Simulating dendrite,

Different innervate. Somatic conmertment, also simulating other compartment. Dendritic compartment cannot spike

LIF has compartment that can spike, depolarize, repolarize. Current injection and synapse. (has function)

When add compartments in a cable, also get two additional currents with each compartment

Each compartment can spike(but decide it cannot), it can also have a synapse or not. There’s only 1 synapse and can be located on compartment 1,2,3,4… . in addition it has 2 currents one to each side.

For each compartment, has synapse, out and in.

In HH, the spikes aren’t mickey mouse. Soma would happen in dendrites. The way they’re hooked is a current going left and current going right.

Impedience Mismatch, soma is big, when soma spikes, lots of current going into the soma. That current will pass into the dendrite dendrite. Its small relative to soma, so soma is very efficieincy in depolarizing the dendrite. But conversely, depolarize a dendrite, when it reaches soma it’ll be inefficient. Easy for soma to produce a spike and back propagage into soma, but hard for dendrite to produce something that propagages into the soma.

Have to depolarize the dendrite more than the spiking threshold

Soma spikes. Dendrite does have sodium channel but way less than soma so cannot spike on its own. So the dendrite can sustain semi-active back propagation but cannot do on its own. Not an entirely passively device. It does have voltage dependent that depolarize. Fast sodium and voltage gated calcium channels channel. bAp. The more it collapses.

BaP, L5, spikes perfectly into soma and back propagates into dendrite.

Purkinke cells: cannot bAp, spikes in soma all the time but bAp into dendrite, won’t see the spike, its gone.

Dendrite is electronically tonically isolated from the soma. Distance is very long.

If plotted dendritic arbour is distance is 100m long, too far

Substantial niatra and mitral cells, the dendrites are basically axons, once it spikes in soma it’ll spike perfectly. It bAp perfectly. Will spike the dendrites.

* Won’t bounce due to refractory period.

Change amount of sodium channel in stick dendrite.

* 0 sodium or more, stil have leakiness
* Most reliable, most sodium channel
* Unreliable, lest sodium channel

If take HH and stick it in the soma and in the dendrite you reduce the sodium conductance by 10x, get L5 pyramidal, back propagate into the dendrite but also forward propagate.

If start with making HH, add a stick dendrite exactly the same cylinder. Its just the area.

Make identical, then automatically go SB neuron, subsequent to that, make it possible to reduce the amount of sodium conductance in the dendrite compartments. Soma can still spike, because it’ll be a large compartment. When make something spike, any dendrite will drag it down. Dendrite cant spike, soma will have to spike despite the fact that the dendrite cannot. Because of mismatch, wont be a problem.

Soma can still spike, produce current that goes back to segment, that it’ll help dendrite 1 spike but spike poorly.

Make the percentage factor that tune the sodium channel and apply to all other compartment. Set sodium to 50%, 100%... If set to 0, get purkinje cell. If set to more get C1 pyramidal cell.

Then can depolarize the 10th compartment and have it travel into the soma

If current injection is done in the middle in both sides. Will show lambda and how passive propagation would work.

Active propagation could work too. Simulate an axon if make soidum the same.

Now we have the active and passive propagation, would be nice to put a synapse, then have to implement the synapse, have to get the shape right.

Add stick dendrite, do the exactly the same with stick dendrite. gc compartment conductance. All the conductance, sodium, potassium, calcium.

G\_conductance=800 it’s a setting, has to do with the axial resistance of the cable. How conductive the medium is within the dendritic cable.

Paper used 800 in the model. Model had 20,000ns.

HH has the squid giant axon, which has a different internal conductance compared to layer 5 pyramidal cells.

* See the conductance for L5 pyramidal cell.

Each compartment has conductance across the membrane. The synaptic conductance of sodium and potassium. In addition, can go inside the cell, not just across and that’s where gc matters. It’s a setting, because its has to do wit resistive with cell medium.

Started with setting set to 800 and then make it behave property and made it 20,000.

Squid giant axon doesn’t have axon, get value that’s reasonable

Set is as a tracker, make it spike in a reasonable manner. Just play around. If too low won’t be able to propagate, cannot go through too high.

Gc of the soma, squid giant axon lives in sodium. Everything will be a bit different much more conductive.

Multicompartmental model, its approximation, when you do the Euler, its slightly wrong, it can show its an approximation and doesn’t do a very good job. If want to simulate a spike propagation in squid giant axon properly, have to do a finite difference method, have

Right now, for each time slot, have whole axon/soma and for each compartment, you have a time step, time step, goes forward in time for each compartment. To do it properly, have to reiterate for each time step to converge. It’ll do a poor job of it in space.

Will give wrong shape in space, so if care about shape of spike in space have to do a mitrix method. Space and time at the same time, and simulate with bounder constraints and repeat until it converges.

Code on line where they simulate cable theory HH axon or dendrite. MATLAB code would be the easiest. MATLAB code use build in equation holder and don’t get the code. If find somewhere where explicitly execute forward Euler code. Have to combine with HH code which is also solved with Euler.

Just adds current right current. Current left and current right.

694 for dendrite

Current right is 0 if it’s the last segment,

712 currLeft vLeft somatic voltage or comparmtment on the left.

G coupling and dendrite.