APS Scientific Computation Seminar Series

Speaker: Faisal Khan
X-Ray Science Division (XSD)
Argonne National Laboratory

Title: A Highly Parallel Implementation of X-Ray Photon Correlation Spectroscopy (XPCS) Data Analysis

Date: Monday, July 18, 2016

Time: 1:00 p.m.

Location: 401/A1100

Host: Nicholas Schwarz and Brian Toby

Abstract:
X-Ray photon Correlation Spectroscopy (XPCS) is a unique technique for probing the motion/fluctuations of nanoscale structures over a wide range of spatial and temporal scales. In an XPCS experiment, the data collected comprises of a series of 2D images exhibiting the speckle fluctuations over space and time that correspond to the actual spatial and temporal fluctuations in the sample. The technique has been successfully applied to a wide range of science encompassing soft- and hard-condensed matter.

Recent advances in detector technology and light sources are making it possible to acquire these images at much higher frame rates and with finer detail than was possible before. This rapid acquisition often results in huge volumes of data that need to be efficiently analyzed, often within a reasonable time frame - preferably at the same time as the actual acquisition, i.e. near real-time. However, this poses a serious challenge because such analysis is not only complex but also computationally intensive. In this talk, we discuss a parallel implementation for XPCS data analysis that has been successfully used for near real-time analysis of XPCS data at Sector 8 of the Advanced Photon Source (APS). Our technique is based on the Hadoop MapReduce framework, a widely popular open-source framework for analyzing Big Data. The analysis approach is very scalable and is continually optimized as the demands of data analysis increase.

XPCS is one of the signature techniques of the Advanced Photon Source Upgrade (APS-U) project. The APS-U will result in extending dynamical time scales for XPCS experiments by 6 orders of magnitude, greatly increasing data rates. Plans to improve data analysis methods to keep up with these enhanced data rates will be discussed.