Layer 5 pyramidal cell

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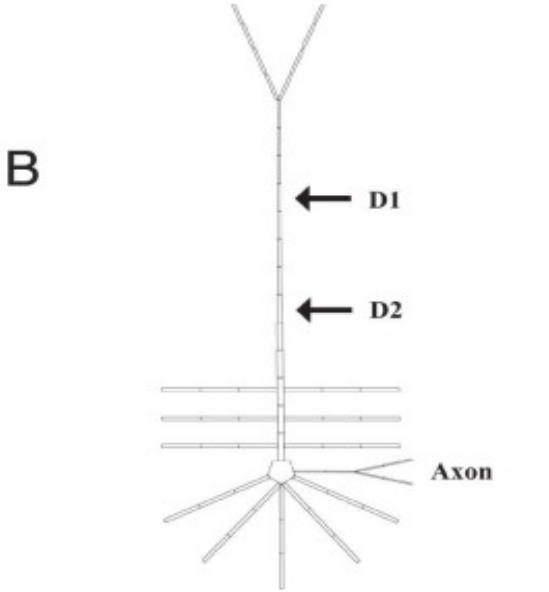
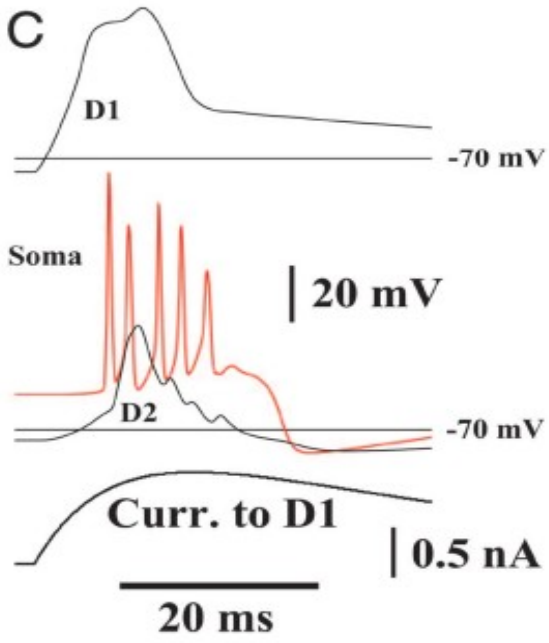
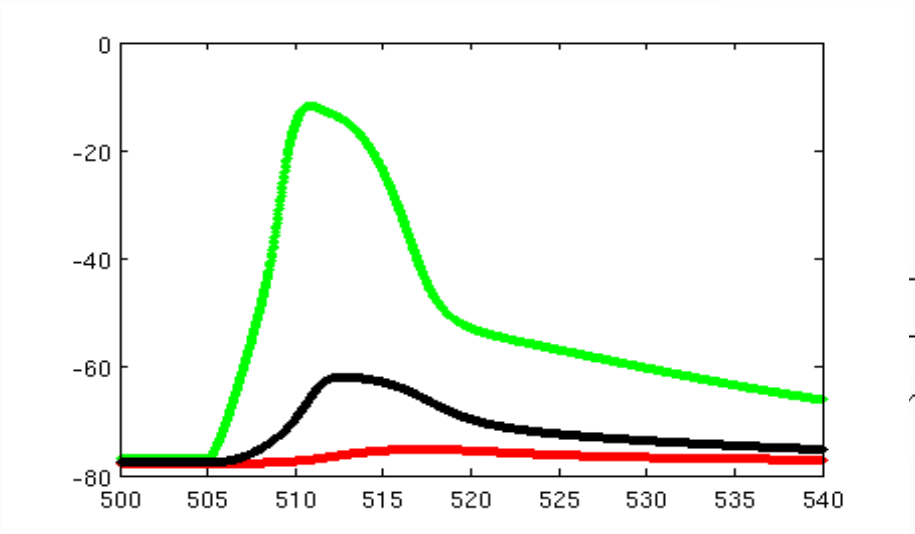
7th November, 2013. London.

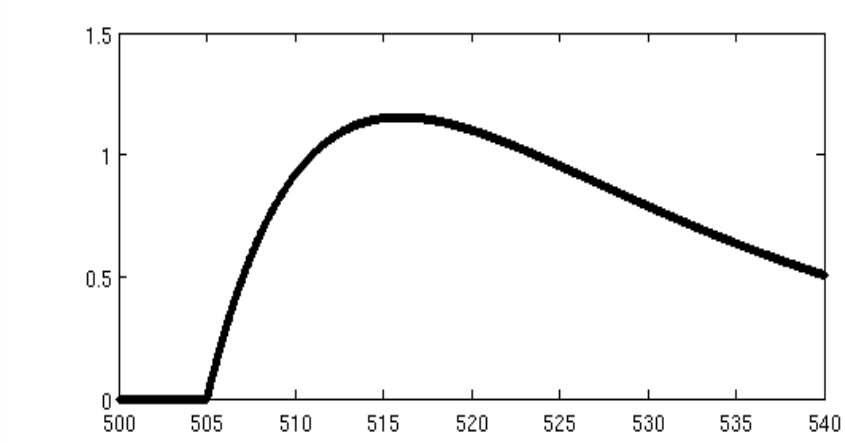
Tufted pyramidal cell
article vs. Neuron implementation





Neuron

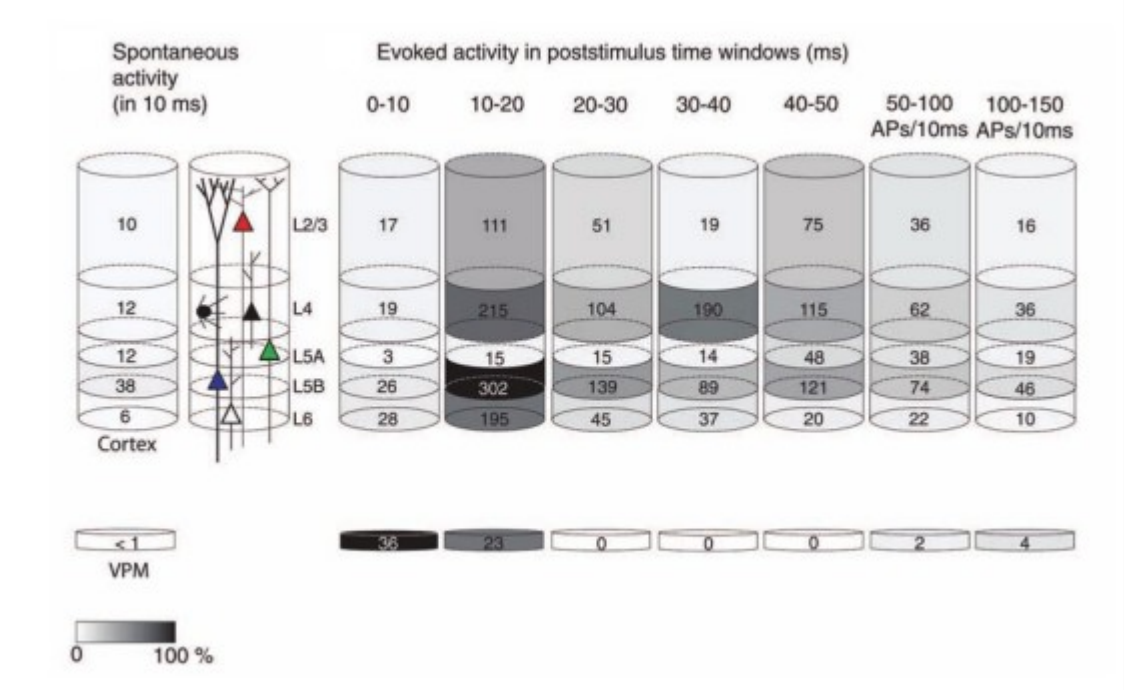




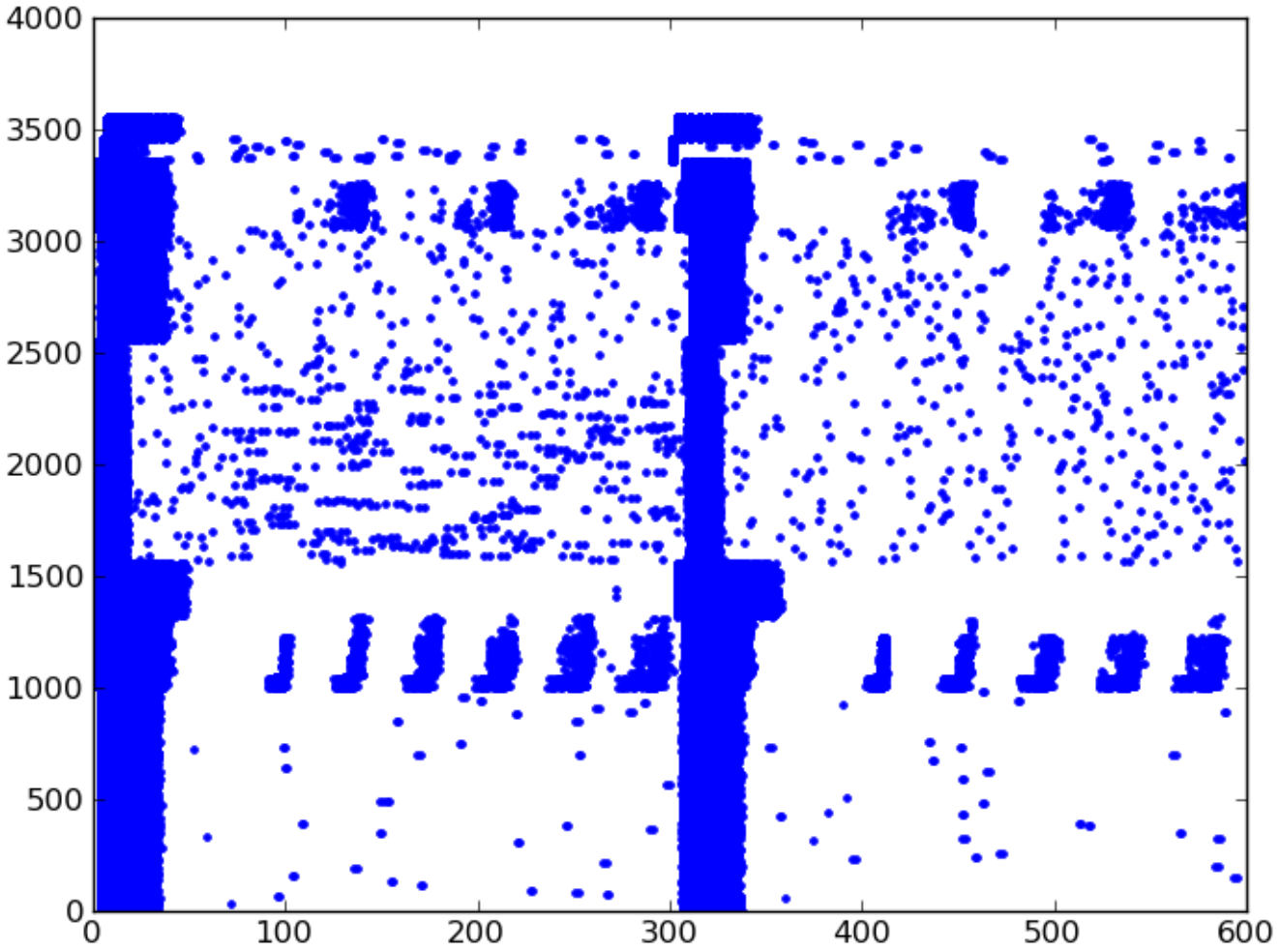
Adapt the model to thalamo-cortical loop in the rat somatosensory system (Sakmann et al. and others)

- Behavior (e.g M. Oberländer thesis)

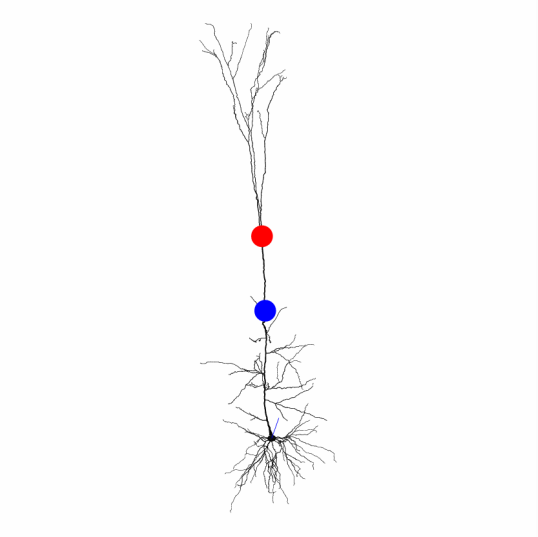
Marcel Oberländer

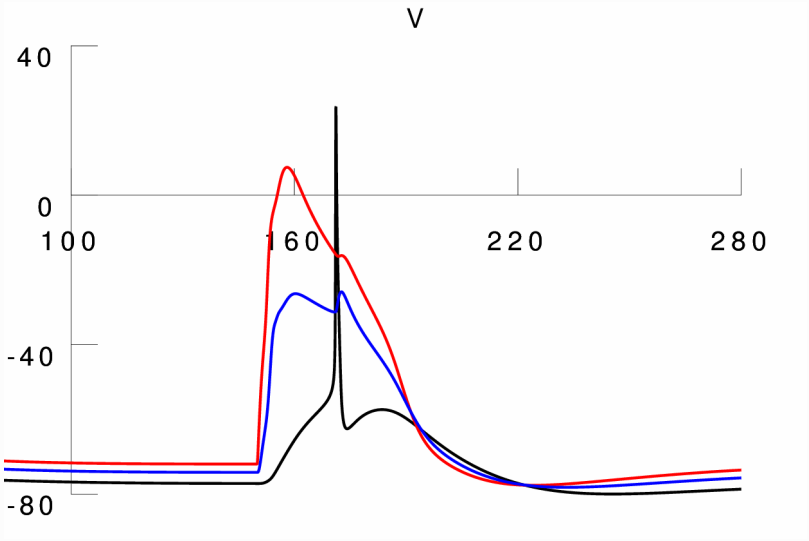


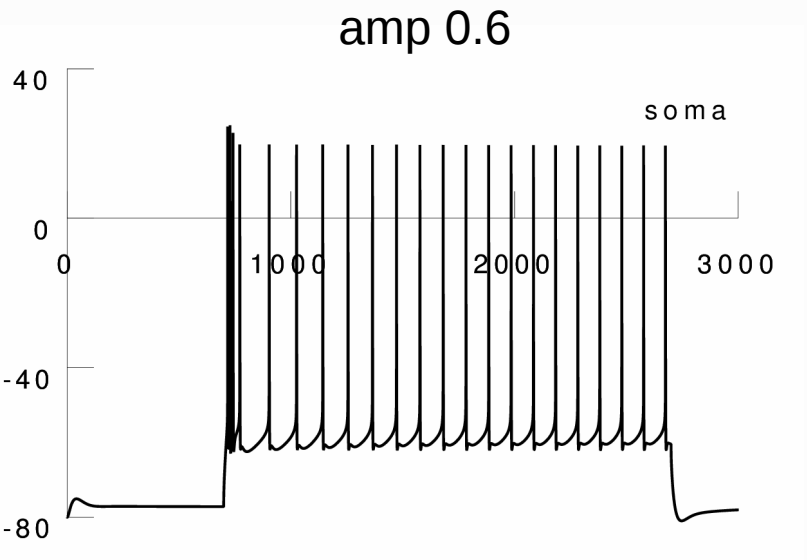
Thalamic input, Neuron, GABA * 0.06, awake = 0.5



Hay model



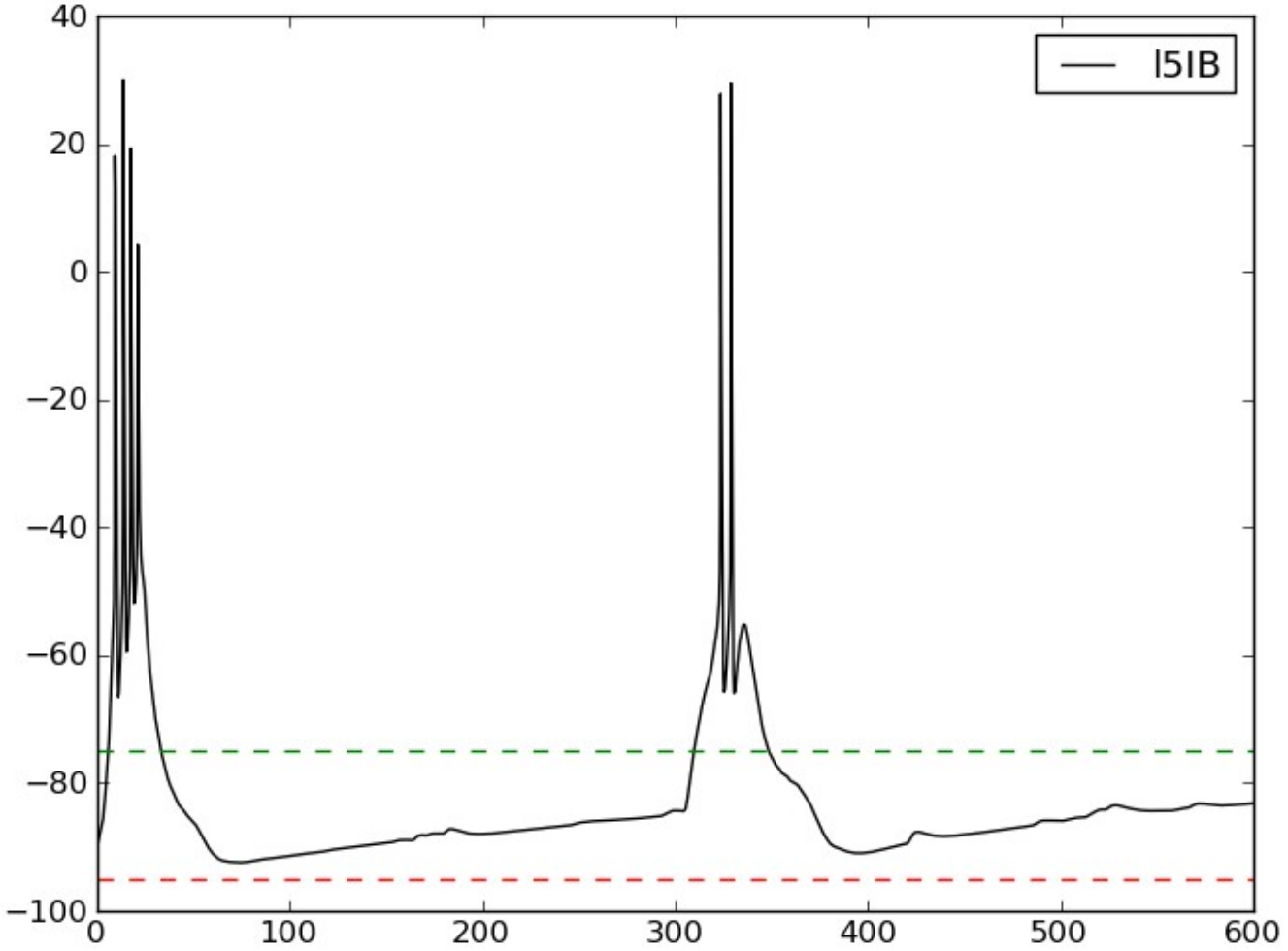




Replacing Traub tuftIB by Hay cell

- In original Neuron version every section should be named as comp[i] (it is required in definition of synaptic connections)
- https://github.com/hglabska/Thalamocortical/tree/Neuron_
- Commited on 04 Jul

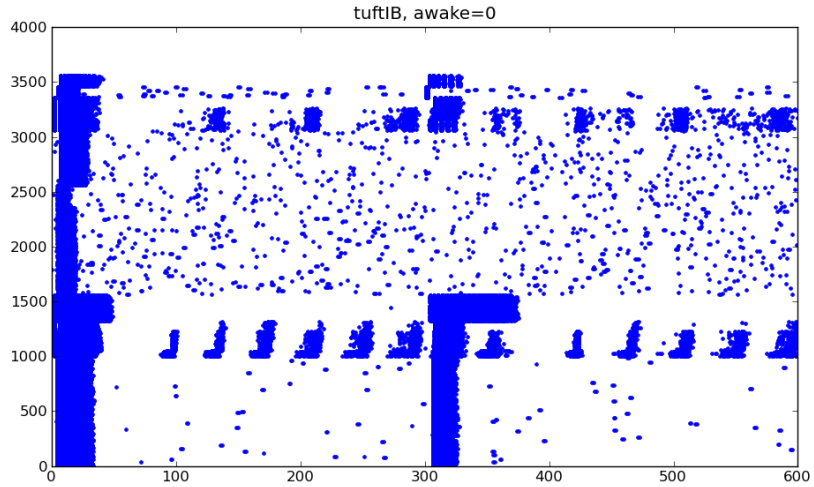
- Problems:
- What value should have e_gaba?
- Difficulties to get ectopic spikes

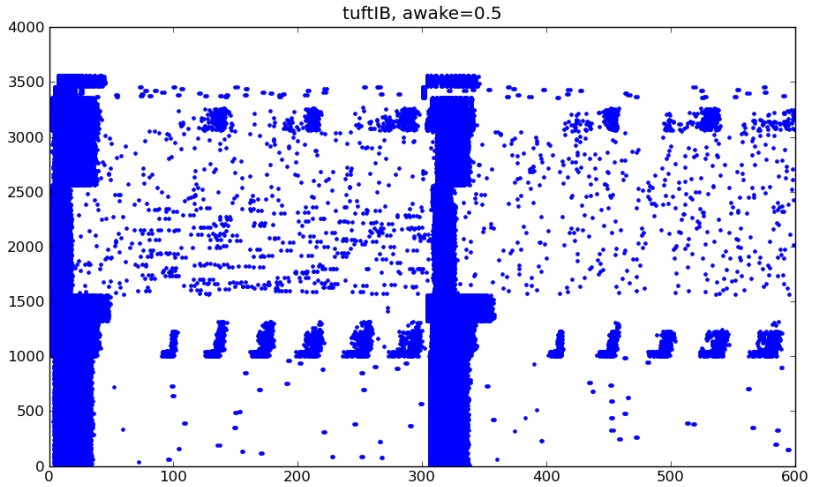

l5IB
40
20
0
−20
−40
−60
−80
−100
0
100
200
300
400
500
600

awake = 0

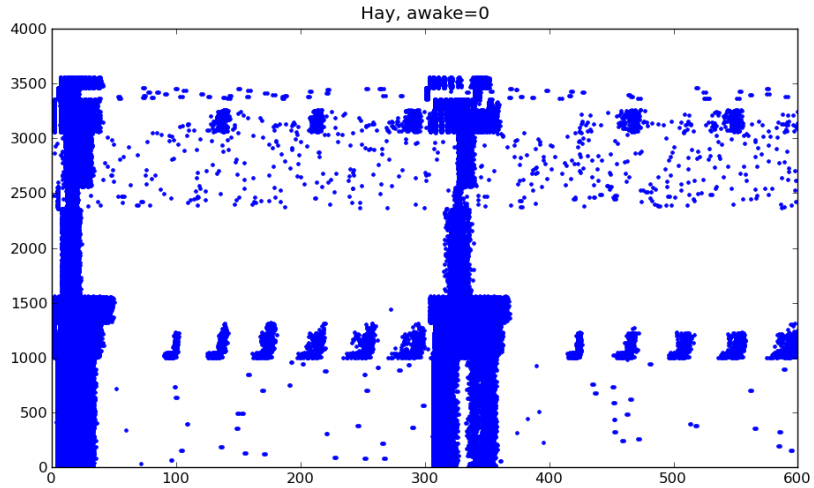
awake = 0.5

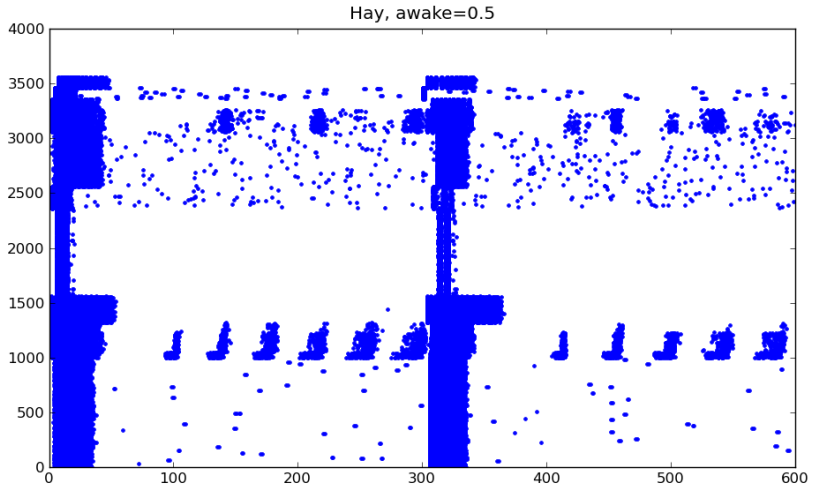
tuftIB





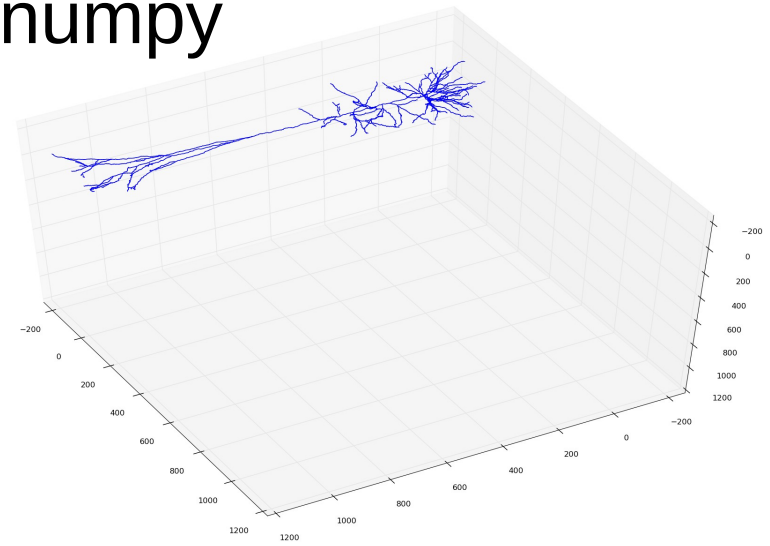
Hay





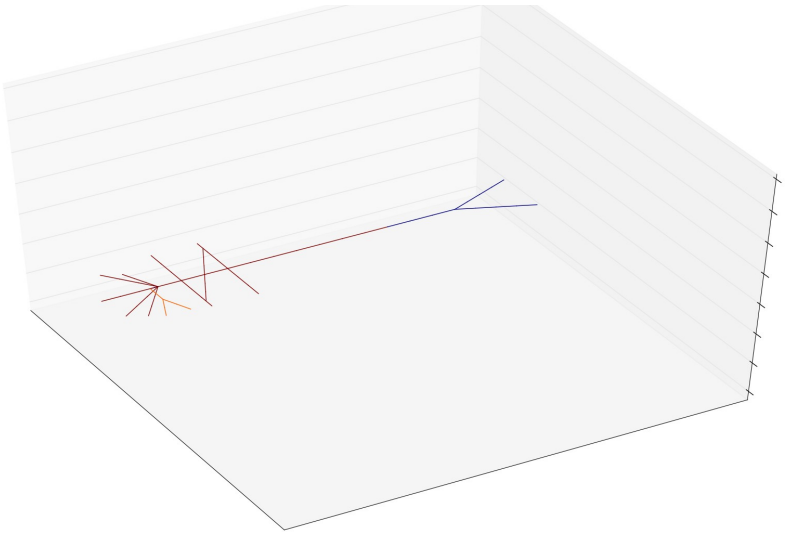
Testing models
(Traub tuft IB and Hays Pyr cell*)

Requirements: PyNeuron , matplotlib, numpy



Morphology
Surface area
Cell length

Passive membrane properties
Channel densities
Currents (Na-K-Ca)



Scripts (github.com/ccluri/L5Pyr)

* idea is to extend to other models

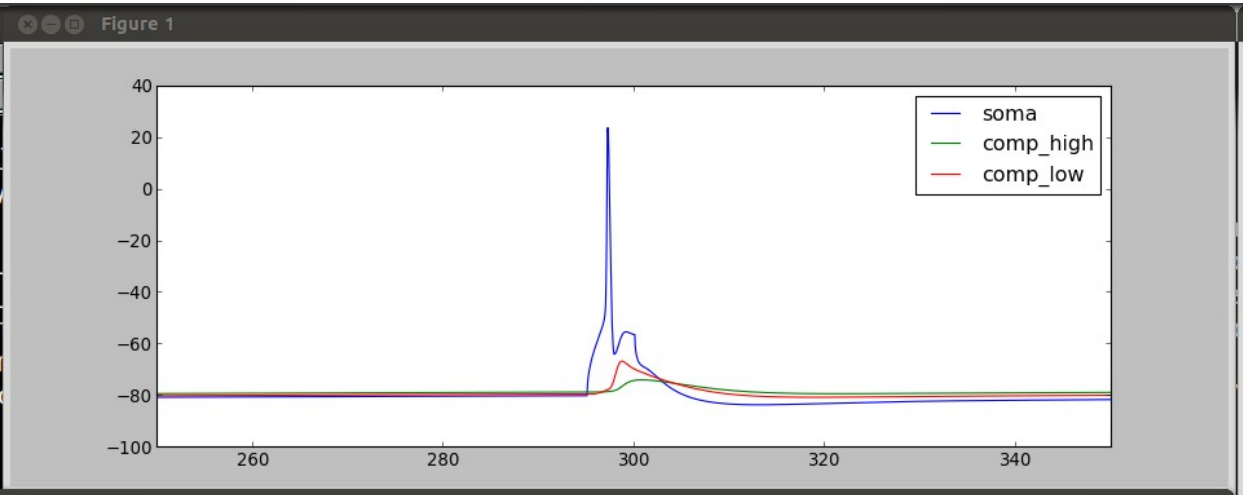


Figure 1
soma
comp_high
comp_low

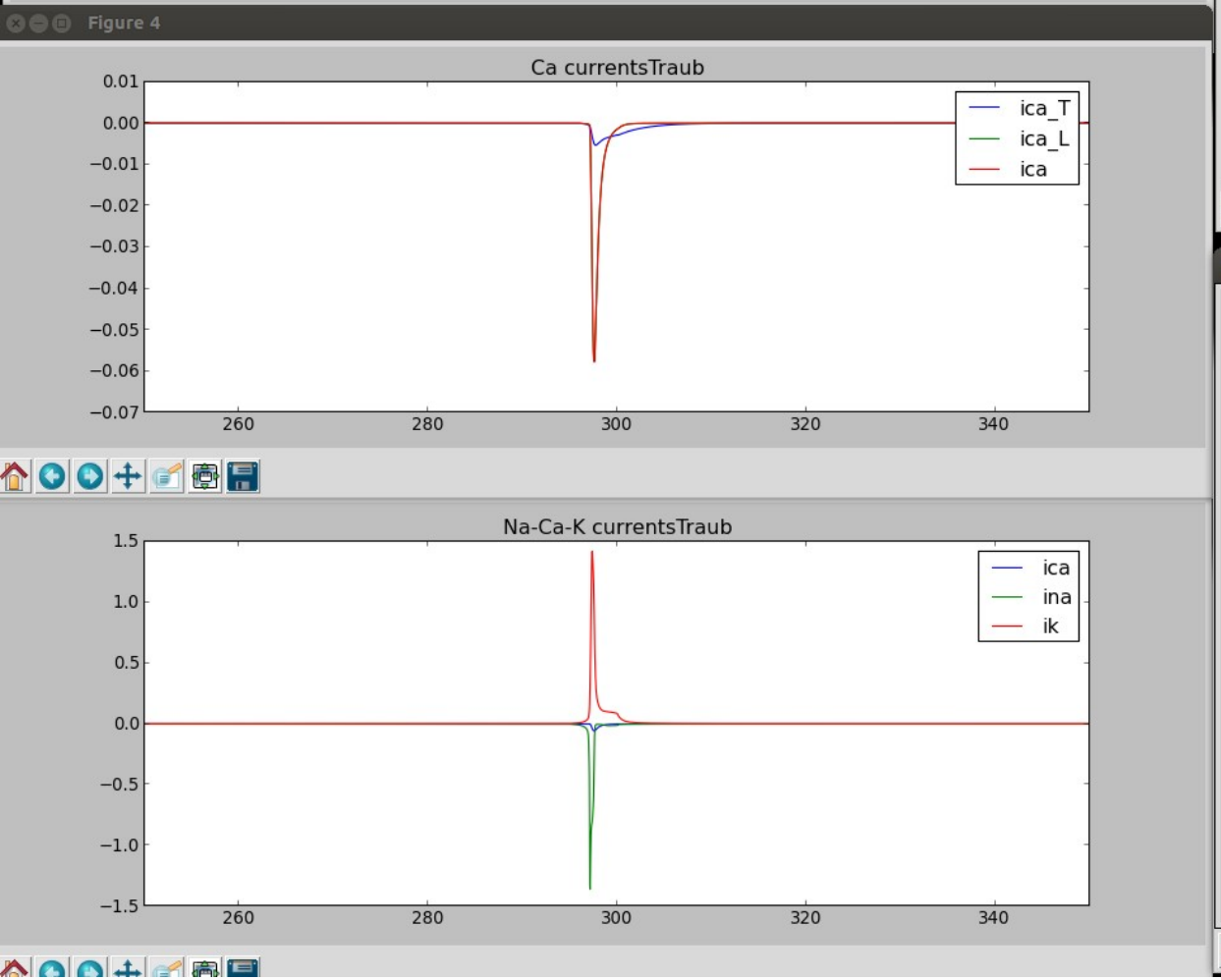


Figure 4
Ca currentsTraub
ica_T
ica_L
ica
Na-Ca-K currentsTraub
ica
ina
ik

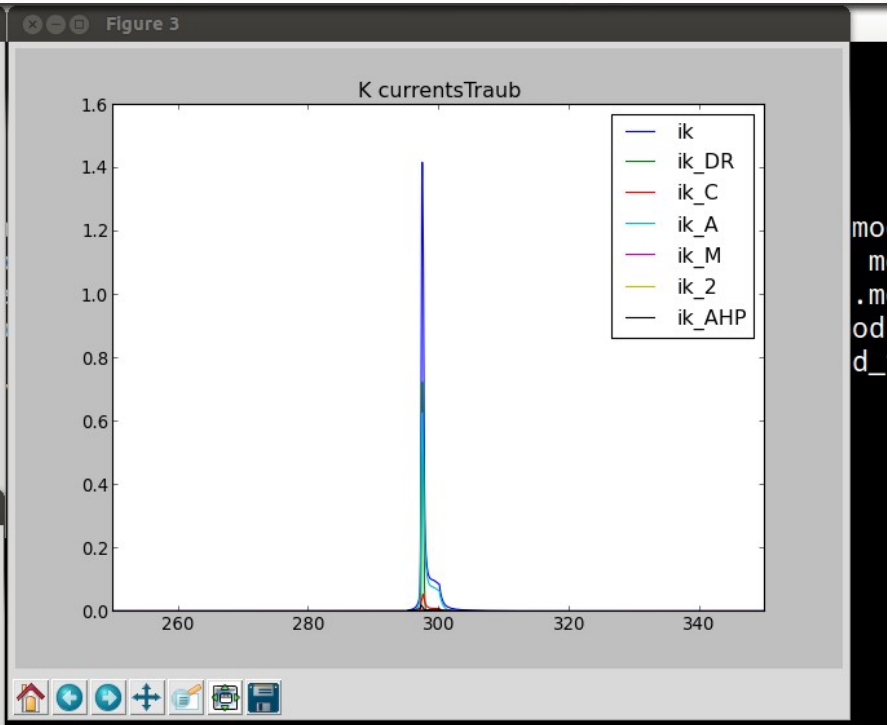


Figure 3
K currentsTraub
ik
ik_DR
ik_C
ik_A
ik_M
ik_2
ik_AHP

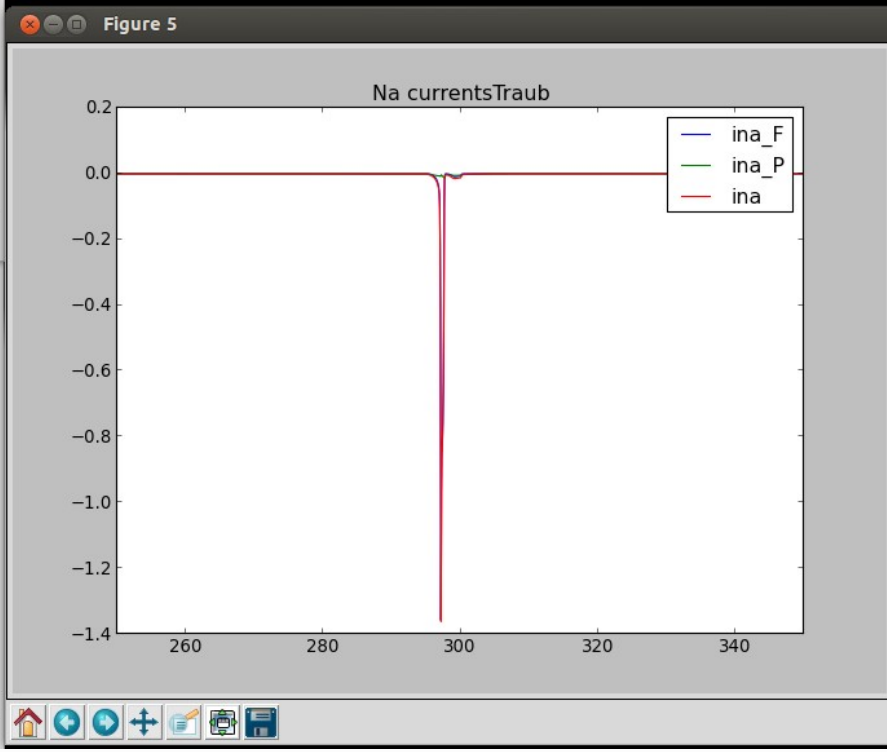
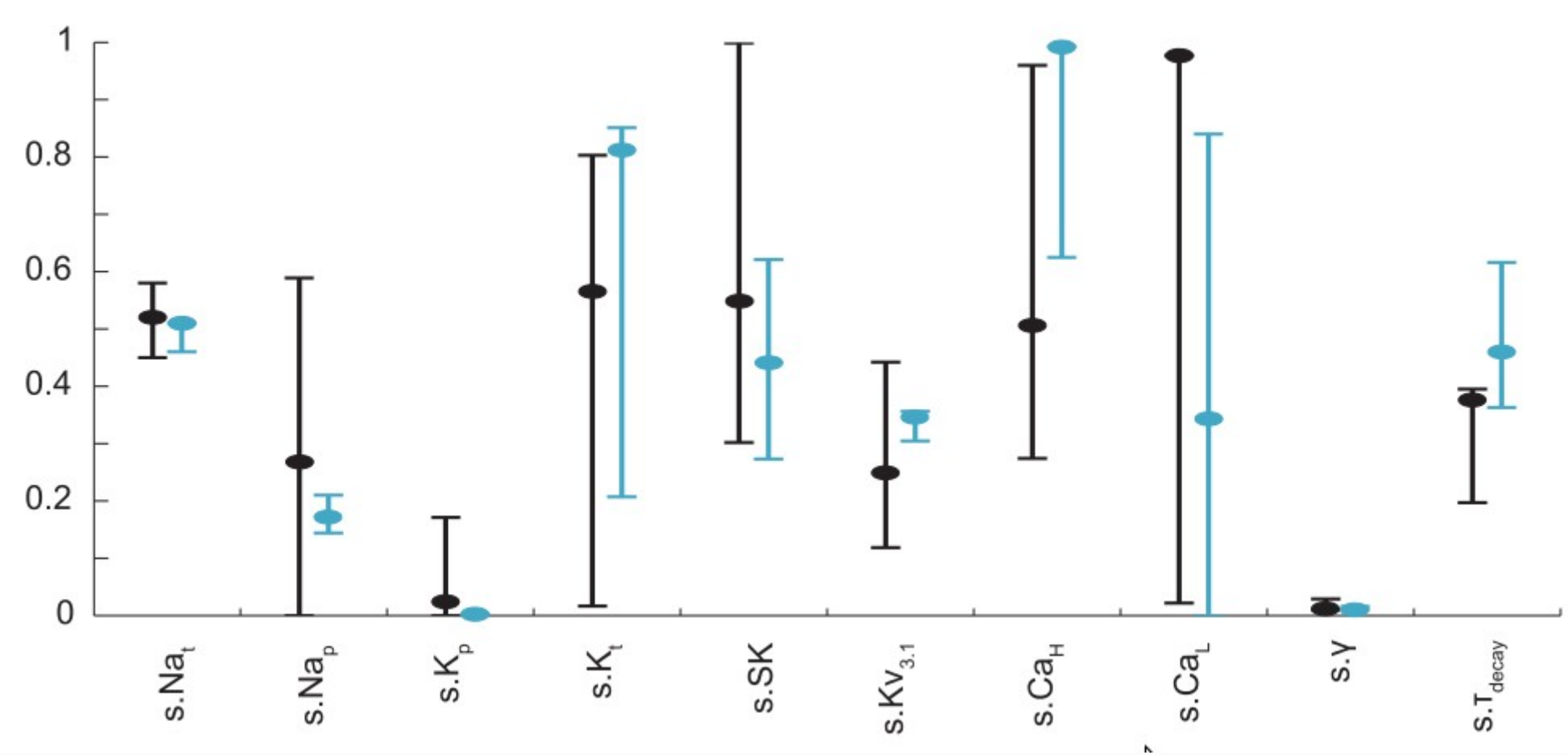


Figure 5
Na currentsTraub
ina_F
ina_P
ina

Frequently used models

	Rm KOhm-cm^2	Cm uF/cm^2	Surface Area um^2
Mainen (1996)	30	0.75 - 0.04	52996
Traub (2005)	50	0.9	4132
Kole (2008)	15	0.9 - 0.02	
Larkum (2009)	20	1.0	44500
Hay (2011)	34-5(?)	1.0-2.0	17340

Hays Model



Distribution of the normalized parameter values in models targeted at only the perisomatic step current firing (black, n = 52), and in models that also fit the BAC firing target (blue, n = 4). The black and blue circles refer to the parameter values of specific models shown in Figure 2 and this figure, respectively. Ranges of some parameters in both cases overlapped, whereas the range of the Ca^{2+} τ_{decay} was markedly different in the two optimizations. Real values for the different ion conductances can be derived by referring to the upper limits given in Table 2.
doi:10.1371/journal.pcbi.1002107.g004

Some insights

Incomplete descriptions

Inconsistencies between published paper and model

Variability across models of the same cell

Naming conventions

Channel distribution over cells – generic rules?

Towards plug and play neuron models

1) Consistent naming convention for compartments / cells.

2) Channel naming conventions. (Channelpedia?)

3) Meta data. (Temperature, animal, preparation etc)

4) Automated tests and benchmarks that include variability.

5) Consensus on good model of a L5BPy neuron

Cheers!