of search results is displayed. The first result is 'View all'. The second result is 'Olfactory Mitral Cell (Shen et al 1999)'. The third result is 'Arteriolar networks: Spread of potential (Crane et al 2001)'. The fourth result is 'Olfactory Mitral cell: AP initiation modes (Chen et al 2002)'. The fifth result is 'Local variable time step method (Lytton, Hines 2005)'. The sixth result is 'Olfactory bulb mitral cell: synchronization by gap junctions (Migliore et al 2005)'. The seventh result is 'Discrete event simulation in the NEURON environment (Hines and Carnevale 2004)'. The eighth result is 'Spatial gridding and temporal accuracy in NEURON (Hines and Carnevale 2001)'. The ninth result is 'Discrete event simulation in the NEURON environment (Hines and Carnevale 2004)'.

- **Search box** on the top-left of every page.
- Do **full text** or **attribute** searches.
- Word completions (based on ModelDB entries not English) and attribute results **updated as you type**.
- **Advanced search** and **browsing** are also available.

ShowModel features

The screenshot shows the ShowModel website interface. At the top, there is a search bar (1) and a 'ModelDB' logo. Below the search bar, a navigation menu on the left lists various options like 'ModelDB Help', 'User account', 'Login', 'Register', 'Find models by', 'Model name', 'First author', 'Each author', 'Region(s)', 'Find models for', 'Cell type', 'Current', 'Receptor', 'Gene', 'Transmitters', 'Type', 'Simulations', 'Methods', 'Find models of', 'Realistic Networks', 'Neurons', 'Electrical synapses (gap junctions)', 'Chemical synapses', 'Ion channels', 'Neuromuscular junctions', 'Axons', 'Other resources', 'ModelDB related resources', 'Computational neuroscience', 'ecosystem', and 'Models in mercurial repository'. The main content area displays a model titled 'Amyloid beta (A β) block effects on a model CA1 pyramidal cell (Morse et al. 2010)'. Below the title, there are links for 'Download zip file' (3), 'Auto-launch' (4), and 'Help downloading and running models'. The model details are organized into sections: 'Model Information' (5), 'Model File' (6), 'Citations' (7), 'Model Views' (8), 'Simulation Platforms' (9), and '3D Print'. The 'Model Information' section includes 'Accession: 87284', 'The model simulations provide evidence oblique dendrites in CA1 pyramidal neurons are susceptible to hyperexcitability by amyloid beta block of the transient K⁺ channel, IA. See paper for details.', 'Reference: 1. Morse TM, Carnevale NT, Muzalik PG, Migliore M, Shepherd GM (2010) Abnormal excitability of oblique dendrites implicated in early Alzheimer's: a computational study *Front. Neural Circuits* 4:16 [PubMed]', 'Model Information (Click on a link to find other models with that property):', 'Model Type: Neuron or other electrically excitable cell.', 'Brain Region(s)/Organism:', 'Cell Type(s): Hippocampus CA1 pyramidal cell.', 'Channel(s): I Na; I L; High threshold; I N; I T low threshold; I A; I K; I h;', 'Gap Junctions:', 'Receptor(s):', 'Gene(s):', 'Transmitter(s):', 'Simulation Environment: NEURON.', 'Model Concept(s): Dendritic Action Potentials; Active Dendrites; Detailed Neuronal Models; Pathophysiology; Aging/Alzheimer's;', 'Implementer(s): Carnevale, Ted [Ted.Carnevale at Yale.edu]; Morse, Tom [Tom.Morse at Yale.edu]'. The 'Search NeuronDB for information about: Hippocampus CA1 pyramidal cell; I Na; I L; High threshold; I N; I T low threshold; I A; I K; I h;' is also shown. At the bottom, there are social media links (Twitter, RSS), a 'ModelDB Home' link, and a 'Questions, comments, problems? Email the ModelDB Administrator' link. The footer includes 'How to cite ModelDB', 'ModelDB Credits', and '© This site is Copyright 2015 Shepherd Lab, Yale University'.

- (1) Search models. (2) Browse models. (3) Link to download the entire model code. (4) Auto-launch a NEURON simulation (requires browser configuration). (5) View model files. (6) Find models and papers cited by this model's paper, or that cite this model. (7) ModelView: visualize model structure. (8) Simulation platform (5 minutes of remote desktop access to experiment with the model). (9) 3D printable versions of cells from the model (in 3DModelDB). (10) Description of model. (11) Paper(s) describing or using model. (12) Searchable metadata. (13) Links to NeuronDB (channel distributions etc within cell types).

ShowModel features

Amyloid beta (IA block) effects on a model CA1 pyramidal cell (Morse et al. 2010)

Download zip file Auto-launch

Help downloading and running models

Model Information **Model File** Citations Model Views Simulation Platform 3D Print

Download the displayed file (14)

(15)

- /
- CA1_abeta
 - translate
 - readme.html**
 - cacumm.mod
 - cagk.mod *
 - cal2.mod *
 - can2.mod *
 - cat.mod *
 - distr.mod *
 - h.mod
 - lpulse2.mod *
 - kadist.mod
 - kaprox.mod
 - kdrca1.mod
 - na3n.mod
 - naxn.mod *

(16)

This is the readme for a model used in the paper

[Morse TM, Carnevale NT, Mutalik PG, Migliore M, Shepherd GM \(2010\) Abnormal excitability of oblique dendrites implicated in early Alzheimer's: a computational study Front. Neural Circuits 4:16](#)

The model code was contributed by Tom Morse. It was created (see paper for details) from earlier models (especially Migliore et al. 2005 and calcium channels from Hemond et al. 2008) with modifications and additions by Tom Morse and Ted Carnevale with interaction with the other authors. It requires the NEURON simulator to be installed (available at <http://www.neuron.yale.edu>).

To recreate figures from the paper, start the simulator by auto-launching from ModelDB *OR*

Under unix systems:

In the expanded archive's folder compile the mod files using the command "nrnivmodl"
run the simulation with the command "nrngui mosinit.hoc"

Under Windows systems:

Compile the mod files using the "mknrndll" program.
A double click on the simulation file
mosinit.hoc

model=E7284&file=D=23&a=yes&file=/%2FCA1_abeta...

(14) Download the currently selected file. (15) Directory browser, showing model files.

(16) View pane for the currently selected file.

Identifying existing reuse

Amyloid beta (IA block) effects on a model CA1 pyramidal cell (Morse et al. 2010)

Download zip file Auto-launch

[Help downloading and running models](#)

Model Information **Model File** Citations Model Views Simulation Platform 3D Print

Download the displayed file

File browser contents:

- /
- CA1_abeta
- translate
- readme.html
- cacumm.mod
- cagk.mod *
- cal2.mod *
- can2.mod *
- cat.mod *
- dislr.mod *
- h.mod
- jpulse2.mod *
- kadist.mod
- kaprox.mod
- kdrca1.mod
- na3n.mod
- naxn.mod *
- zcaquant.mod
- aBeta.hoc

Other models using cagk.mod:

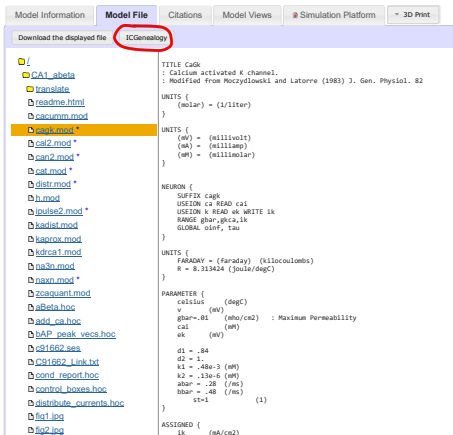
- A model of unitary responses from A/C and PP synapses in CA3 pyramidal cells (Baker et al. 2010)
- CA1 pyramidal neuron: effects of R213Q and R312W Kv7.2 mutations (Miceli et al. 2013)
- CA3 pyramidal neuron (Safuлина et al. 2010)
- CA3 pyramidal neuron: firing properties (Hemond et al. 2008)
- Neuronal dendrite calcium wave model (Neymotin et al. 2015)

Other models using naxn.mod:

- CA1 pyramidal neuron: effects of R213Q and R312W Kv7.2 mutations (Miceli et al. 2013)
- CA1 pyramidal neuron: functional significance of axonal Kv7 channels (Shah et al. 2008)
- CA1 pyramidal neuron: rebound spiking (Ascoli et al. 2010)
- CA1 pyramidal neuron: schizophrenic behavior (Migliore et al. 2011)
- CA1 pyramidal neuron: signal propagation in oblique dendrites (Migliore et al. 2005)
- CA1 pyramidal neurons: binding properties and the magical number 7 (Migliore et al. 2008)
- CA1 pyramidal neurons: effect of external electric field from power lines (Cavarretta et al. 2014)
- CA1 pyramidal neurons: effects of Alzheimer (Culmone and Migliore 2012)
- CA1 pyramidal neurons: effects of Kv7 (M-) channels on synaptic integration (Shah et al. 2011)
- CA1 pyramidal neurons: effects of a Kv7.2 mutation (Miceli et al. 2009)
- Ca1 pyramidal neuron: reduction model (Marasco et al. 2012)
- Effect of the initial synaptic state on the probability to induce LTP and LTD (Migliore et al. 2015)
- Effects of electric fields on cognitive functions (Migliore et al. 2016)
- Neuronal morphology goes digital ... (Parekh & Ascoli 2013)
- Spine head calcium in a CA1 pyramidal cell model (Graham et al. 2014)

Asterisks in the file browser indicate that the file is reused in other models; click the asterisk to see a list of the other models.

ICGenealogy: ion channel metadata



The screenshot shows the ICGenealogy web interface. At the top, there are tabs: 'Model Information', 'Model File' (selected), 'Citations', 'Model Views', 'Simulation Platform', and '3D Print'. Below the tabs, there is a button 'Download the displayed file' and a button 'ICGenealogy' which is circled in red. On the left, there is a list of model files, including 'CA1_abeta', 'translate', 'readme.html', 'cacumm.mod', 'cagk.mod', 'cal2.mod', 'can2.mod', 'cat.mod', 'distr.mod', 'h.mod', 'ipulse2.mod', 'kadist.mod', 'kaprow.mod', 'kdrca1.mod', 'na3n.mod', 'naxn.mod', 'zcaquant.mod', 'aBeta.hoc', 'add_ca.hoc', 'bAP_peak_vecs.hoc', 'c91662.sas', 'C91662_Link.txt', 'cond_report.hoc', 'control_boxes.hoc', 'distribute_currents.hoc', 'fig1.jpg', and 'fig2.jpg'. On the right, the content of the 'cagk.mod' file is displayed, showing the title, units, neuron, and parameter sections.

```
TITLE Cagk
: Calcium activated K channel.
: Modified from Moczydlowski and Latorre (1983) J. Gen. Physiol. 82

UNITS {
    (molar) = (1/liter)
}

UNITS {
    (mV) = (millivolt)
    (nA) = (milliamp)
    (nM) = (millimolar)
}

NEURON {
    SUFFIX cagk
    USEION ca READ cai
    USEION k READ ek WRITE ik
    RANGE gbar,gkca,ik
    GLOBAL oinf, tau
}

UNITS {
    FARADAY = (Faraday) (kilocoulombs)
    R = 8.313424 (joule/degC)
}

PARAMETER {
    celcius (degC)
    v (mV)
    gbar=.01 (mho/cm2) : Maximum Permeability
    cai (mM)
    ek (mV)
    d1 = .84
    d2 = 1.
    k1 = .48e-3 (mM)
    k2 = .13e-6 (mM)
    abar = .28 (/ms)
    bbar = .48 (/ms)
    st=1 (1)
}

ASSIGNED {
    ik (nA/cm2)
```

General data

- **ICG id:** 2464
- **ModelDB id:** 87284
- **Reference:** Morse TM, Carnevale NT, Mutalik PG, Migliore M, Shepherd GM (2010): [Abnormal Excitability of Oblique Dendrites Implicated in Early Alzheimer's: A Computational Study.](#)

Metadata classes

- **Animal Model:** rat
- **Brain Area:** hippocampus, CA1
- **Classes:** KCa
- **Ion Type:** K
- **Neuron Region:** unspecified
- **Neuron Type:** pyramidal cell
- **Runtime Q:** Q4 (slow)
- **Subtype:** not specified

Metadata generic

- **Age:** 7-14 weeks old.
- **Comments:** Calcium activated k channel, modified from moczydlowski and latorre (1983). From hemond et al. (2008), model no. 101629, with no changes (identical mod file). Animal model taken from chen (2005) which is used to constrain model. Channel kinetics from previous study on hippocampal pyramidal neuron (hemond et al. 2008)
- **Runtime:** 76.722

When viewing most mod files describing an ion channel, an ICGenealogy button appears. Clicking this button loads the corresponding page of the ICGenealogy database which shows curated information about the channel model (how it was derived, information about the underlying data, etc) and response curves.

Amyloid beta (IA block) effects on a model CA1 pyramidal cell (Morse et al. 2010)

[Download zip file](#)[Auto-launch](#)[Help downloading and running models](#)**Model Information**[Model File](#)[Citations](#)[Model Views](#)[Simulation Platform](#)[3D Print](#)**Accession:**87284

The model simulations provide evidence oblique dendrites in CA1 pyramidal neurons are susceptible to hyper-excitability by amyloid beta block of the transient K⁺ channel, IA. See paper for details.

Reference:

1 . Morse TM, Carnevale NT, Mutalik PG, Migliore M, Shepherd GM (2010) Abnormal excitability of oblique dendrites implicated in early Alzheimer's: a computational study *Front. Neural Circuits* 4:16 [PubMed]

Model Information (Click on a link to find other models with that property)

Model Type:	Neuron or other electrically excitable cell;
Brain Region(s)/Organism:	
Cell Type(s):	Hippocampus CA1 pyramidal cell;
Channel(s):	I Na,t; I L high threshold; I N; I T low threshold; I A; I K; I h;
Gap Junctions:	
Receptor(s):	
Gene(s):	
Transmitter(s):	
Simulation Environment:	NEURON;
Model Concept(s):	Dendritic Action Potentials; Active Dendrites; Detailed Neuronal Models; Pathophysiology; Aging/Alzheimer's;
Implementer(s):	Carnevale, Ted [Ted.Carnevale at Yale.edu]; Morse, Tom [Tom.Morse at Yale.edu];

Search NeuronDB for information about: Hippocampus CA1 pyramidal cell; I Na,t; I L high threshold; I N; I T low threshold; I A; I K; I h;

Morse et al. 2010

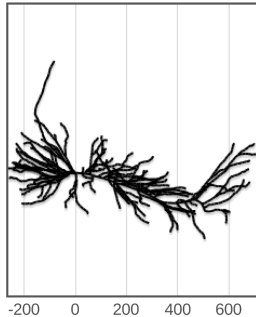
- 194 sections; 974 segments
- + 1 cell with morphology
 - 0 artificial cells
 - 0 NetCon objects
 - 0 LinearMechanism objects
- + Temperature: 35°C
- + Density Mechanisms
- + 1 point processes (0 can receive events) of 1 base classes
- + 7 files shared with other ModelDB models
- + References

root: soma

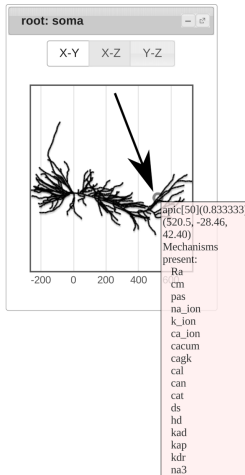
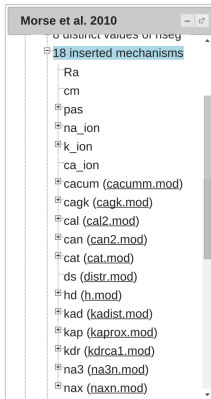
X-Y

X-Z

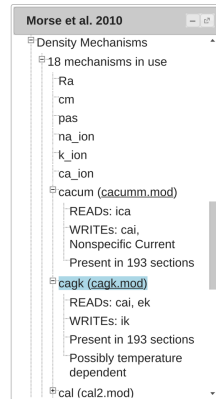
Y-Z

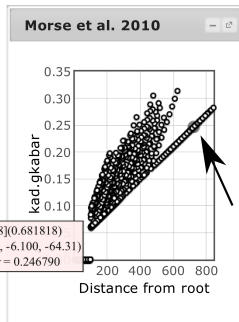
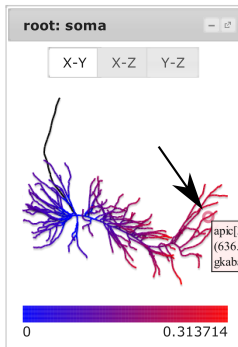
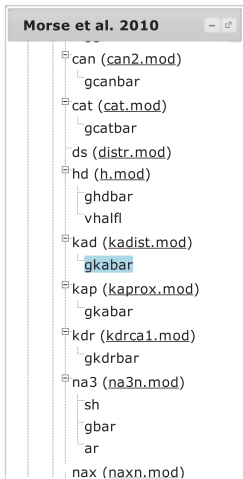


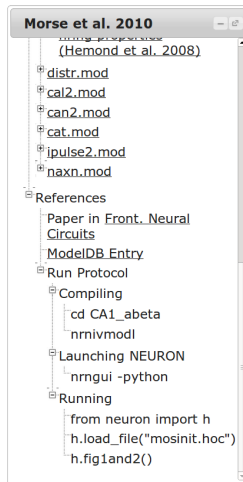
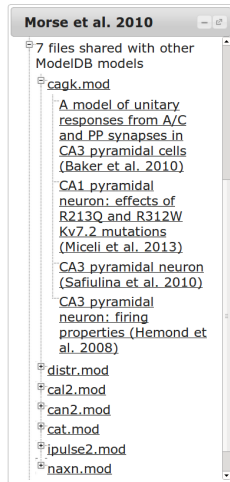
a



b

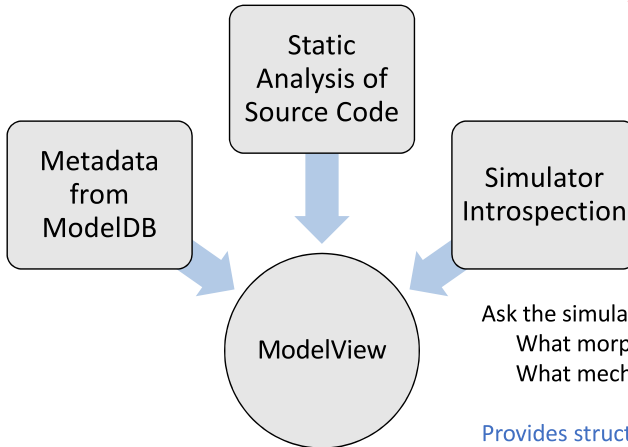






What described where?

Beware: comments, if statements.



Simulator?
Papers?
Species?
Channels?
Context?

Ask the simulator what it did.
What morphology?
What mechanisms?

Provides structured data from
unstructured code.

How do people use ModelDB?

- Find a model described in a paper, download it, and experiment to understand the model's predictions.
- Find a model described in a paper. Use ModelView to understand the model's structure.
- Locate models and modeling papers on a given topic.
- Locate model components (e.g. L-type calcium channel) for potential reuse.
- Search for simulator keywords (e.g. FInitializeHandler) to find examples of how to use them.

You can help by sharing your model code on ModelDB after publication.

Sharing your models

Advanced search

ModelDB Help
User account
Login
Register

Find models by
Model name
First author
Each author
Region(circuits)

Find models for
Cell type
Current
Receptor
Gene
Transmitters
Topic
Simulators
Methods

Find models of
Realistic Networks
Neurons
Electrical synapses (gap junctions)
Chemical synapses
Ion channels
Neuromuscular junctions
Axons

Other resources
ModelDB related resources
Models in mercurial repository

Submit Model

ModelDB provides an accessible location for storing and efficiently retrieving computational neuroscience models. ModelDB is tightly coupled with [NeuronDB](#). Models can be coded in any language for any environment. Model code can be viewed before downloading and browsers can be set to auto-launch the models. For further information, see [model sharing in general](#) and [ModelDB in particular](#).

Browse or search through over 1000 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.

Tweets

 by @SenseLabProject

SenseLab @SenseLabProject
New in #ModelDB: A Layer V CCS type pyramidal cell, inhibitory synapse current conduction (Kubota Y et al., 2015)
modeldb.yale.edu/183424
19 Apr

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ModelDB

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Submit New Model

Required information:

Your full name:

Your email address:

Zip file of model code:

 No file chosen

Read-Write access code (15 character max):

Used as a password to only access this model

PubMed ID(s) or citation(s) associated with the model:

Only required for publicly shared models.

Citation(s) can be in any bibliographic format.

You may with just the above information, but to make your model more discoverable, please fill out as much of the next section as you can. *Note:*

Your model will remain private until you request the ModelDB administrator make it public.

Let us find ModelDB keywords for you!

Click the button to automatically find, approve, and populate model entry keywords based on your paper abstract.

Additional information: *More information will help your model more discoverable*

Sharing your models

The screenshot shows the ModelDB website interface. On the left is a sidebar with navigation links: search, Advanced search, ModelDB Help, User account, Login, Register, Find models by (Model name, First author, Each author, Region/circuits), Find models for (Cell type, Current, Receptor, Gene, Transmitters, Topic, Simulators, Methods), Find models of (Realistic Networks, Neurons, Electrical synapses (gap junctions), Chemical synapses, Ion channels, Neuromuscular junctions, Axons), and Other resources (ModelDB related resources, Computational neuroscience ecosystem). The main content area is partially obscured by a modal window titled "Automatic keyword identifier". The modal contains a text area with a paper abstract about amyloid beta protein and hyperexcitability. Below the text area are "Cancel" and "Submit" buttons. At the bottom of the modal is a button that says "Let us find ModelDB keywords for you!". Below the modal, there is a link that says "Click the button to automatically find, approve, and populate model entry keywords based on your paper abstract." and a section for "Additional information:" with a link to "More information will help your model more discoverable". At the very bottom, there is a label "Model Name".

search

Advanced search

ModelDB Help

User account

Login

Register

Find models by

Model name

First author

Each author

Region/circuits

Find models for

Cell type

Current

Receptor

Gene

Transmitters

Topic

Simulators

Methods

Find models of

Realistic Networks

Neurons

Electrical synapses (gap junctions)

Chemical synapses

Ion channels

Neuromuscular junctions

Axons

Other resources

ModelDB related resources

Computational neuroscience ecosystem

Required

Your full name

Your email address

Zip file of your model

Read-Write permissions

Used as a parent model

PubMed ID

Only required if you have a citation(s) on PubMed

You may also want to

Your model keywords

SimToolDB

Automatic keyword identifier

Please paste your paper abstract here.

The integrative properties of cortical pyramidal dendrites are essential to the neural basis of cognitive function, but the impact of amyloid beta protein (*abeta*) on these properties in early Alzheimer's is poorly understood. In animal models, electrophysiological studies of proximal dendrites have shown that *abeta* induces hyperexcitability by blocking A-type K⁺ currents (I(A)), disrupting signal integration. The present study uses a computational approach to analyze the hyperexcitability induced in distal dendrites beyond the experimental recording sites. The results show that back-propagating action potentials in the dendrites induce hyperexcitability and excessive calcium concentrations not only in the main apical trunk of pyramidal cell dendrites, but also in their oblique dendrites. Evidence is provided that these thin branches are particularly sensitive to local reductions in I(A). The results suggest the hypothesis that the oblique branches may be most vulnerable to disruptions of I(A) by early exposure to *abeta*, and point the way to further experimental analysis of these actions as factors in the neural basis of the early decline of cognitive function in Alzheimer's.

Cancel

Submit

Let us find ModelDB keywords for you!

Click the button to automatically find, approve, and populate model entry keywords based on your paper abstract.

Additional information: More information will help your model more discoverable

Model Name

Sharing your models

The screenshot shows the ModelDB website interface. On the left is a sidebar with navigation links: search, Advanced search, ModelDB Help, User account (Login, Register), Find models by (Model name, First author, Each author, Region(circuits)), Find models for (Cell type, Current, Receptor, Gene, Transmitters, Topic, Simulators, Methods), Find models of (Realistic Networks, Neurons, Electrical synapses (gap junctions), Chemical synapses, Ion channels, Neuromuscular junctions, Axons), and Other resources (ModelDB related resources, Computational neuroscience, neuroscience). The main content area is partially obscured by a modal dialog box titled 'Automatic keyword identifier: results'. The dialog box contains the text: 'Deselect keywords that do not describe the model, then press the button to accept the rest.' Below this is a list of keywords with checkboxes: Neuron or other electrically excitable cell, Dendritic Action Potentials, I Potassium, Action Potentials, Calcium dynamics, I A, Active Dendrites, and Aging/Alzheimer's. All checkboxes are checked. At the bottom of the dialog is a button labeled 'Accept selected keywords'. In the background, the 'Required' section of the model submission form is visible, including fields for 'Your full name', 'Your email address', 'Zip file of model', 'Read-Write permissions', and 'PubMed ID'. A 'Submit' button is visible below the 'Your full name' field. A large blue button in the center of the page reads 'Let us find ModelDB keywords for you!'. At the bottom, there is a section for 'Additional information: More information will help your model more discoverable' with a 'Model Name' field.

search

Advanced search

ModelDB Help

User account

Login

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Find models by

Model name

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Region(circuits)

Find models for

Cell type

Current

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Chemical synapses

Ion channels

Neuromuscular junctions

Axons

Other resources

ModelDB related resources

Computational neuroscience

neuroscience

Required

Your full name

Your email address

Zip file of model

Read-Write permissions

Used as a public model

PubMed ID

Only required if you have a PubMed citation(s) cite your model

You may **Submit** with just the above information, but to make your model more discoverable, please fill out as much of the next section as you can. *Note:* Your model will remain private until you request the ModelDB administrator make it public.

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Model Name

Sharing your models

search 
[Advanced search](#)

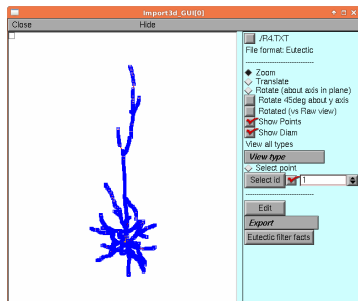
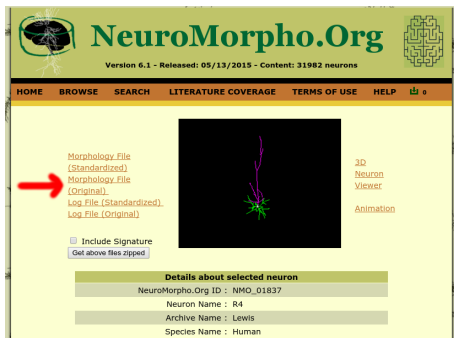


ModelDB

SimToolDB

Other Neuron	<input type="text"/>
Model Neurotransmitters	<input type="text"/>
Other Neurotransmitter	<input type="text"/>
Model Receptors	<input type="text"/>
Other Receptor	<input type="text"/>
Model Currents	<div><div>x I Potassium</div><div>x I A</div><div></div></div>
Other Current	<input type="text"/>
Gap Junctions	<input type="text"/>
Gene	<input type="text"/>
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Model Type	<div><div>x Neuron or other electrically excitable cell</div><div></div></div>
Other Model Type	<input type="text"/>
Model Concept	<div><div>x Dendritic Action Potentials</div><div>x Action Potentials</div><div>x Calcium dynamics</div><div>x Active Dendrites</div><div>x Aging/Alzheimer's</div><div></div></div>
Other Concept	<input type="text"/>
Simulator software	<input type="text"/>
Other Simulator	<input type="text"/>
Region Organism	<input type="text"/>
Implemented by	<input type="text"/>


Other resources



Tools ► Miscellaneous ► Import 3D

- **NeuroMorpho.Org** is home to 50,356 reconstructed neurons from 212 cell types and 37 species as of October 24, 2016.
- Warning: not every morphology was reconstructed with the intent of being in a simulation. Before using: rotate to check for z-axis errors, check to make sure the diameters are not all equal.
- Use the Import 3D tool to import morphologies into NEURON. For details, see: neuron.yale.edu/neuron/docs/import3d

Channelpedia (Channelpedia.epfl.ch)



BLUE BRAIN PROJECT

RECHERCHE EN NEUROSCIENCE
FACULTÉ DE LAUSANNE

CHANNLPEDIA

Channelpedia: The Ion Channel Database

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ION CHANNELS

Ion channels

Na

Nav1

Nav1.1

Nav1.2

Nav1.3

Nav1.4

Nav1.5

Nav1.6

Nav1.7

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Nav1.99

Nav1.100

NAV1.3

sodium channel, voltage-gated, type III, alpha

Channelpedia: The Ion Channel Database

Introductions

The tetrodotoxin-insensitive (TTX-IV) channel Nav1.3 is abundantly expressed in neuronal tissues during embryonic and neonatal stages of development and is rare in adult tissues [48].

After axonal transection, Nav1.3 is upregulated in dorsal root ganglia (DRG) neurons adding to the evidence that upregulation of Nav1.3 may play a role in restoring axotomized DRG neurons hyperexcitability, thus contributing to neuropathic pain [128]. It is thought that the fast activation and inactivation kinetics of Nav1.3, together with its rapid repriming kinetics and persistent current component, contributes to the development of spontaneous ectopic discharges and sustained rates of firing characteristics of injured sensory nerves [130a].

Genes

Experiments on sodium channels in DRG cells (a dorsal line of rat (spinal cord)) showed that monogenic treatment caused a moderate reduction (approx. 30%) of the mRNA for Nav1.3 and a marked reduction (approx. 70%) of the mRNA for Nav1.3. Treatment with Bay K 8646 produced 40–120% increases in these same mRNAs, in contrast [203].

Gen3a: sodium channel, voltage-gated, type III, alpha

Gene ID	Chromosome	Position	Species
736602	2	65245175-65435549	Mouse
736601	2	165944330-166905577	Human

Transcripts

Acc No	Sequence	Length	Source
NM_013119			NCBI
NM_018732			NCBI

Models

[1] Nav1.3 (Model ID = 43)

Animal	rat
CellType	Neocortical
Age	8 Days
Temperature	23.0°C
Reversal	50.0 mV
Ion	Na ⁺
Legend ion	
Reference	T R Cummins et al. J. Neurosci. 2001 Aug 15
mpower	3.0
mkappa	$(0.182 * (1 + (-26)) / (1 + exp(-(V - (-26)) / 0)))$ if v neg -26
mbeta	$(0.324 * (1 + (-26)) / (1 + exp(-(V - (-26)) / 0)))$ if v neg -26
hpower	3.0
htau	$2 * (1 + exp((V - (-26)) / 0))$
htau	$0.40 * (1 + exp((V - (-26)) / 0))$

MOD and channel

References

[1] Thirumangalakudi S, et al. Distribution and functional characterization of human Nav1.3 splice variants. *Eur. J. Neurosci.*, 2003 Jul, 22 (1-6).

[2] Tan S, et al. Heterologous and endogenous Nav1.3 voltage-gated sodium channels differ in inactivation properties and sensitivity to the pyridyl toxin scorpion venom.

- Home to information about ion channels.
- Many channels have one or more associated models (e.g. different species or cell types); all are downloadable as MOD files.
- Shows gating variable and channel response to voltage clamp for each model.

Biomodels (www.ebi.ac.uk/biomodels-main)

The screenshot shows the BioModels Database interface. At the top, there's a navigation bar with 'Services', 'Research', 'Training', and 'About us'. Below that, the 'BioModels Database' logo and a search bar are visible. The main content area displays the model details for 'BIOMD0000000073 - Leloup2003_CircClock_DD'. A red arrow points to the 'Download SBML' button. Other options include 'Other formats (auto-generated)', 'Actions', and 'Send feedback'. The 'Model' tab is selected, showing a table with columns: Overview, Math, Physical entities, Parameters, and Curation. The 'Reference Publication' section lists the publication by Leloup JC, Goldbeter A. (2003) titled 'Toward a detailed computational model for the mammalian circadian clock'. The 'Model' section shows the 'Original Model' as 'BIOMD0000000073.xml' and the 'set #1' as 'bqbio1a/VersionOf Gene Ontology regulation of circadian rhythm'.

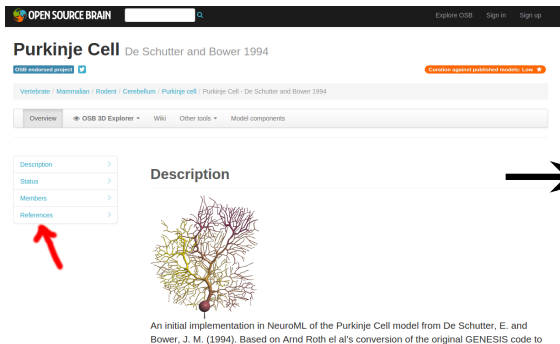
jnml BIOMD0000000073_LEMS.xml -neuron

Biomodels model (SBML) → LEMS model → MOD file

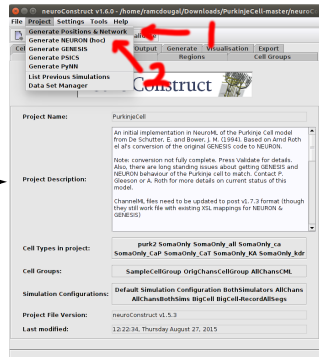
```
jnml -sbml-import BIOMD0000000073.xml 1000 5
```

- Biomodels is a systems biology model repository.
- Models are in SBML but can be converted to MOD files via e.g. jNeuroML (github.com/NeuroML/jNeuroML). Test converted models before using in a larger model. Edits will likely be necessary to get them to interoperate with other mechanisms.
- A native SBML importer for NEURON's rxd module is under development.

Open Source Brain (OpenSourceBrain.org)

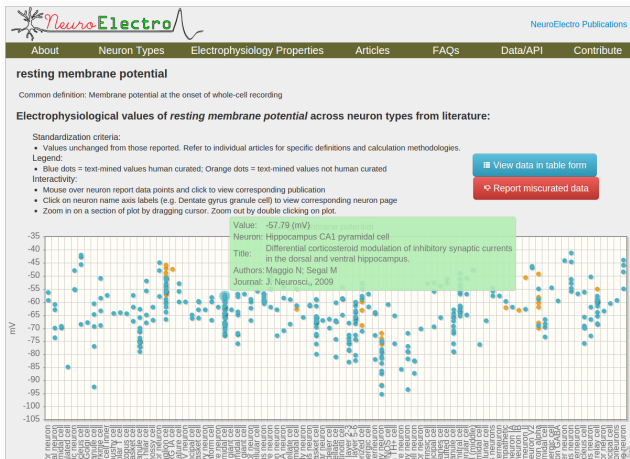


The screenshot shows the Open Source Brain website. At the top, there's a navigation bar with the logo, a search bar, and links for 'Explore OSB', 'Sign in', and 'Sign up'. Below the navigation bar, the main heading is 'Purkinje Cell' by 'De Schutter and Bower 1994'. There's a 'OSB endorsed project' badge and a 'Contribute against published models' link. A breadcrumb trail shows 'Vertebrate / Mammalian / Rodent / Cerebellum / Purkinje cell / Purkinje Cell - De Schutter and Bower 1994'. Below this, there's a 'Description' tab selected, showing a 3D visualization of a Purkinje cell. A red arrow points to the 'References' link in the left sidebar. A large black arrow points from the 'Description' tab to the right-hand screenshot.



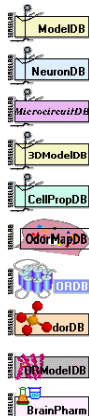
The screenshot shows the neuroConstruct v1.6.0 application interface. The top menu bar includes 'File', 'Project', 'Settings', 'Tools', and 'Help'. The 'Project' menu is open, showing options like 'Generate Positions & Network', 'Generate NEURON (hoc)', 'Generate GENESIS', 'Generate PSICS', 'Generate PyNN', 'List Previous Simulations', and 'Data Set Manager'. A red arrow points to the 'Output' button in the 'Generate' submenu. Another red arrow points to the 'Construct' button. The main window displays project details for 'PurkinjeCell', including a description, project description, cell types, cell groups, simulation configurations, project file version, and last modified date.


- Open Source Brain promotes collaborative model development via github.
- Models are typically in NeuroML or neuroConstruct format; neuroConstruct ([neuroConstruct.org](https://neuroconstruct.org)) converts both formats to NEURON.
- The conversion process places different ion channels in different MOD files, which allows extracting model components.



- NeuroElectro archives experimentally measured electrophysiology values for different cell types; it shows the spread and allows comparing values across different cell types.
- Read the paper associated with a value to understand: species, experimental conditions, etc.

SenseLab (senselab.med.yale.edu)




NeuronDB

[Back](#)

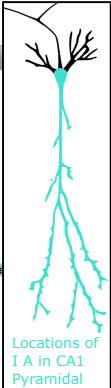
Overview | Data/Search | plus Connectivity | plus Classical References/Notes | Models | BrainPharm

Hippocampus CA1 pyramidal cell

Are: Present Absent

Neuron Type: principal
 Organism: Vertebrates
 ElectroPhysiology: NeuroElectro.org
 Pharmacology: IUPHAR
 Reconstructions: NeuroMorpho.Org
 Genes: [Allen Brain Atlas - Links](#)
 Genes: [Human Brain Transcriptome](#)
 NeuroLex:
 Microcircuit: [Hippocampal Microcircuit](#)
 Connectivity: Live connectivity specified by colored boxes. Dark yellow: distant connectivity. Light yellow: auto connectivity

	Input Receptors	Intrinsic Currents	Output Transmitters
Distal apical dendrite	Hippocampus CA1 oriens alveus interneuron Axon terminal Gaba	Gaba	I _{Na,t}
			I _T low threshold
		AMPA	I _A
		NMDA	I _N
	Perforant pathway entorhinal pyramidal neuron terminals (T)	Glutamate	I _L high threshold
		I _{p,q}	
		I _h	
Middle apical dendrite	Hippocampus CA1 oriens alveus interneuron Axon terminal Gaba	GabaA	I _{Na,t}
	Hippocampus CA1 oriens alveus interneuron Axon terminal Gaba	GabaB	I _T low threshold
	Hippocampus CA3 pyramidal cell Axon terminal Glutamate	NMDA	I _{Potassium}



Locations of I_A in CA1 Pyramidal

User Public

- SenseLab is a suite of 10 interconnected databases (listed at left).
- ModelDB and NeuronDB (at right) are the most useful for modeling.
- NeuronDB shows what channels are present and the inputs and outputs *by cell region* (e.g. distal apical dendrite vs proximal apical dendrite).

Twitter

Many groups announce new developments on Twitter, including:

- SenseLab (including ModelDB): [@SenseLabProject](#)
- Open Source Brain: [@OSBTeam](#)
- NeuroMorpho.Org: [@NeuroMorphoOrg](#)
- ICGenealogy Project: [@ICGenealogy](#)
- Int. Neuroinformatics Coordinating Facility (INCF): [@INCForg](#)