APS Scientific Computation Seminar Series

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Title:

Data Challenges in Ultrafast X-Ray Imaging: Additive Manufacturing and Beyond

Date:

Thursday, May 17, 2018

Time:

1:00 p.m.

Location:

401/A1100

Hosts: Nicholas Schwarz and Brian Toby

Abstract:

At the APS, ultrafast and high-speed x-ray imaging and scattering on 100-ps temporal scales has brought a revolutionized tool to the scientific and engineering communities interested in studying highly transient phenomena. One of the applications of the unique imaging technique is visualizing additive manufacturing processes. Additive manufacturing (AM, a.k.a. 3D printing) refers to a suite of transformative technologies that build three-dimensional objects by adding materials layer by layer based on digital design. Metal AM has found many applications in the fields of biomedical, aerospace, automobile, and defense. Despite the multitude of the applications, a precise control of microstructures and properties of additively manufactured products remains challenging owing to the extreme thermal conditions involved in metal AM. At the APS, we are tackling this problem by using high-speed x-ray imaging to in situ probe the metal AM processes. We demonstrated that many important physical processes, including melt pool dynamics, powder spattering ejection, and rapid solidification, can be studied quantitatively with unprecedented spatial and temporal resolutions. One the other experiment front, the ultrafast and high-speed imaging method has been applied to understand highly transient phenomena in turbulent and cavitating liquid flows. The challenging problem is how to visualize highly- transient 3D morphology from 2D images in real space and how to combine the theory and simulation with experiment data to aid the processing of the big data sets. With more user groups joining the beamline experiments, we are receiving an ever-increasing demand for developing effective and efficient computational algorithms for image processing and data analysis. In this presentation, we will introduce the ultrafast and high-speed experiments at the respective beamlines, explain the challenges in extracting quantitative information from large volume of x-ray imaging data, and highlight the opportunities to use machine learning in understanding the dynamic processes.