

FAR-FIELD VECTORIAL POLARIMETRY

Oscar Rodríguez^{1,*}, David Lara², and Chris Dainty¹

¹Applied Optics, School of Physics, National University of Ireland, Galway, University Road, Galway, Ireland

²The Blackett Laboratory, Imperial College London, SW7 2BW, London, United Kingdom

E-mail: *oscar.rodriguez@nuigalway.ie

KEYWORDS: Polarization, polarimetry, three-dimensional fields.

1. INTRODUCTION

According to the vectorial theory of diffraction [1], the field distribution in the focal region of a focusing lens depends on the polarization state of the incident light and the numerical aperture (NA) of the lens. This dependence becomes important as the NA is increased. It is known that for some incident polarization states, the field distribution in the focal region has a three-dimensional structure; that is, the field has components in the three spatial directions. In the most general case, after the interaction of a three-dimensional focused field with a specimen, a three-dimensional scattered field, with potentially valuable information about the specimen, is produced. A near-field method for the analysis of three-dimensional fields has been previously introduced by Ellis and Dogariu [2].

In this work, we present an alternative far-field scattering-angle-resolved method, based on known polarimetry techniques, for the analysis of the three-dimensional field scattered by the specimen. We refer to this method as the far-field vectorial polarimetry method. Fig. 1 shows a schematic diagram of the method.

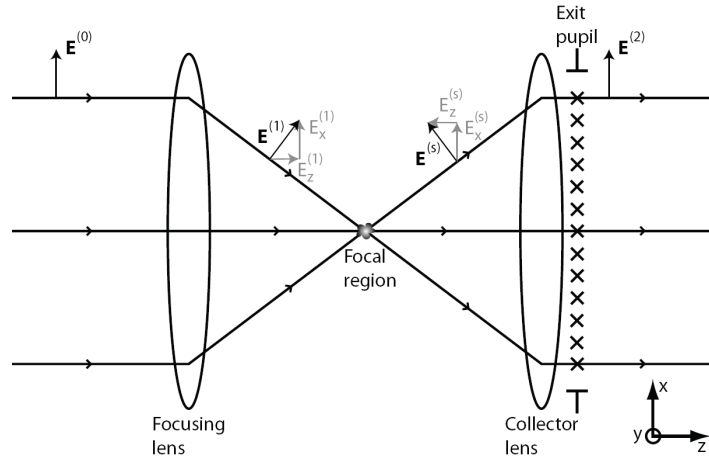


Fig. 1. Schematic diagram of the vectorial polarimetry method.

The scattering-angle-resolved polarization state distribution is analyzed across the exit pupil of the collector lens. The crosses in Fig. 1 represent sample positions, within the exit pupil of the lens, where the polarization state is analyzed. We shall present numerical and experimental evidence showing that our method allows for high sensitivity on sub-resolution displacements of a sub-resolution scatterer within the focal region of a high NA lens [3].

[1] B. Richards and E. Wolf, *Proc. R. Soc. A*, **253** (1274), 358–379, (1959).

[2] J. Ellis and A. Dogariu, *Phys. Rev. Lett.*, **95** (20), 203905, (2005).

[3] O. G. Rodríguez Herrera, PhD thesis, National University of Ireland, Galway, (2009).

http://optics.nuigalway.ie/people/orodriguez/Oscar_Rodriguez_PhD_thesis.pdf