Quick Guide for Using NeMo-TMS

Compile mod files

Compile the **.mod** files inside the following folders:

'Model_Generation\Eyal Jarsky_files\lib_mech'
'Model_Generation\Eyal_files\lib_mech'

Note that you only need to do this once on each computer. Skip this step if you have already compiled the mod files. For more information on mod files and how to use them, see: https://www.neuron.yale.edu/phpBB/viewtopic.php?t=3263

Model generation

Generate the model by following the instructions for each model type:

Jarsky CA1 pyramidal cell: place the desired morphology file (**.swc**) inside **'Model_Generation\morphos'** folder or use one of the example morphology files provided in that folder (**cell_#.swc**). Then, change your MATLAB directory to **'Model_Generation'** folder and run **Jarsky_model('??.swc');** in MATLAB, where **??** is the name of the desired morphology file, and follow the prompts.

Eyal cortical pyramidal cell: change your MATLAB directory to **'Model_Generation'** folder and run **Eyal_model_060303();** in MATLAB with no arguments. The generated model is placed inside **'Models\model_name'** folder.

All the next steps are model-specific and therefore operate within this folder.

Electric field type

If you are interested in using a spatially uniform electric field, skip to 'TMS waveform generation'.

If you are interested in using a spatially realistic electric field, Simulate the spatial distribution of the electric fields in SimNIBS. Refer to the following resources for more details:

Online SimNIBS tutorial: https://simnibs.github.io/simnibs/build/html/tutorial/tutorial.html
Translational FEM models: https://zenodo.org/record/4009465

Export neuron segment location

Export the neuron segment coordinates by running **'Code\NEURON\save_locations.hoc'** in NEURON environment.

Tip: run NEURON scripts by double-clicking on the file on Windows or running the command **nrniv file_name.hoc** in the terminal on macOS and Linux.

Realistic electric field coupling

Change your MATLAB directory to **'Code\E-Field_Coupling'**, run **couple_gui();** in MATLAB, and follow the prompts.

TMS waveform generation

Change your MATLAB directory to **'Code\TMS_Waveform'**, run **TMS_Waveform();** in MATLAB, and follow the prompts.

NEURON simulation

Select NEURON simulation parameters by running **'Code\NEURON\GUI_params.hoc'** in NEURON environment and following the prompts. Then, start the simulation by running **'Code\NEURON\TMS_script.hoc'** in NEURON environment. The window will automatically close upon successful completion of the simulation.

Tip: run NEURON scripts by double-clicking on the file on Windows or running the command **nrniv file_name.hoc** in the terminal on macOS and Linux.

Calcium simulation

Change your MATLAB directory to **'Code\Calcium'**, run **run('calcium_simulation_setup.mlapp');** in MATLAB, enter the location of UG4 software and the parameters for calcium simulation. Then click on the **Convert NEURON files** button to convert the files to a format compatible with UG4. Afterward, click on the **Generate script**, **Save script**, and **Run script** buttons respectively and wait for the simulation to finish.

Visualization

Change your MATLAB directory to **'Code\Visualization'**, execute **run('visualization.mlapp');** in MATLAB. Click on File and select **Open Voltage Data** and **Open Calcium Data** to visualize the 3D voltage and calcium results across time respectively.

Full tutorial

For more information refer to the full PDF tutorial.