

ARTEFACTS IN COMPUTATIONAL TOMOGRAPHIC DIFFRACTIVE MICROSCOPY WITH SAMPLE ROTATION

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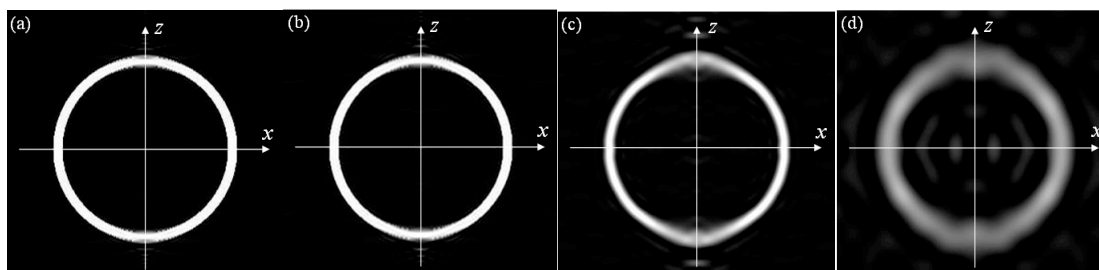
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The observation of transparent samples poses a real challenge because of their inherent low contrast in refractive index (RI), which makes it difficult to identify intra-cellular structures.

Tomographic diffractive microscopy in coherent light is one of the studied techniques to address this issue [1]. For weakly diffractive samples, the 3-D distribution of the complex RI can be reconstructed from the knowledge of the measured scattered fields sampled under various view angles according to the diffraction tomography theorem [2,3]. The 3-D observation of weakly diffractive samples have been so far realized by varying the sample illumination with a fixed sample [3,4] or by rotating the sample using a fixed illumination [5,6]. In the first method, tomography is realized by varying the sample illumination angle in a range limited by the illumination system numerical aperture, and, therefore, this approach suffers from the same “missing cone” than conventional transmission microscopes, hence produces important deformation along the optical axis. With the second method, the reconstruction of the transparent sample is usually obtained using an inverse Radon transform [5] and the obtained spatial resolution is isotropic. However this approach can lead to reconstruction artefacts [7].

We have studied the reconstruction process in tomographic microscopy with sample rotation to find that, contrary to first thought, the Optical Transfer Function still lacks some frequencies along the rotational axis, when taking into account the diffraction process. We have then investigated numerically the influence of these missing frequencies onto the precision of the reconstructed object [8]. In our poster, we present simulation results of the effect of these missing frequencies as functions of the object’s size and shape.



Figs. 1(a), (b), (c) and (d): simulated tomographic images of membrane-type objects with diameters of 44, 31.5, 9.5 and 3 μm respectively. The reconstructed images exhibit deformations along the specimen rotation axis, the effect being more pronounced for smaller objects.

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