APS Scientific Computation Seminar Series

Speaker: Walter J. Scheirer
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Title: Scalable Strategies for Image Analysis in Neuroscience

Date: Thursday, June 2, 2016

Time: 11:00 a.m.

Location: 401/A1100

Host: Doga Gursoy

Abstract:

Mapping the synaptic connectivity of neurons in the brain provides diagrams that frame the structural and computational constraints of neuronal circuits. In combination with physiology, these circuit maps unravel the underlying mechanisms of neuronal computations, and hold much promise for the field of artificial intelligence, where new classes of algorithms that mimic the sensory processing and reasoning abilities of biological systems may be discovered. Imaging large data sets to do this is presently very time consuming and reconstruction remains prohibitively slow and expensive. This talk introduces an Assisted Reconstruction Technique for Electron Microscopic Interrogation of Structure (ARTEMIS) that circumvents these limitations. By enhancing the signal of genetically encoded markers expressed in defined circuit elements and quickly mapping them in large volumes, it enables sparse unsupervised reconstructions of genetically defined circuit motifs.

Further, this same approach for unsupervised reconstruction can be applied to a variant of spectral confocal reflectance microscopy, facilitating the long-range tracing of myelinated axons, as well as the automatic assessment of myelin thickness. Finally, directions in open set recognition for machine learning will be discussed. Unknown structures will appear in all imaging modalities as volumes grow – how do we identify unknown data and incorporate it into a reconstruction model? A new class of supervised learning methods that can minimize the risk of the unknown and incrementally learn from new data addresses this. In all cases, suggestions for further scalability considering various parallel computing architectures will be discussed at each step.