Contribution ID: **2586** Contribution code: **THPA011** Type: **Poster Presentation**

Study of noise impact on AI-based ptychography for beam characterization

Thursday, 11 May 2023 16:30 (2 hours)

Coherent X-ray beam focus can be characterized using ptychography, a lensless imaging technique used at synchrotron X-ray light sources and free-electron lasers. Ptychography relies on collecting X-ray diffraction from a thin sample at overlapping regions and reconstructing an image from the data. Since the phase is not measured by the detector, ptychography can solve for the phase of the sample and the probe. This is useful for characterizing the beam focus, coherence, and energy dependence, and for exploring experimental conditions.

Ptychography, however, is challenging due to the time to collect data from each sample point and also for iterative reconstruction of the phase. Recently, AI-based ptychographic methods have shown promise in making ptychography-based beam characterization faster and more efficient.

This poster presents a study on the effect of various types of noise present in ptychographic data. A number of noise sources occur in ptychographic setups and include noise from parasitic scattering (background), outliers, correlated noise sources, cosmic rays, bad frames, beam jitter, motor jitter, fluctuating dark noise, beam miscentering, a static sloped background and fluence jitter.

This study explores the effect of random noise in experimental data used for AI-based ptychographic reconstruction and how it impacts reconstructed probe and object image accuracy. Results on noise impact using both AI-based and iterative ptychographic methods are compared.

Funding Agency

Footnotes

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Yes

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Session Classification: Thursday Poster Session

Track Classification: MC6: Beam Instrumentation, Controls, Feedback and Operational Aspects: MC6.T03: Beam Diagnostics and Instrumentation