Division News Note Template

SAND2009-0510P

Please complete all sections and obtain approval following Center review and approval process. SAND number

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If appropriate, please include web site references (URLs) photos, event dates, and media references.

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Topic area: Technical Accomplishment If Other, please describe

Program funding source: ☐ NW ☐ Defense Systems & Assessments ☐ Energy Resources & Nonproliferation ☐ Homeland Security ☐ Integrated Enabling Services ☐ Science, Technology & Engineering ☒LDRD ☐WFO

Title: Dynamic neurological modeling constraints

News note (provide paragraph):

To understand how complex neurological systems work, one must appreciate how the fundamental component neurons behave and how they are connected together. Any complex neurological system model will contain hundreds to millions of neurons. Thus, the soundness of the full system model will depend on how well the neuron components are modeled. Much like electrical component modeling, one must have good model parameters to accurately model individual neuron behavior.

We have developed computational and statistical tools that enable uncertainty quantification of neural simulations by extending fourier-based techniques to use experimental data in the refinement of neuron simulations. The neuron simulations are posed as neuron-circuits and solved with Sandia's parallel circuit simulator, Xyce. Uncertainty quantification of the neuron model parameters is orchestrated by Sandia's optimization package, Dakota, which then calls on Xyce to do the computational work. Because both Xyce and Dakota are designed for large scale computing, gigabytes of experimental data can be used to refine the simulations which is critical as the experimental signals are inherently very noisy.

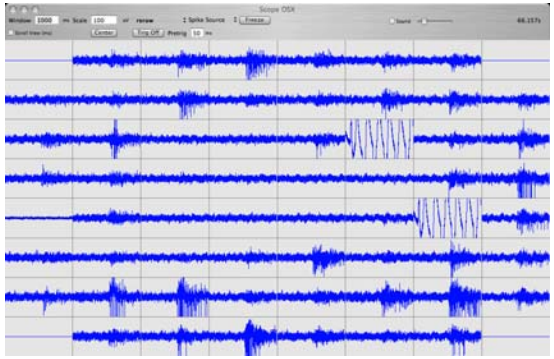
Posing and solving this problem required the combined efforts of staff from Cognitive Systems (6341 & 6443) and Electrical & Microsystem Modeling (1437). The result of this collaboration is unique capability allowing neuroscientits to fully utilize large experimental data sets and have insight into the accuracy limits of neural simulations. Additionally, we have opend new opportunities for Sandia to address the neuroscience community at the Society for Neurology national meeting (Washington DC, Nov. 2008).

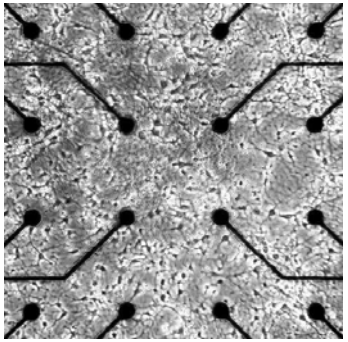
Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy’s National Nuclear Security Administration under contract DE-AC04-94AL

Manager Approval:

Name: _____ **Date:** _____

Sandia National Laboratories





experimental neuron cell culture

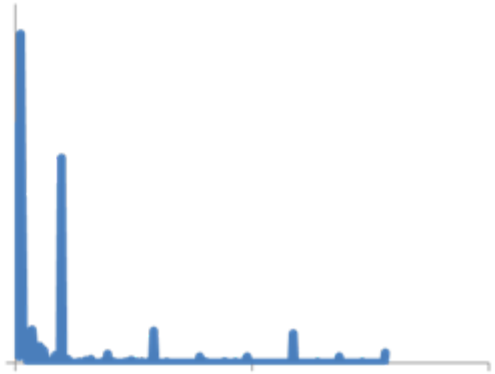
8x8 micro-electrode experimental data

Neuron Model Parameters

Xyce™ PARALLEL ELECTRONIC SIMULATOR

8x8 micro-electrode simulation data

Power Spectrum Analysis



DAKOTA

Comparing the frequency response of a neuron cell culture with simulated *neuron circuits* to estimate and constrain the model parameters.