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Longitudinal Ptychographic Coherent Diffractive Imaging

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In recent years Coherent Diffractive Imaging (CDI) has rapidly matured into a powerful tool for high-resolution X-ray phase contrast imaging. However, a fundamental limit exists on the size of object that can be imaged when using conventional CDI due to the need to correctly sample the measured diffraction intensities. Ptychography, a technique initially developed for electron microscopy, can overcome limitations on the sample size by combining data collected from multiple overlapping probe positions. Whilst almost all ptychographic CDI experiments are performed using plane-waves our group has been exploring the benefits of introducing phase curvature into the image reconstruction algorithms by illuminating the sample with the diverging probe produced by a focused X-ray beam. We have shown that this geometry allows for rapid image reconstructions from large sample areas with far fewer scanning points needed. Furthermore, by combining data taken with the sample at different longitudinal positions parallel to the incident beam as well as data taken at different transverse positions perpendicular to the beam it has been shown that the dose delivered to the sample can be greatly reduced without loss of spatial resolution. Here we carry this idea further, showing that it is possible to reconstruct an image of a sample scanned through the focal plane without any transverse data being included. This has a number of potential applications for biological imaging including 'zooming in' on regions of interest without imparting potentially damaging X-ray doses to the rest of the sample.

Keywords or phrases (comma separated)

coherent diffraction imaging, ptychography, X-ray imaging

Summary

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