APS Scientific Computation Seminar Series

Speaker: Ming Du
PhD Candidate
Department of Materials Science and Engineering
Northwestern University

Title: 3D Object Reconstruction Beyond the Depth-of-Focus Limit Using Automatic Differentiation

Date: Monday, August 20, 2018

Time: 1:00 p.m.

Location: 401/A1100

Hosts: Nicholas Schwarz and Brian Toby

Abstract:
As the spatial resolution of x-ray imaging is pushed towards the diffraction limit, depth-of-focus (DOF) emerges as a non-negligible problem for 3D imaging. When the specimen becomes larger than the depth-of-focus, the pure-projection approximation fails. This has been addressed in part by the use of multi-slice methods to reconstruct several depth planes which are then combined to yield an approximation of a pure projection. However, these methods do not provide an isotropic resolution, and suffer from inter-slice "seeping" when two slices are arranged too closely. We describe here an optimization-based approach to recover extended 3D with isotropic voxel size. In particular, the optimization of the object function in our algorithm is implemented using the automatic differentiation function of Tensorflow, a well-known deep learning software. This allows us to avoid the tough and tedious manual derivation of the update function and makes the interface of our program highly accessible and flexible. Moreover, since the proposed algorithm works with full-field transmission microscopy data, it is compatible with alternative high-resolution imaging techniques such as point-projection x-ray microscopy (PPXM) where one may work with partially coherent sources where the propagation fringes from any single object feature do not extend beyond the coherence width.