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High speed free-run ptychography at the Australian Synchrotron

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The Australian Synchrotron X-ray Fluorescence Microscopy (XFM) beamline has recently implemented fast-scanning ptychography, a scanning X-ray diffraction microscopy method. Ptychography creates super-resolution images from transmitted microdiffraction patterns acquired as the sample is scanned through the beam. High-speed detectors and high-performance computers are required to iteratively reconstruct these complex images. The experimental methods and reconstruction algorithms have significantly evolved over the last decade and a half into a mature and user-friendly complementary imaging method to XFM.

Here we present the implementation of high speed ptychography at the XFM beamline, which includes a free-run data collection mode where detector dead time is eliminated, and the scan time is optimized. We show that free-run data collection is viable for fast and high-quality ptychography by demonstrating extremely high data rate acquisition covering areas up to $352,000 \mu\text{m}^2$ at up to $140 \mu\text{m}^2/\text{s}$, with $18\times$ spatial resolution enhancement compared to the beam size. With these improvements, ptychography at velocities up to $250 \mu\text{m}/\text{s}$ is approaching speeds compatible with fast-scanning X-ray fluorescence microscopy. The combination of these methods provides morphological context for elemental and chemical information, enabling unique scientific outcomes.

Level of Expertise

Expert

Presenter Gender

Man

Pronouns

Which facility did you use for your research

Australian Synchrotron

Students Only - Are you interested in AINSE student funding

Do you wish to take part in the Student Poster Slam

Condition of submission

Yes

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