

MICROSCOPY WITH NON-DIFFRACTING BEAMS

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KEY WORDS: light-sheet based microscopy, non-diffracting beams, spatial light modulator

Established microscopic methods, as confocal microscopy, lead to images with weak contrast and resolution when imaging larger ($>100\mu\text{m}$) objects. This is mainly due to scattering of light at structures within the objects. Based on the successful concept of light-sheet based microscopy [1] a module was developed and built which permits illumination of samples with phase-modulated beams in a direction perpendicular to the axis of detection. The phase of the beam is manipulated by a spatial light modulator (SLM) thus entailing the properties of a non-diffracting beam. The light-sheet is then realized by fast lateral scanning of the focus.

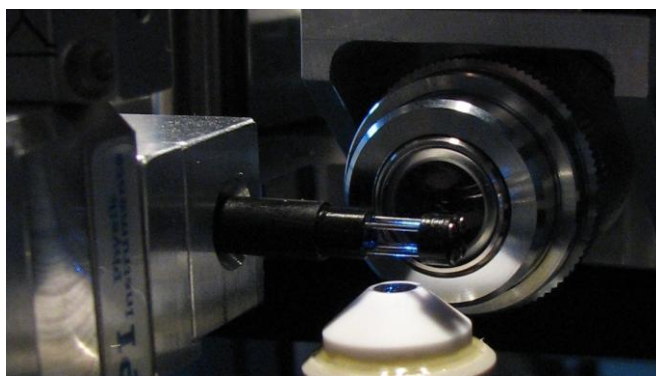


Figure1: Photo of the setup showing illumination, detection optics as well as the sample mount.

As a prominent member of the class of non-diffracting beams, Bessel beams [2] are used for sample illumination, since they promise a number of advantages, such as a more isotropic resolution over a larger field of view or the ability of self-reconstruction behind obstacles [3], leading to a more homogeneous sample illumination. Artifacts produced by coherent scattering are significantly reduced. The setup is a versatile tool for the study of the interaction of various

illumination beams with well-defined or biological material with the aim of increasing the quality of 3D-images. We present images from objects with known and unknown structure and discuss results from both experiments and computer simulations.

[1] J. Huisken et al, "Optical sectioning deep inside live embryos by selective plane illumination microscopy", *Science* **305**, 1007 (2004)

[2] Durnin et al, "Diffraction-free beams", *Phys. Rev. Lett.* **58**, 1499 (1987)

[3] Bouchal et al, "Self-reconstruction of a nondiffracting beam", *Opt. Com.* **151**, 207 (1998)