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Tesis: **"POLARIMETRY OF IMAGES USING CLASSICAL ENTANGLEMENT OF LIGHT"**

Resumen:

The study of the polarization of light nowadays is conceived within two main branches: conventional and unconventional polarization. Conventional polarization is the term assigned to the spatially homogeneous amplitude and phase associated to the electric field distributions. On the other hand, the spatially non-homogeneous amplitude and phase electric field distributions are termed as unconventional polarization. From all the possible unconventional polarization states, there exist a very special kind of states which cannot be expressed as a single product of a spatial and a polarization distribution. Such kind of polarization states are nonseparable or entangled, because the electric field can be represented only by the use of two coordinate-independent Jones vectors and two independent scalar fields. This type of entanglement is denoted as classical entanglement, because occurs in a single light beam (intra-system), contrary to the case of quantum entanglement, which occurs between two separated photons (inter-system entanglement). Two of the main unconventional polarization states, radial and azimuthal, are classically entangled.

The Mueller matrix represents the linear responses associated to optical materials and it contains all the available polarimetric information. Usually, it can be determined by using at least 4 incident conventional polarization states. In this work, a single incident polarization is employed: an azimuthal polarization state is generated and used as a classical entangled beam for the experimental determination of the Mueller matrix associated to birefringent, transparent samples. The procedure developed here shows the way the entangled degrees of freedom of the beam (the spatial or mode distributions, represented as Hermite-Gauss and Laguerre-Gauss modes, and the polarization states) can be analyzed independently. Based in two previous works (Töppel et al. (2014) and Aguilar (2017)) an experimental setup is proposed and improved. The experimental setup consists of a complex set of modules: a polarization state generator, an unconventional or entangled polarization state generator, the sample under study, a mode converter, a modified Mach-Zehnder interferometer, a conventional polarization state analyzer, and a spatially-resolved detection system. An analysis of each module is realized, in order to test the optical alignment and expected functionality.

The Mueller matrices associated to air, to a half-wave plate and to a quarter-wave plate retarders, respectively, are determined by applying the relationships reported by Töppel et al. (2014) and the relationships obtained by the ideal polarimetric arrangement (IPA), reported by Atondo-Rubio et al. (2005).

Results are reported by using both, images and the spatial average symmetry (SAS), which show to be consistent with the expected responses. To our knowledge, this is the first study associated to the experimental determination of the Mueller matrix of transparent objects under open space conditions, using the classical entangled azimuthal polarization state as a single incident polarization state.