Simulation Laboratory Neuroscience

Collaborative Support and Research for Exploiting HPC in Neuroscience

10 April 2019 | Abigail Morrison

SimLab Neuroscience – Profile

The SimLab Neuroscience is an interdisciplinary team of scientists and engineers with complementary backgrounds and skills.

Expertise

- In both neuroscience and high performance computing
- Simulation technology, data analysis and visualization technology for neuroscience
- Software engineering, methodologies and scientific software development
- Computer architecture, programmable logic

SimLab Neuroscience – Teams

- Large Scale Simulation and Neuromorphic Systems
- Multiscale Simulation and Architectures
- Analysis, Visualization and Learning
- Machine Learning and Data Analytics for Neuroimaging
- Coordination, Communication and Project Management

Prof. Abigail Morrison

Dr. Alexander Peyser

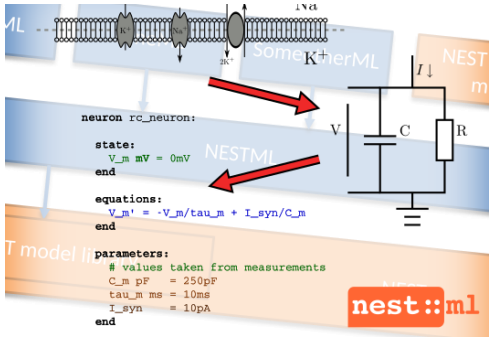
Fahad Khalid

Dr. Kai Krajsek

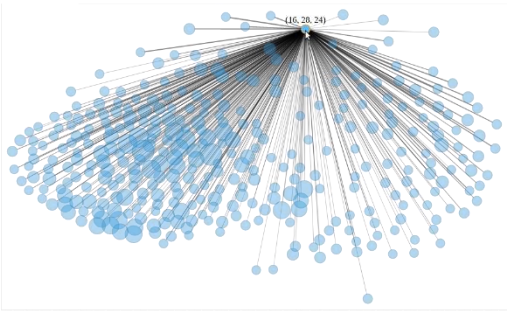
Dr. Boris Orth

Areas of Reasearch & Collaboration

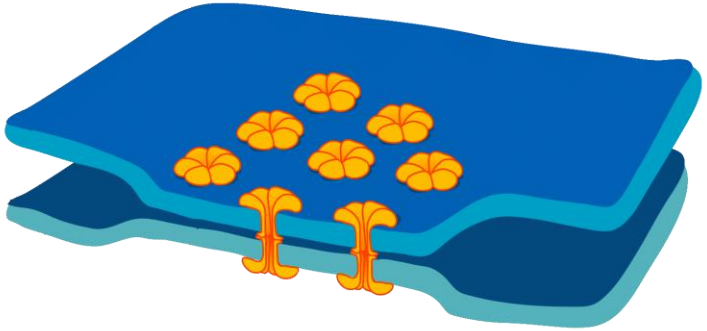
Simulation Engineering



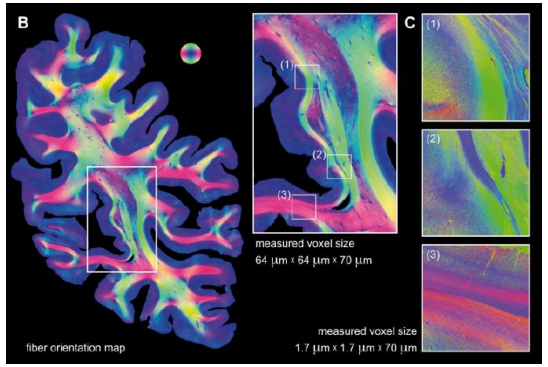
Analysis and Visualization



Simulation Science



Neuroimaging Pipelines



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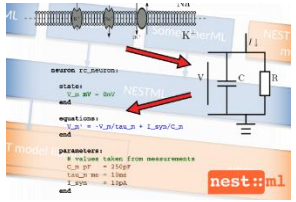
Selected Simulation Engineering Projects



NEST (FZJ (INM-6, JSC-SimLab), NMBU)

Neural simulation tool for the simulation of large networks of point neurons.

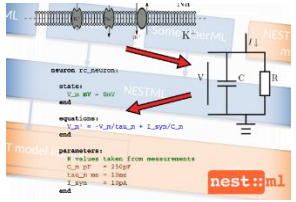
NESTML (JSC-SimLab, INM-6)

Domain-specific language for describing neuron and synapse models.

[Plotnikov et al., 2016, NESTML: a modeling language for spiking neurons]

[Blundell et al., 2018, Code Generation in Computational Neuroscience: A Review of Tools and Techniques]

Selected Simulation Engineering Projects



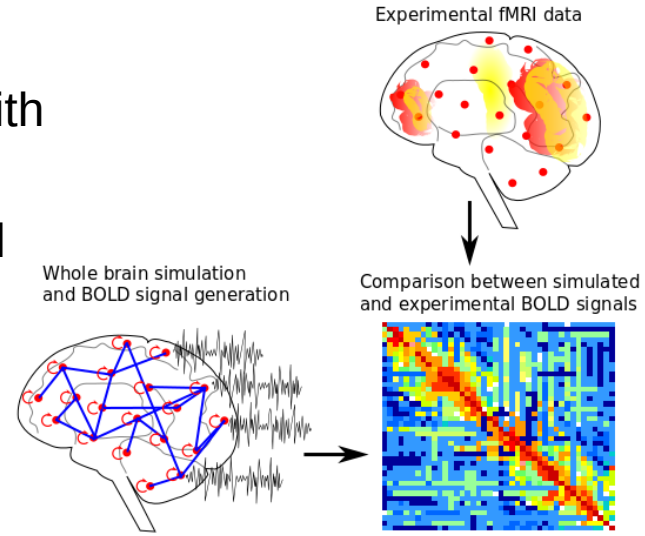
Arbor (FZJ (JSC-SimLab), CSCS, RWTH)

Simulator for large networks of morphologically-detailed, spiking neurons for modern HPC architectures.

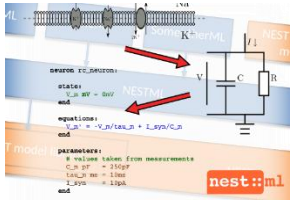
The VirtualBrain (TVB) (U Marseille, Charité, FZJ (JSC-SimLab))

Simulation of the dynamics of large-scale brain networks with biologically realistic connectivity.

Tractography data can be combined with a variety of neural mass models in order to predict experimental and clinical observables such as local field potential, EEG and fMRI measures.



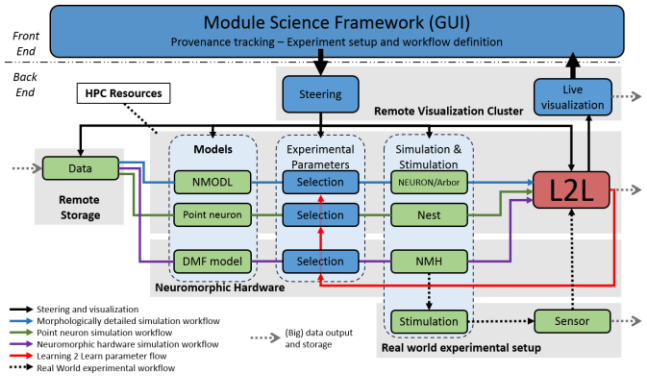
Selected Simulation Engineering Projects



Multiscale Simulation and Workflows

(FZJ (JSC-SimLab, INM-6), RWTH, U Trier, FH Bielefeld, U Marseille, UNIC)

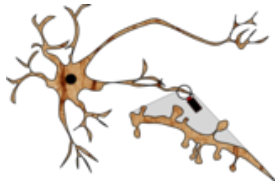
Coupling of Arbor, NEST and TVB, coupling of simulations to visualization and analysis.

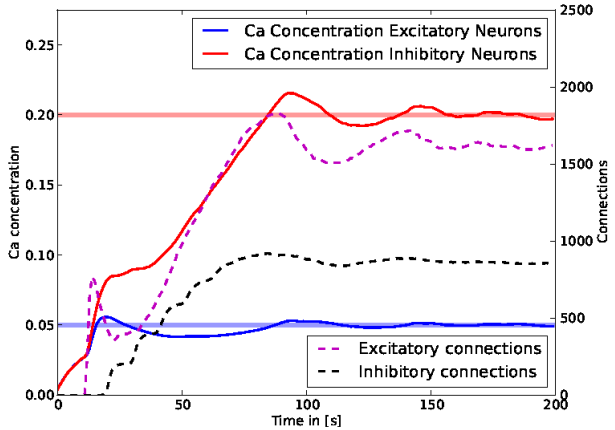


Structural plasticity (INM-6, JSC-SimLab)

Automatic generation of connectivity as part of the neural network simulator NEST.

[Diaz et al., 2016, Automatic Generation of Connectivity for Large-Scale Neuronal Network Models through Structural Plasticity]





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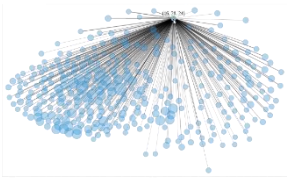
Selected Analysis & Visualization Projects

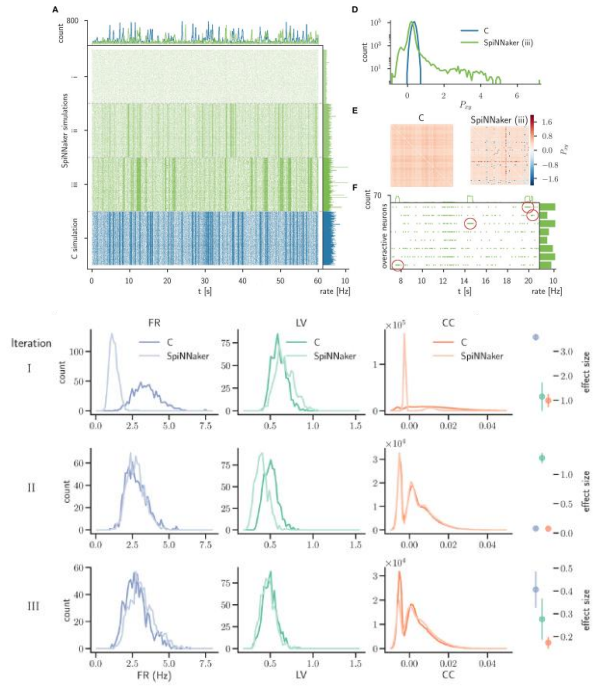


Model Verification and Validation (JSC-SimLab, INM-6)

Application of verification and validation methodologies to neural network simulations. Validation on the level of network activity data.

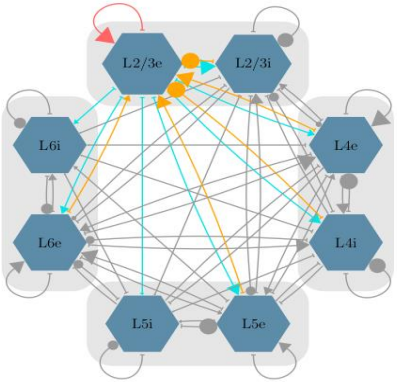
[Gutzen et al., 2018, Reproducible Neural Network Simulations: Statistical Methods for Model Validation on the Level of Network Activity Data]

[Trensch et al., 2018, Rigorous Neural Network Simulations: A Model Substantiation Methodology for Increasing the Correctness of Simulation Results in the Absence of Experimental Validation Data]



ViCoGen (FZJ (JSC-SimLab), RWTH, URJC, UPM)

Visual and source-agnostic interactive interface to generate connectivity in neural networks at various scales.



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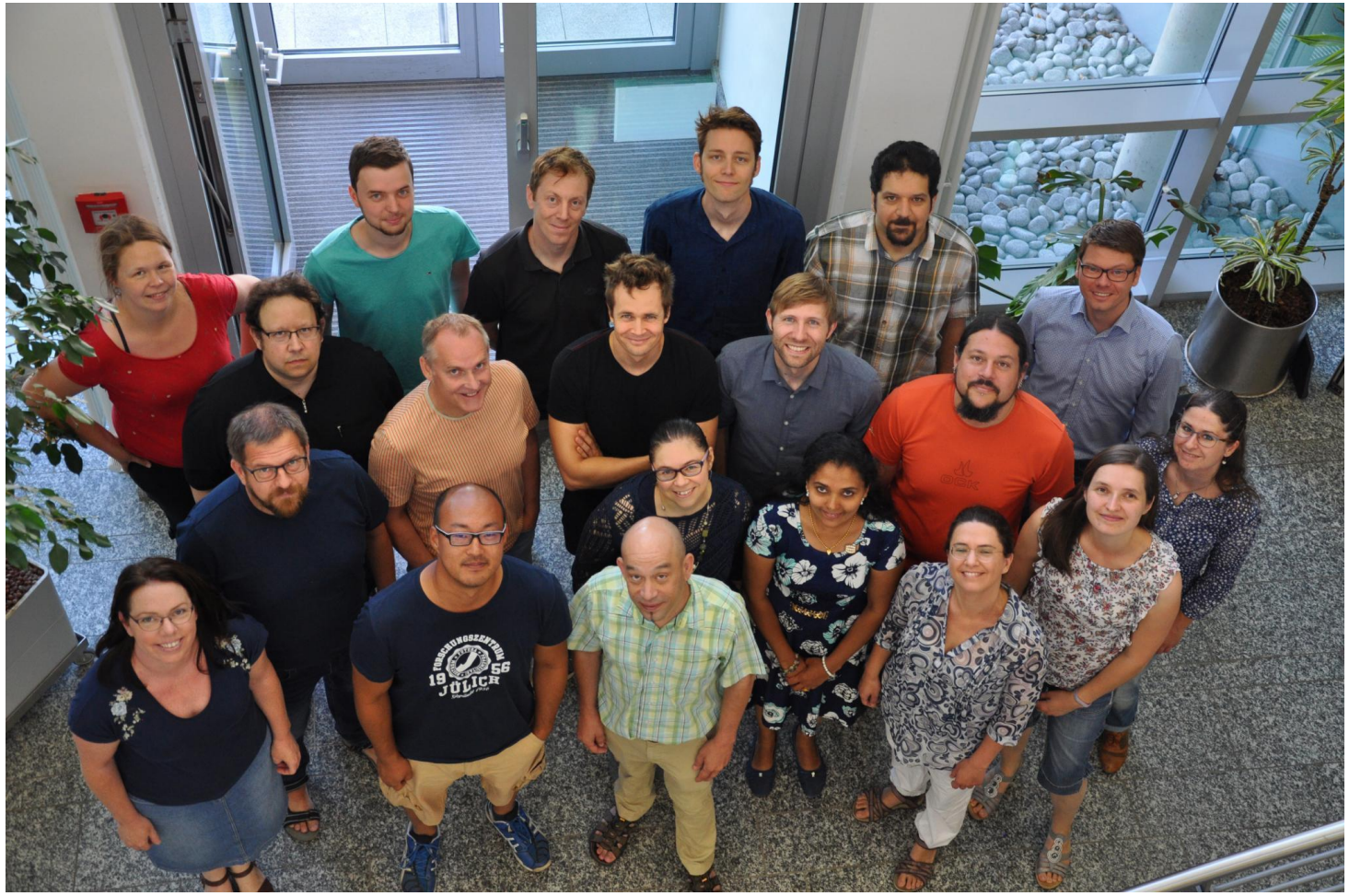

For more projects and publications see: http://www.fz-juelich.de/ias/jsc/EN/Expertise/SimLab/slns/_node.html