Towards interferometric Light Sheet Microscopy

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ABSTRACT:

Detailed imaging of biological tissue, particularly when thick and strongly scattering, continues to be one of the main challenges of modern microscopy. In said effort, Light Sheet Microscopy (LSM) constitutes a very interesting tool for high contrast 3D imaging, due to its benefits regarding excellent acquisition speed and low illumination intensities and energies.

While imaging fluorescently labelled samples by LSM has become a standard in the last decade, there are only a few studies[1] concerning coherent LSM, even though exploiting the phase correlation of scattered photons opens a wide range of possibilities. This is particularly true when done in combination with pulsed laser light, or light with low coherence length, which enables the separation of rarely- and often-scattered photons.

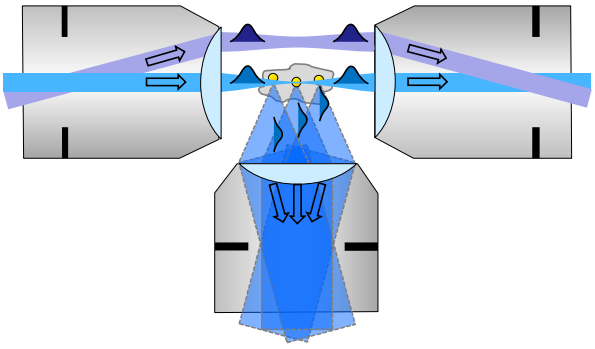

Figure 1: Schematic of the illumination and reference beams.

In this work, we explore the alternative of using coherent imaging by building an interferometric light sheet microscope, where we interfere scattered light, collected perpendicularly to the illumination direction, with a reference beam, by means of a modified Mach-Zehnder interferometer. Phase shifting the reference beam and calculating the difference of the interference patterns results in images that contain only information from photons that travelled an optical path length that is close to the length of the reference beam path.[2]

We present our first experimental results and discuss the theoretical and practical bases for coherent Light-Sheet Microscopy, based on simulations.

REFERENCES:

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