Experiences with Traub model in MOOSE

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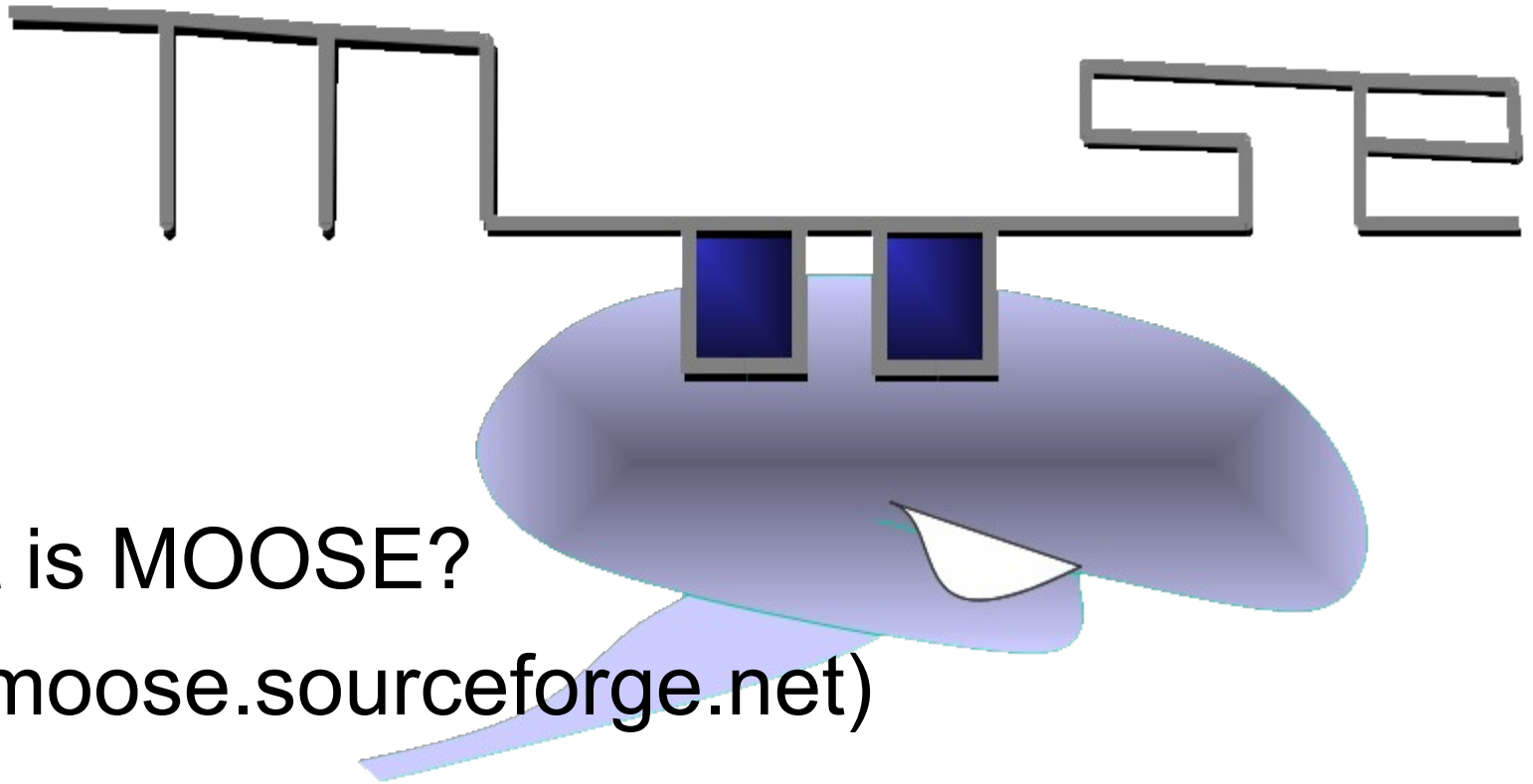
Introduction

- First a story …



- What is MOOSE?

(http://moose.sourceforge.net)

Why Traub model?

- Highly detailed single cell models put together

- Possibly the most biologically realistic model of a cortical column at the time

Porting Traub 2005 model to moose

FORTRAN version

- Almost impossible to read
- Too many dialect specific material
- Did not compile in the first place

Porting Traub 2005 model to moose

NEURON version

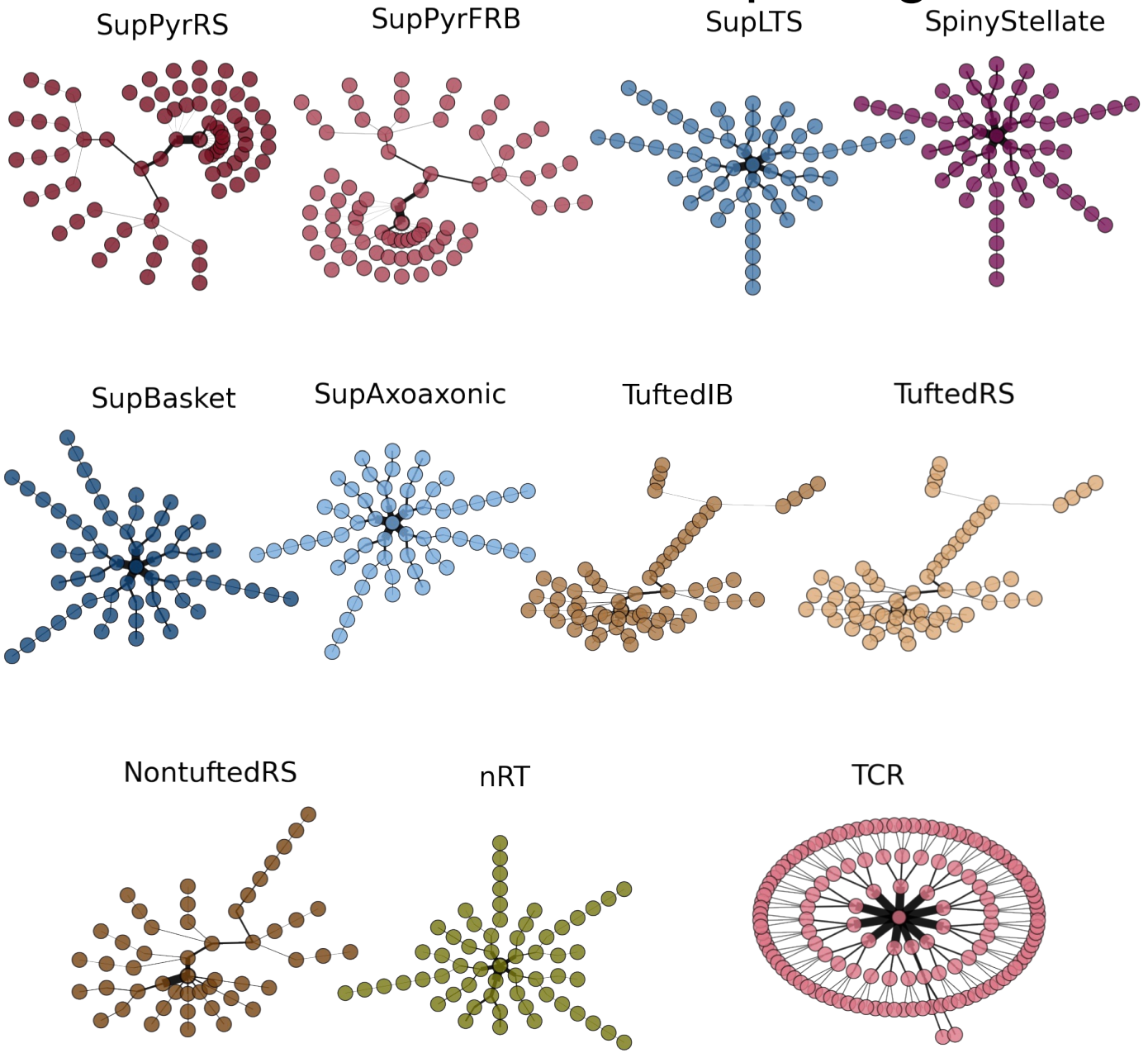
+ Closer to biological description and convention in GENESIS/MOOSE

+ Less code

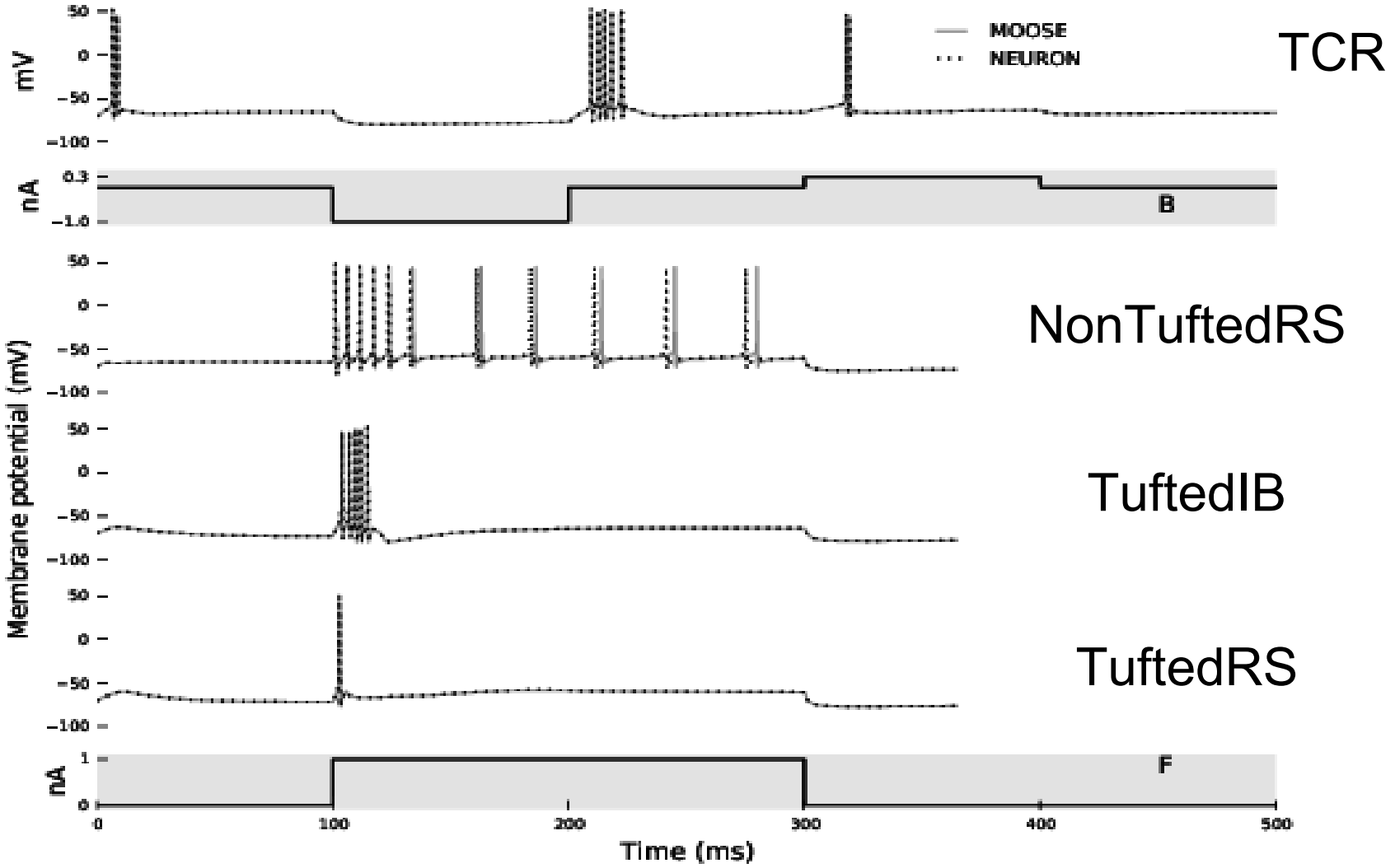
+ More organized, numerics separated from model structure

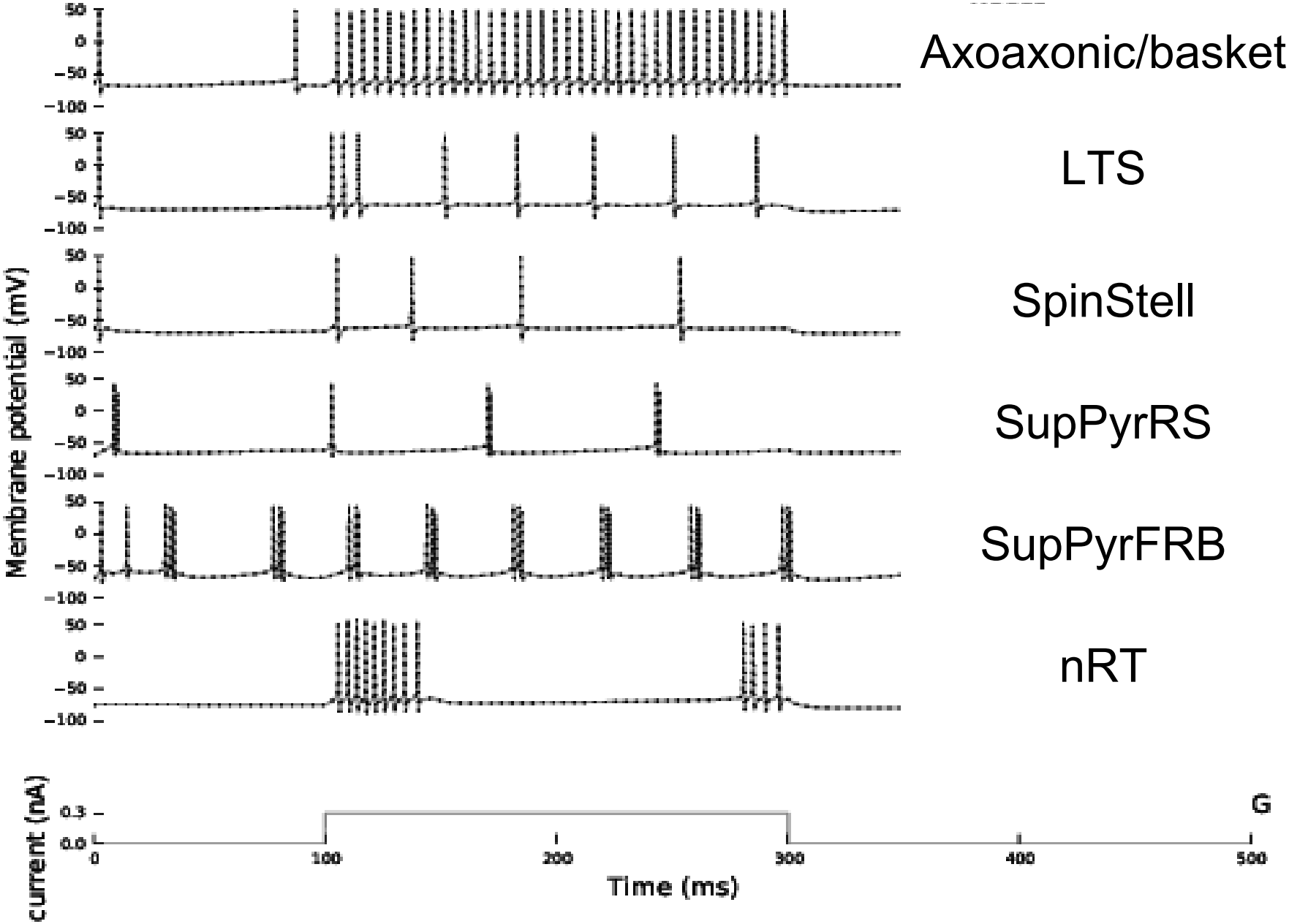
Easier to read.

Some of the cell morphologies



Comparison of single cell model behaviour




Axoaxonic/basket
LTS
SpinStell
SupPyrRS
SupPyrFRB
nRT
Membrane potential (mV)
50
0
−50
−100
current (nA)
0.3
0.0
0
100
200
300
400
500
Time (ms)
G

All single cell models are available with moose

http://moose.sourceforge.net

moose/Demos/traub_2005

Issues faced

- Non smooth functions for Ca2+ dependence, Mg2+ dependence – biological functions are usually smooth!

Issues faced

Units!

- The biggest source of problem (the world does not seem to have agreed upon SI units)!

- Ca2+ dynamics with arbitrary units

Issues faced

Initialization of parameters

- What is m_inf, tau_m etc ? Is this reasonable?

Initial conditions ...

- Huge spike at the start – does it affect in the long run?

Does this model make sense for longer simulations?

Different behaviour showing up in longer simulations

Plasticity will matter

Some of the lessons from the conversion process

- Incremental development

  ... but this can be difficult if the model is not modular.

  ... start with passive model

  ... test single channel on single compartment

  ... put mutiple channels together (debugging can still be a combinatorial problem) in single compartment

  ... test whole cells

- Minor differences in behaviour can come from major errors and vice versa

Some of the lessons from the conversion process

Manual conversion good for getting a hang of the model – but ultimately programmatic conversion is a must.

Looking at the model in multiple ways can find bugs.

** Discussing it with somebody else helps!

Can we be sure of our code?

Network behaviour can be highly variable depending on the exact connectivity.

- Comparison of exact connectivity important.

- Getting exact sequence of random numbers between simulators may be impossible.

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Thank you

Questions?