

PUPIL FUNCTION ENGINEERING.

T. Wilson, F. Massoumian and R. Juskaitis,

Department of Engineering Science,
University of Oxford, Parks Road, Oxford, OX1 3PJ, UK.
e-mail: tony.Wilson@eng.ox.ac.uk

A fundamental aspect of all optical imaging systems, whatever their particular form might be, is that a probe of light – and the probe can take many forms -- is caused to be incident upon a specimen. The ensuing interaction gives rise to the optical emission which is used to form an image. The particular nature of the emission from which the image contrast originates is determined by the specific nature of the particular photo-physical, photo-chemical interaction but the optimum resolution and contrast can be achieved only if the optical field of the probe light is of the appropriate form. In many cases this will simply mean as small a spot of light as possible and the challenge will be little more than correctly coupling a beam of light into the imaging optical system. In other cases it will be important to be able to control the amplitude, phase and even polarisation of the optical field incident on the specimen.

The ability to accurately generate an arbitrary scalar complex optical wavefront is important in many fields from optical shop testing to adaptive optics applications. In this latter case it is desirable to be able to reconfigure these wavefront shapes as quickly as possible. There are however an increasingly large number of instances in which it is desirable to create arbitrary vectorial beams in which the polarisation is spatially varying.. In this paper we will show how we can generate such beams accurately using a ferroelectric liquid crystal spatial light modulator in an appropriate 4- f optical system. We will concentrate on the use of radial polarisation in a confocal microscope to both enhance the axial component of the electric field in the focal plane as well as to generate a very finely focussed spot of light..