PUPIL PLANE POLARIZATION STRUCTURING FOR SHAPING THE FOCAL VOLUME IN HIGH N.A. MICROSCOPY

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When focusing with a high NA objective the vectorial description of the light must be used to describe the focal volume. As has been shown[1], structuring the polarization at the pupil plane can induce interesting distributions of intensity in the focal volume for the different polarization components. These distributions of intensity can be of value for different purposes when the polarization of the electric field play a role in the interaction of light with matter or, as proposed[2], to build specially compact PSFs in superresolution systems.

In this work we investigate the feasibility of the use of liquid crystal spatial light modulators (in particular the Meadowlark Hex69) to structure the polarization of light in the pupil plane. These are interesting devices to explore considering that they allow to change dynamically the polarization structure in the focal volume without the need for moving parts in the optical system. The temporal change in polarization that they allow can be added to the available tools to control the interaction of the light with matter in the focal region. The down side is the limited polarization changes they can induce and the relative slow response.
Results of computer simulations of the focal volume for incoming spatial varying polarization states are presented. To do that we developed a software to numerically calculate the vectorial field propagation using a three-dimensional fast Fourier transform of spherical caps in the propagation wave vector space. Also, results using a genetic algorithm to search for pupil plane polarization structures that give rise to required focal volume polarization distributions are shown.

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2. Dorn, R., S. Quabis, and G. Leuchs, *Sharper focus for a radially polarized light beam.* Phys. Rev. Lett., 2003. **91**(32): p. 233901.