Abstracts

Limitations of Imaging with First-Order Diffraction Tomography

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In this paper, the results of computer simulations used to determine the domains of applicability of the first-order Born and Rytov approximations in diffraction tomography for cross-sectional (or three-dimensional) imaging of biosystems are shown. These computer simulations were conducted on single cylinders, since in this case analytical expressions are available for the exact scattered fields. The simulations establish the first-order Born approximation to be valid for objects where the product of the relative refractive index and the diameter of the cylinder is less than 0.35 lambda. The first-order Rytov approximation is valid with essentially no constraint on the size of the cylinders; however, the relative refractive index must be less than a few percent. We have also reviewed the assumptions made in the first-order Born and Rytov approximations for diffraction tomography. Further, we have reviewed the derivation of the Fourier Diffraction projection Theorem, which forms the basis of the first-order reconstruction algorithms. We then show how this derivation points to new FFT-based implementations for the higher order diffraction tomography algorithms that are currently being developed.

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