Optical phase tomography

In optical phase tomography, the object is illuminated from various angles with a coherent plane wave. From the resulting images, the phase shift---or equivalently, the refractive index---in each voxel of the three-dimensional object is retrieved. The reconstruction algorithm operates by recasting the scattering of the photons within the object as an artificial neural network.

In this project, experiments are conducted on the optical bench, equipped with a laser, a scientific CMOS camera and a custom-made rotation holder. Then, reconstructions are carried out with IDPS, our in-house GPU-based reconstruction algorithm. Finally, improving the reconstruction algorithm belongs to the possibilities, too.

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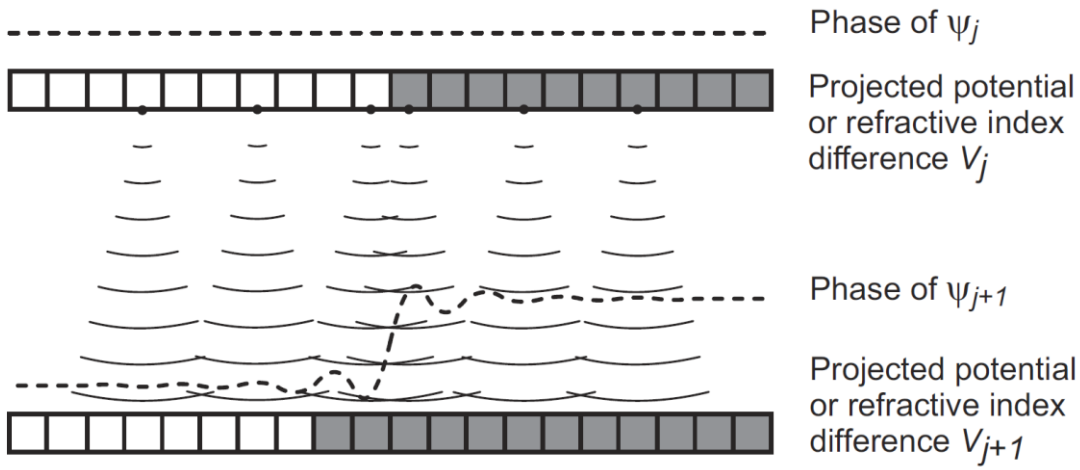

Fig. 1. Scattering of the light through the object; can be recast as an artificial neural network

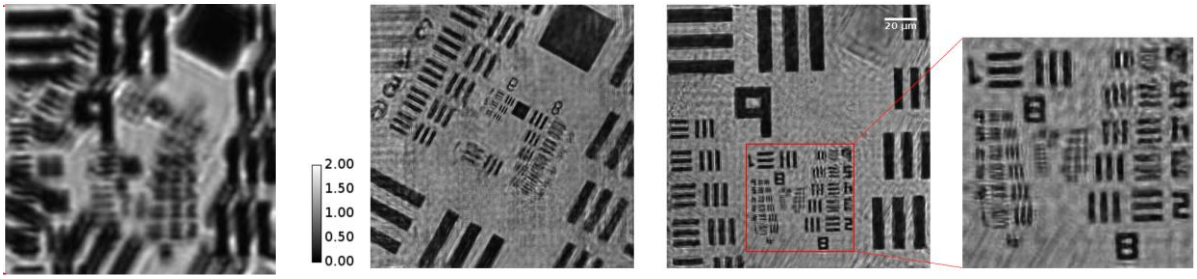

Fig. 2. *Left*: Image of two stacked resolution targets. Many more images at different beam tilts have been made. *Right*: Reconstruction of each of the resolution targets. The reconstruction is three-dimensional, but with limited resolution due the limited beam-tilt range. In this project, larger object tilts will lead to a better resolution. Although both layers are well-reconstructed, many artifacts can be seen in the vacuum surrounding the dark bars. These “wiggles” are due to a combination of the noise in the measurements and the approximate nature of the IDPS reconstruction algorithm. The improved algorithm is expected to eliminate these artifacts completely.