Topic for Master or Diploma Thesis

Depth-Resolving Microscopy with Helical Wavefronts and Aberration Correction

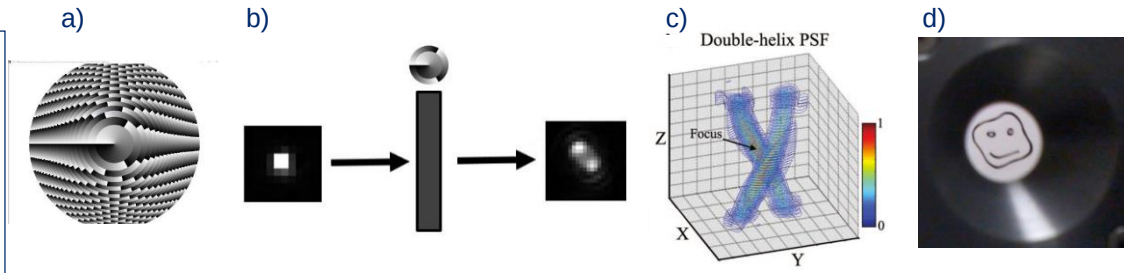
Motivation

Measurement methods applied for characterizing microfluidic flows, e.g. flow cytometry, are usually based on light microscopy. These, however, capture images only at a single focal plane (2D). A distinct depth information necessary for reconstructing a volumetric information (3D) is missing. Another problem are temporarily varying aberrations, caused e.g. from freely fluctuating air-liquid interfaces (e.g. nutrient solution).

Within this Master work, a depth-resolving microscope based on helical wavefronts shall be realized and characterized. Helical wavefronts generated by a phase mask transform a single object point into a twin image, the orientation of which is determined by the depth of the object. A dynamic correction of aberrations shall be realized using a deformable membrane mirror which has to be implemented into the setup as well.

The Master work comprises the characterization of the spatial resolution, the investigation of the influence of aberrations as well as applications of the microscope in the field of biomedicine.

This up-to-date work will be carried out within the framework of an excellence project of the German Research Foundation (DFG).



a) spiral phase mask, displayed on a liquid-crystal spatial light modulator
b) generation of a twin image with depth-dependent orientation
c) helical point spread function (PSF)
d) deformable membrane mirror with displayed aberration (here: quadrafoil)

Tasks

- setting up a light microscope with helical wavefronts
- realization of a dynamic correction of time-varying aberrations
- investigation of the spatial resolution under the influence of aberrations
- proving and application at biomedical experiments

Keywords

3D microscopy, helical wavefronts, adaptive optics, aberration correction

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