THREE-DIMENSIONAL IMAGING OF TRANSPARENT SPECIMENS WITH QUANTITATIVE PHASE MICROSCOPY

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Quantitative phase microscopy (QPM) is an emerging technique offering diffraction limited spatial resolution and non-invasive observation of transparent specimens [1-4]. Originally developed for imaging of the phase of an object, its applications have been demonstrated for a variety of objects, thick and thin, biological and inorganic [1-3]. QPM has also been used in determining both two-dimensional (2D) [2] and three-dimensional (3D) [3, 4] refractive index distribution (RI) of a range of transparent specimens. In addition, it has also been used with polarised light to determine the retardation introduced by a specimen which permits simultaneous mapping of the refractive-index and birefringence of a specimen.

The observation of phase objects and the 3D RI distribution are subjects of long-standing interests in the imaging community. In particular, reconstructing the 3D refractive index spatial distribution using tomographic techniques is currently receiving a renewed attention because of its importance in determining the optical properties of a range of specimens studied in various industries including pharmaceutical, biotech, chemical and forensic analysis. Furthermore the refractive index of micro-sized particles is a highly sought-after property since it characterises particle interaction with light systems.

In this presentation we focus on combining QPM with standard tomographic reconstruction techniques for the investigation of the 3D refractive index of various photonic devices. In addition, we comment on recent results reconstructing the refractive index of an individual spherical transparent specimen embedded in a microcapillary tube immersed in a known medium. The results of this research may shed light on characterising and modelling the optical properties and organelles within biological cells.

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