Advancing X-ray Tomography using Deep Learning (TomoGAN)

Speaker: Zhengchun Liu (Argonne National Laboratory, USA)
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*** *exceptional time to be compatible with USA timezone (Central time)*

Synchrotron-based x-ray tomography is a noninvasive imaging technique that allows for reconstructing the internal structure of materials at high spatial resolutions from tens of micrometers to a few nanometers. We apply artificial intelligence techniques to advance X-ray tomography imaging experiments at synchrotron light sources, in both post processing and online (or near real-time streaming) processing scenarios. We also explore its applicability in practical experiment configurations, for example in scenarios in which a deep learning model is trained on a supercomputer but executed for inference on an edge computing device (e.g., Google edge TPU, NVIDIA Jetson). Specifically, we will share three aspects of deep learning for X-ray tomography in this talks: (1) TomoGAN, a denoising technique based on generative adversarial networks, for improving the quality of reconstructed images in various noisy imaging conditions (e.g., low-dose). (2) We integrate TomoGAN into the real-time streaming tomography pipeline to enable better-quality images in the early stages of data acquisition. Compared with conventional streaming tomography processing, our method can significantly improve tomography image quality, deliver comparable images using only 32% of the data needed for conventional streaming processing, and save 68% of experiment time for data acquisition. (3) We evaluate deployments of TomoGAN on the Google Edge TPU and NVIDIA Jetson. We adapt TomoGAN for edge execution and propose methods to address the accuracy drop caused by model quantization. We show that these edge computing devices can deliver accuracy comparable to that of a full-fledged CPU or GPU. TomoGAN is open source at https://github.com/lzhengchun/TomoGAN

Bio.
Zhengchun Liu is an Assistant Computer Scientist at the Data Science and Learning division of Argonne National Laboratory. He works on applying advanced data science and machine learning techniques to transform understanding of the behavior of computer systems in extreme-scale science environments. He also focuses his effort on designing deep learning models to advance various domain science problems (e.g., X-ray, energy, climate), and developing frameworks to facilitate the application of data science and machine learning techniques for solving domain science problems.