Using the Neuroscience Gateway Portal (NSG) for Parallel Simulations – Satellite Workshop, Society for Neuroscience Annual Meeting
San Diego, Nov 12 2016

Time: 9AM – 12PM, Pacific Time Zone, USA

Location: San Diego (near the convention center where SFN Annual meeting will take place)

Address: Attendees will be informed

Workshop abstract: This workshop combines didactic presentations and hands-on instruction on how to use the Neuroscience Gateway Portal (NSG) for computationally intensive simulations and data analysis. NSG eliminates most technical and adminstrative barriers to using high performance computing (HPC) resources, and even gives away free CPU time on parallel supercomputers. Software currently installed on NSG includes Brian, GENESIS, MOOSE, NEST, NEURON, PyNN, Freesurfer, BluePyOpt and the Virtual Personalized Multimodal Connectome Pipeline.

Workshop will also include three research presentations by neuroscientists on computational neuroscience research topics and where the NSG is used to access HPC resources.

Agenda: (Please try to arrive by 8:30 am; light breakfast will be provided)

9:00 AM - 9:20 AM: Introduction to NSG
9:20 AM - 10:20 AM: Hands on Demo - How to use the NSG

Speakers: Amit Majumdar[1], Subhashini Sivagnanam[1], Kenneth Yoshimoto[1], Ted Carnevale[2]

[1]San Diego Supercomputer Center, UCSD
[2]Yale School of Medicine

Abstract: We will introduce the Neuroscience Gateway (NSG) and mention what capabilities it provides, what neuronal simulations tools it provides for running free of charge on US NSF funded supercomputers. We will show how users can easily upload models, choose some parameters (e.g. number of cores, runtime etc.), run a simulation on parallel machines, and download results.

10:20 AM – 10:30 AM Break

10:30 AM – 11:00 AM Using the NSG for community modeling with the Human Brain Project

Speakers: M Migliore[1], A Romani[2], CA Rössert[2], R Migliore[1], CA Lupascu[1], LL Bologna[1], F. Franchina, S Saray[3], J-D Courcol[2], W Van Geit[2], S Kali[3], and E Muller[2]

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[2]Blue Brain Project, École Polytechnique Fédérale de Lausanne Geneva, Switzerland
[3]Institute of Experimental Medicine, Hungarian Academy of Sciences, Budapest, Hungary

Abstract: One of the EU-funded Human Brain Project (HBP) general priorities is to directly fostering relations with communities that can contribute to the development of standards, resources and tools of general benefit to the scientific community relevant to the HBP. From this point of view, the plan is to provide benchmark tests suites for modelling and simulation (from molecular models to whole organism models, and from biologically realistic to biologically inspired models). These benchmarks will be released on a regular basis, allowing the user communities to more easily assess the capacities and limitations of models built in both HBP and the wider community. In this presentation we will illustrate how we could make this possible, by demonstrating a number of use cases and discussing strengths, limitations and ways of using the NSG to run a variety of community-driven models and tools available in the Brain Simulation Platform.

11:00 AM – 11:30 AM Optimization of multiscale brain models via parallel evolutionary algorithms on supercomputers

Speakers: Salvador Dura-Bernal, Samuel A Neymotin, William W Lytton

SUNY Downstate Medical Center, NY

Abstract: Development of biomimetic simulations permits us to better understand the complex neuronal dynamics underlying brain function and behavior. As the level of detail and fidelity of models increases, so does the number of parameters, and thus, the complexity of finding appropriate parameter configurations. Evolutionary algorithms provide a biologically-inspired and effective approach to optimizing the parameters of a neural system to match experimental data. However, to obtain results in a feasible time it is necessary to parallelize the optimization process via high-performance computing (HPC) systems, such as that provided by the Neuroscience Gateway (NSG). We employed NSG to run evolutionary algorithms in parallel to optimize the parameters of neural systems at different scales. First, we optimized biophysical parameters of a fully reconstructed motor cortex pyramidal neuron model based on experimental electrophysiological and morphological data. Second, we optimized the connectivity and driving inputs of a motor cortex network model to match in vivo dynamics. Finally, we optimized the learning metaparameters of a motor cortical network modulated by real brain recordings and driving a realistic virtual musculoskeletal arm. This system employed reinforcement learning and spike-timing dependent plasticity to match behavioral and physiological data from reaching experiments, setting the groundwork for novel biomimetic neuroprosthesis. Our work demonstrates automated parameter optimization via parallel evolutionary algorithms for neural systems at different spatiotemporal scales.

11:30 AM – 12:00 PM Application of automated brain tissue segmentation in radiation oncology

Speakers: Roshan Karunamuni, Nate S White, Carrie R McDonald, Vitali Moiseenko, Anders M Dale, Jona A Hattangadi-Gluth

Department of Radiation Medicine and Applied Sciences and the Center for Multimodal Imaging and Genetics (CMIG), UCSD

Abstract: Radiation therapy is a mainstay in the treatment of brain tumors, but radiation dose to normal brain tissue can cause debilitating late deficits in neurocognitive function. Automated brain segmentation algorithms such as Freesurfer, available through the Neuroscence Gateway (NSG), are important tools in understanding the effects of radiation on normal brain tissue. Critical structures, such as subcortical white matter, cortical gray matter, and hippocampi can be reliably and robustly segmented. Changes in macro- (volume) and microstructural (diffusion, perfusion) properties can then be measured over time, and correlated with radiation dose to provide clinical dose constraints. Segmentations can then be imported

into treatment planning software to allow for prospective radiation sparing of these structures in an effort to mitigate the detrimental effects of brain radiotherapy.

12:00 PM Lunch