LENSESLESS DIFFRACTIVE IMAGING IN THREE DIMENSIONS USING
PTYCHOGRAPHY

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KEYWORDS: Coherent diffractive imaging, 3D imaging, ptychography, phase retrieval

Ptychography is a form of coherent diffractive imaging (CDI) in which a specimen is scanned through an illuminating ‘probe’ wavefront, a diffraction pattern recorded at each position of the scan and an image recovered algorithmically from the diffraction data [1]. The image is quantitative in both amplitude and phase and offers improved robustness, convergence properties and field of view compared to alternative CDI techniques. It has become popular as a tool for X-ray imaging [2] and has also been demonstrated in the electron regime [3].

Recently ptychography has been combined with tomography, with great success [4,5]. However the redundancy inherent to a ptychographic data set is huge, and the potential for extracting depth information from this data is not tapped by these tomographic techniques. We will show here how a conventional two-dimensional ptychographic experiment can yield three-dimensional images, and that this can be achieved in the presence of large sample thicknesses and multiple-scattering effects that would prohibit accurate tomographic reconstructions. We will present results using visible light where our technique has potential to image thick biological tissues, for which confocal microscopy cannot be employed.


