

CHARACTERISATION OF OBJECTIVE LENSES USING POINT SOURCE INTERFEROMETRY

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KEYWORDS: Objective lens, interferometry, aberrations

The objective lens forms the most important part of a microscope, ultimately determining the resolution and imaging properties of the system. Since a 'perfect' objective lens does not exist, lens design involves compromises between various factors such as constancy of magnification, the presence of aberrations and flatness of field. Since details of the optical design are not usually available, in order to evaluate the performance of a microscope it is desirable to be able to measure the properties of objective lenses. This can be done, for example, by probing the field in the focal region using point-like objects to obtain the focal intensity distribution or the point-spread function of the system. Alternatively, one can examine the phase and amplitude of the optical field in the pupil of the objective.

We have implemented pupil plane measurement using a point source interferometer (see Figure 1). The object arm of a Mach-Zehnder interferometer was adapted to include a coherent point-like source, consisting of a condenser and a sub-wavelength pinhole. The pinhole was fabricated by evaporating a gold layer onto a coverglass and the 200nm diameter aperture was created in the layer by ion beam milling. The point source was positioned in the focal region of the test objective and the complex pupil field was obtained from the resulting interferograms.

The aberration performance of various objectives was measured for different positions of the point source within the focal region. The experimental results indicate disagreement with the theoretical relationship between the field in the focal region and the phase in the pupil of the objective. This could have important consequences in microscope systems where the phase in the pupil is modified in order to control the focal field.

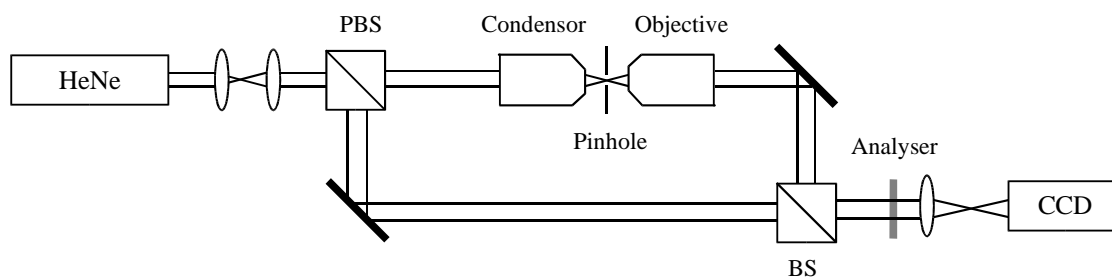


Figure 1: The point source interferometer. (PBS – polarising beam splitter, BS – beam splitter)