APS Scientific Computation Seminar Series

Speaker:
Shimin Tang, Postdoc, Oak Ridge National Laboratory

Title:
Autonomous Hyperspectral Neutron Computed Tomography at the Spallation Neutron Source VENUS Beamline using Artificial Intelligence

Date:
November 4, 2024

Time:
1:00 p.m. (Central Time)

Location:
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Abstract:
Hyperspectral neutron imaging is one of the main capabilities of the Oak Ridge National Laboratory Spallation Neutron Source's newest beamline, VENUS. The neutron instruments available at Oak Ridge provide unique insight into complex engineering and natural materials using both pulsed and steady-state neutron facilities, i.e., the Spallation Neutron Source and the High Flux Isotope Reactor, respectively. Conventional computed tomography involves setting up samples, acquiring data according to pre-set angles, and producing a user-friendly dataset once the experiment has been completed. Considering the long acquisition time of hyperspectral neutron tomography and its inherently low signal-to-noise ratio for a narrow wavelength band of neutrons, a conventional 3D scan can take up to a week of beam time per sample. In addition, there is little to no feedback provided during an experiment, hence making it difficult to make decisions on the fly, which can lead to a suboptimal use of instrument time. In this talk, Dr. Tang will present the implementation of the artificial intelligence autonomous hyperspectral neutron imaging system at VENUS, which significantly reduced the experimental time for high-quality hyperspectral computed tomography data. This system called HyperCT, utilizing a series of compute nodes, can automatically run the experiment using a sample adaptive scanning angle selection (active learning during the measurements), a deep-learning reconstruction quality evaluation, and a deep-learning quality enhancement for very sparse projections used for reconstruction. HyperCT also comes with a custom-made general user interface, developed by our Oak Ridge National Laboratory neutron imaging team.