

Using NEURON to Model Cells and Networks

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Ted Carnevale
Robert McDougal

Supported by NIH and European Human Brain Project

NEURON: a tool for empirically-based modeling of neurons and neural circuits

Active development

Open source project directed by Michael Hines

<https://github.com/neuronsimulator/nrn>

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User support

Downloads, documentation, tutorials, and Forum

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

Individual support via Forum, email

Courses: meetings (SFN, OCNS, other),
summer course, workshops, webinars

The NEURON user community

Used by experimentalists, theoreticians, and educators for neuroscience research and teaching

As of mid 2022

- > 2600 publications
- > 2100 subscribers to Forum and mailing list
- source code for >750 published models at ModelDB
<https://modeldb.yale.edu/>

Building and Using Models with NEURON

Specifying biological properties via
programming: hoc and/or Python

GUI tools:

Import3d for morphometric data

NeuroLucida, SWC, Eutectic

Channel Builder, CellBuilder,

Network Builder, Linear Circuit Builder

Analyzing models

Model View tool

import/export NeuroML

Impedance class and GUI tool

Pythonic introspection

including NMODL-specified mechanisms

Building and Using Models *continued*

Instrumentation

- stimulators, current or voltage clamps,
other signal sources
- recording and plotting variables

Simulation control

- default and custom initializations
- integration methods
 - fixed time step
 - adaptive integration
- event system useful for implementing
"experimental protocols"

User interface

Building and Using Models *continued*

NMODL for adding new functionality

- ion channels, synaptic mechanisms

- chemical signaling: accumulation, transport,
reactions and reaction-diffusion

- algebraic equations

- signal sources (e.g. waveform generators)

- events, state machines, artificial spiking cells

RxD for reactions, accumulation, diffusion, transport

Parallel simulation

- multithreaded execution

- embarrassingly parallel problems

- distributed models

Optimization tools

Where to learn more

The NEURON Book

nrn.readthedocs.io

- Documentation

 - hints and tutorials

 - FAQ list

 - key papers about NEURON

- Programmer's Reference

neuron.yale.edu/phpBB

- The NEURON Forum: > 18000 posts

 - in > 4000 discussion threads

- Getting started

- Hot tips

- Announcements (new releases, courses)

Where to learn yet more

Slides from our June 2022 one-day course

<https://github.com/mcdougallab/neuron-course-june-2022>

Link to videos TBA

ModelDB

<https://modeldb.science>

A database of published computational neuroscience models. Currently contains ~1750 models, of which ~790 used NEURON.