

U01 Project Presentation: MSM of primary motor cortex (M1)

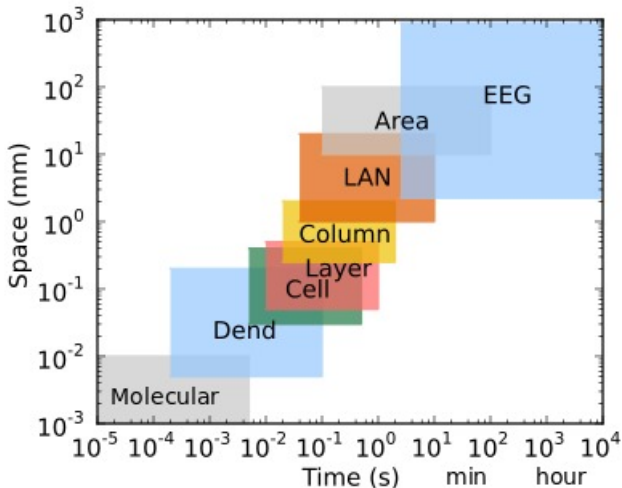
Bill Lytton
Gordon Shepherd

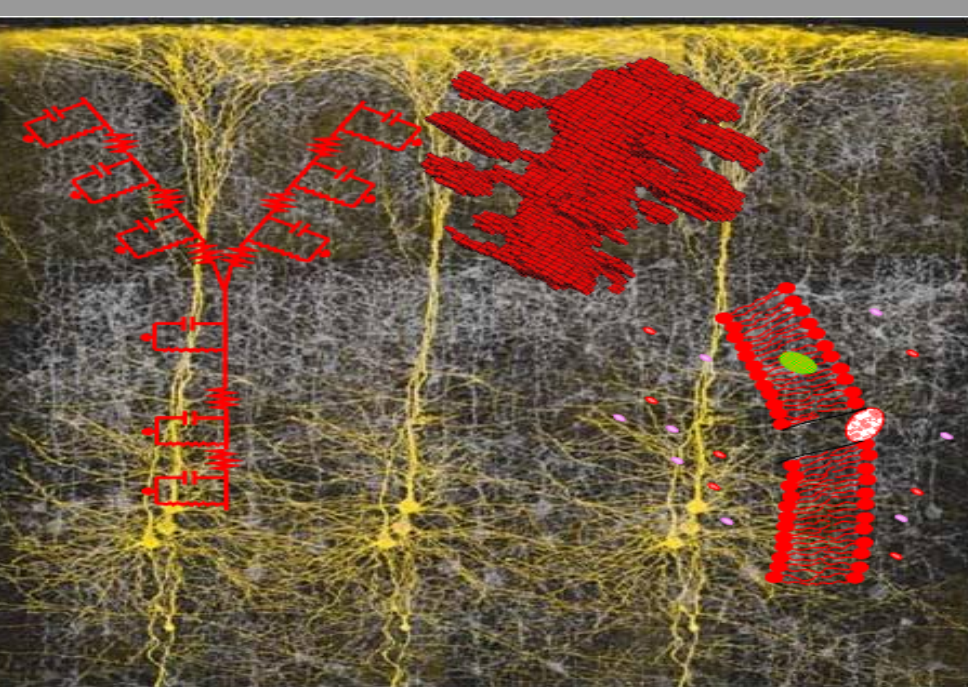
SUNY Downstate, Kings County Hospital, Northwestern University

Mar 2, 2015 15:00

Multiscale modeling

Scales of investigation





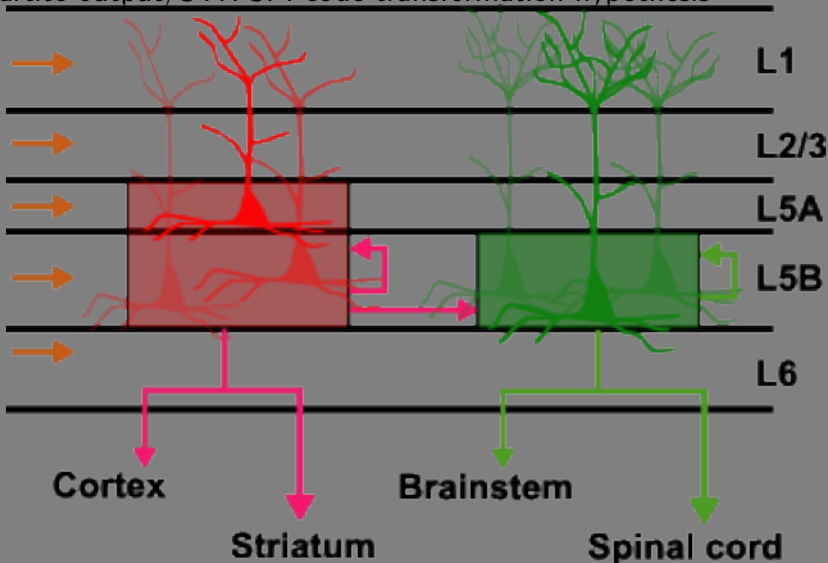
- Neurotechnology
 - dynamical fitting (cell and net, CNR)
 - large networks (HPC technology, Yale)
 - Databasing and data-mining (Yale, UCL)
 - Future: down to RxD; up to multi-area
- Neural dynamics and coding
 - Signal transforms (sensorimotor transforms)
 - “Packets” via $\delta\theta\alpha\beta\gamma$
 - Multiplicity of codes
- Neurobiology of disease and treatment
 - Autism
 - BMI
 - Schizophrenia

Moving away from Frankenstein networks

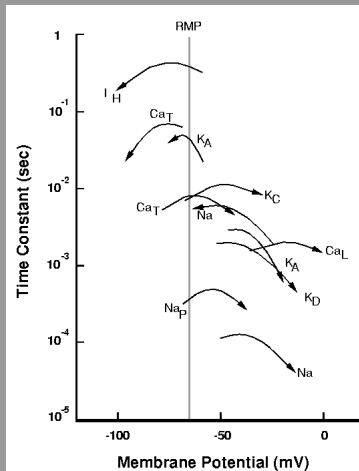
- 1 species
- 1 age range
- 1 lab
- 1 set of techniques

Interactions between levels

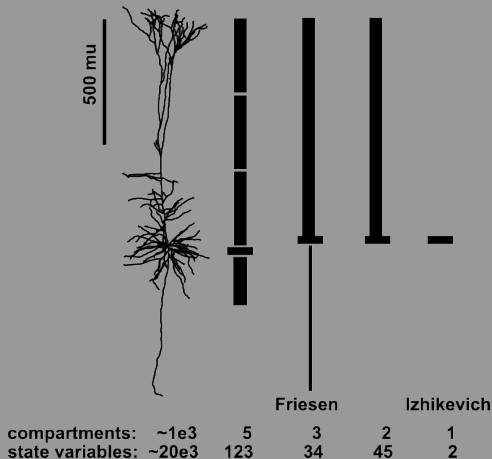
Bipartite output/STR-SPI code transformation hypothesis



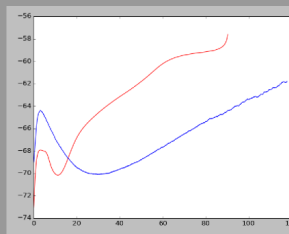
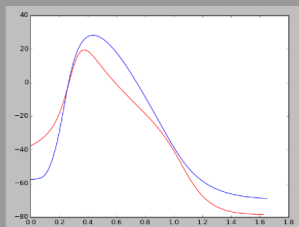
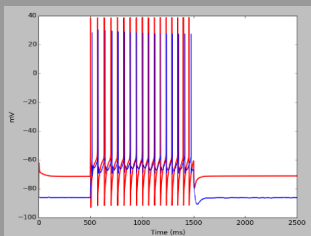
Complex parameterizations: voltage-sensitive ion channel level



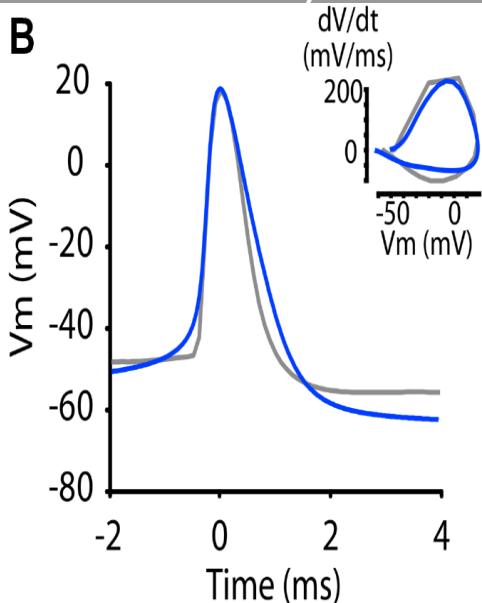
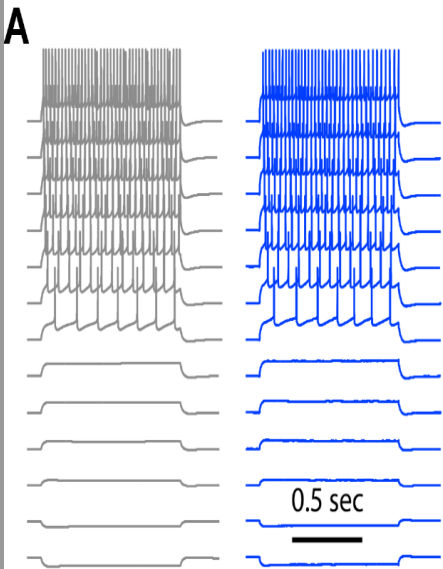
Pyramidal neuron model complexity



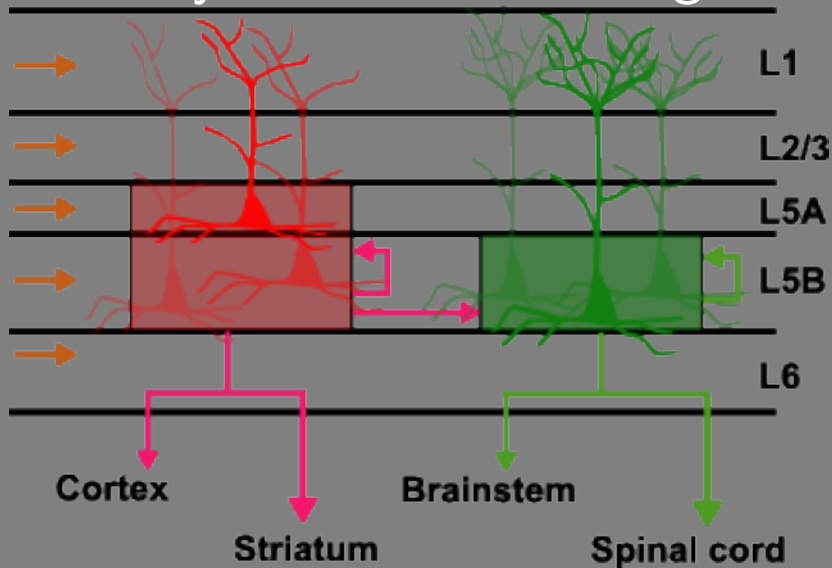
Fitting different aspects



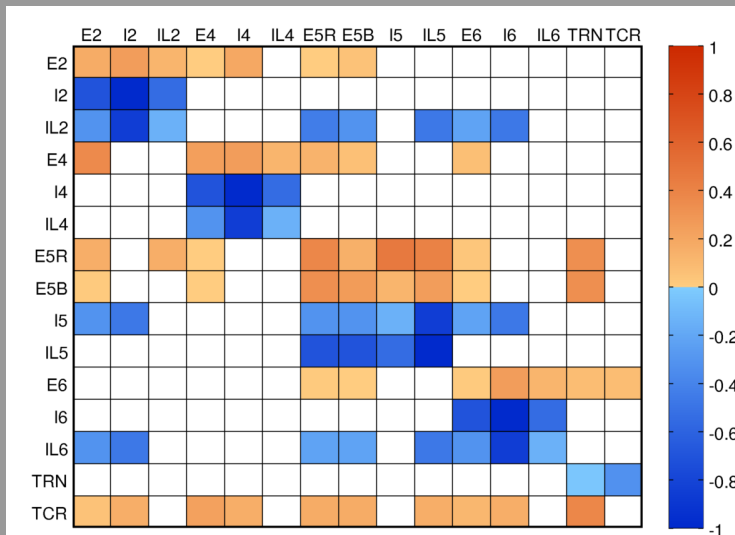
Praxis (principal axis method)



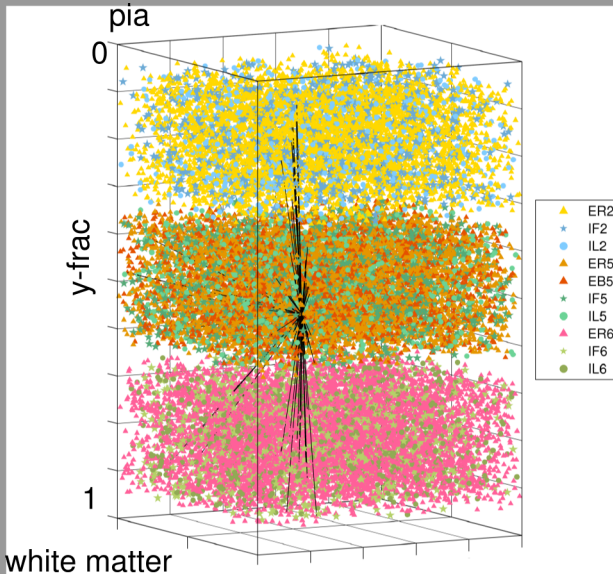
Neural Dynamics and coding



A century of layers

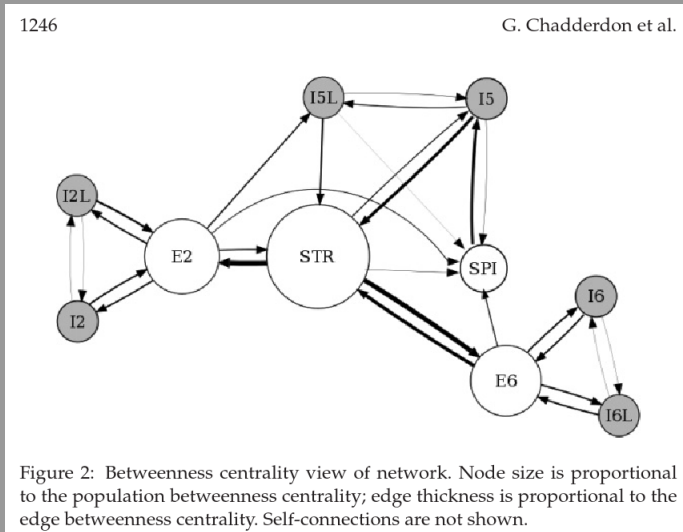


Cell layout: 'y-fraction'



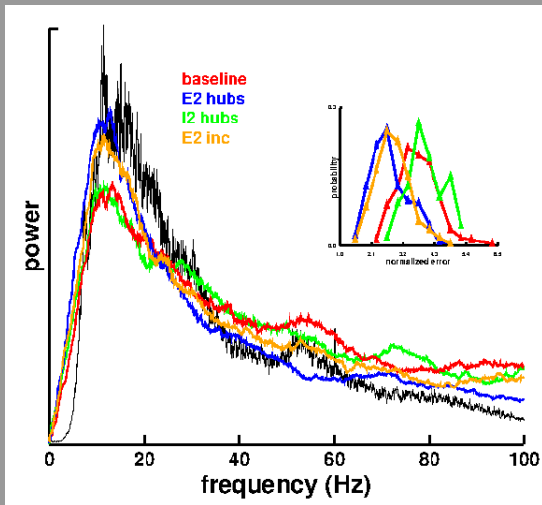
Betweenness centrality view

nodes present in higher proportion of shortest paths



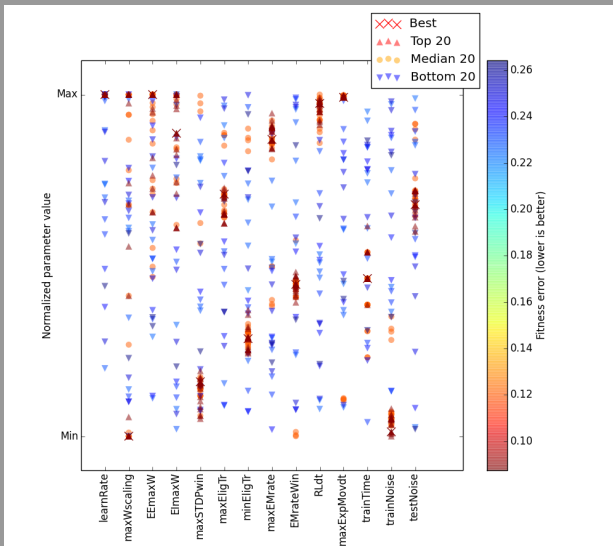
Dynamics of a network

Need to improve LFP generation



Machine learning for biomimesis

2-stage learning EA then STDP



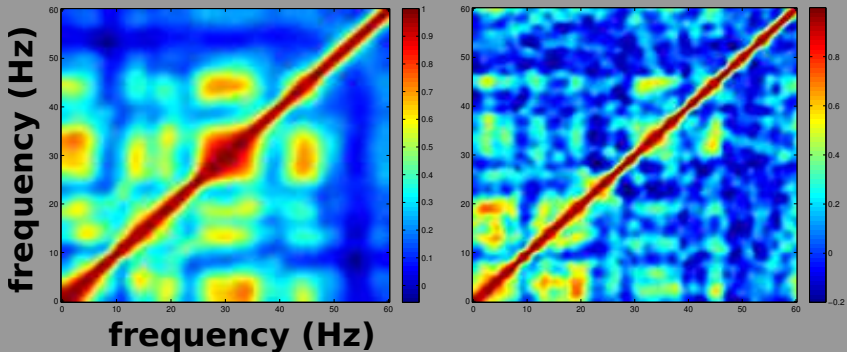
Multiplexing of multICODES

Likely many codes coexist

- Rate code (Adrian)
- First-wave code (Thorpe)
- Synchrony code (Singer)
- Phase code (Lisman)
- Point attractors (Hopfield)

Cross frequency relations

Reality on L (rat L medial PFC)



NEURON simulation environment

← → ↻ 🏠 📄 www.neuron.yale.edu/neuron/ 🔍 ☆ 🗨️



NEURON

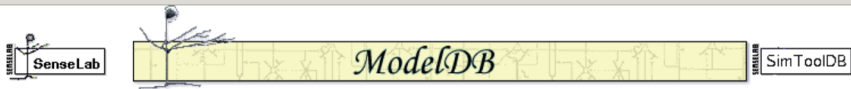
for empirically-based simulations of neurons and networks of neurons

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Welcome to the community of NEURON users and developers!

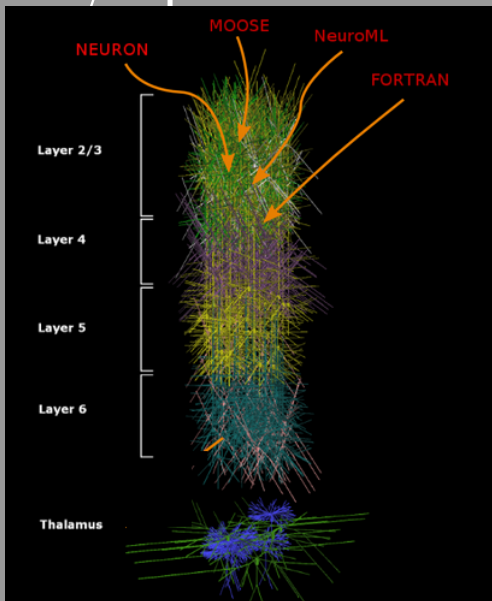
This is the home page of the NEURON simulation environment, which is used in classrooms and laboratories around the world for building and using computational models of neurons and networks of neurons. Here you will find installers and source code, documentation, tutorials,


ModelDB: Simulation databasing



| | | (Luscher, Shiner 1990) |
|-----|---|--|
| 624 | Luthman J, Hoebeek FE, Maex R, Davey N, Adams R, De Zeeuw CJ, Steuber V (2011) [PubMed] | STD-dependent and independent encoding of Input irregularity as spike rate (Luthman et al. 2011) |
| 625 | Lytton WW (1997) [PubMed] | Computer model of clonazepam's effect in thalamic slice (Lytton 1997) |
| 626 | Lytton WW (1998) [PubMed] | Feedforward heteroassociative network with HH dynamics (Lytton 1998) |
| 627 | Lytton WW (2006) [PubMed] | Neural Query System NQS Data-Mining From Within the NEURON Simulator (Lytton 2006) |
| 628 | Lytton WW, Contreras D, Destexhe A, Steriade M (1997) [PubMed] | Thalamic quiescence of spike and wave seizures (Lytton et al 1997) |
| 629 | Lytton WW, Hines ML (2005) [PubMed] | Local variable time step method (Lytton, Hines 2005) |
| 630 | Lytton WW, Lipton P (1999) [PubMed] | Hippocampus temporo-septal engram shift model (Lytton 1999) |
| 631 | Lytton WW, Neymotin SA, Hines ML (2008) [PubMed] | The virtual slice setup (Lytton et al. 2008) |
| 632 | Lytton WW, Neymotin SA, Wester JC, Contreras D (2011) [PubMed] | Computational Surgery (Lytton et al. 2011) |
| 633 | Lytton WW, Omurtag A (2007) [PubMed] | Tonic-clonic transitions in a seizure simulation (Lytton and Omurtag 2007) |
| 634 | Lytton WW, Omurtag A, Neymotin SA, Hines ML (2008) [PubMed] | JitCon: Just in time connectivity for large spiking networks (Lytton et al. 2008) |
| 635 | Lytton WW, Orman R, Stewart M (2008) [PubMed] | Broadening of activity with flow across neural structures (Lytton et al. 2008) |
| 636 | Maass W, Joshi P, Sontag ED (2006) [PubMed] | Computational aspects of feedback in neural circuits (Maass et al 2006) |

NEUROML/Open Source Brain



 SUB NAVIGATION

Our Programs

General Program information

Digital Brain Atlasing

Multiscale Modeling

People

MUSIC - Multi-Simulation
Coordinator

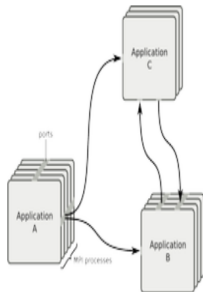
NineML - Network Interchange
format for Neuroscience

CSA - Connection Set Algebra

MUSIC

Multi-Simulation Coordinator (MUSIC) is a software that allows large scale neuron simulators to communicate during runtime.

- > Allows exchange of data among parallel applications in a cluster environment
- > Interconnects large-scale neuronal network simulators with each other or with other tools
- > Participates in multi-simulations
- > Continuously developed and extended
- > Three simulators currently have MUSIC interfaces:
Moose, NEURON and NEST



DOWNLOAD MUSIC



For more information and
download of the library visit

incf Software Center

RELATED MUSIC MATERIAL

Article in Neuroinformatics
8:43-60 (2010)

Run-Time Interoperability Between
Neuronal Network Simulators

BRAIN, HBP/BBB, ABI

