Contribution ID: **50** Type: **Standard 15 min talk**

[Remote] Rapid, High-Resolution Coherent Diffractive Imaging with Physics-Informed Machine Learning

Tuesday 15 October 2024 18:00 (15 minutes)

Coherent diffractive imaging (CDI) techniques like ptychography enable nanoscale imaging, bypassing the resolution limits of lenses. Yet, the need for time consuming iterative phase recovery hampers real-time imaging. While supervised deep learning strategies have increased reconstruction speed, they sacrifice image quality. Furthermore, these methods'demand for extensive labeled training data is experimentally burdensome. Here, we propose an unsupervised physics-informed neural network reconstruction method, PtychoPINN, that retains the factor of 100-to-1000 speedup of deep learning-based reconstruction while improving reconstruction quality by combining the diffraction forward map with real-space constraints from overlapping measurements. In particular, PtychoPINN gains a factor of 4 in linear resolution and an 8 dB improvement in PSNR while also accruing improvements in generalizability and robustness. We validate PtychoPINN's performance on a range of datasets, spanning simulated objects and experimental measurements from the XPP endstation at LCLS, in both ptychographic and CDI modalities. The framework's novel combination of speed and accuracy offers new possibilities for real-time nanoscale imaging at x-ray light sources and beyond.

Focus areas

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