MOVEMENTS ON ANGULAR POINCARE SPHERE DURING BEAM PROPAGATION

T. Alieva[1], M.J. Bastiaans[2]
[1]*Univ. Complutense de Madrid. Spain.*
[2]*Eindhoven Univ. Technology. Netherlands.*
talieva@fis.ucm.es

The Poincaré sphere together with the Stokes parameters is widely used for the representation of the beam polarization state. A similar approach has been generalized [M. J. Padgett and J. Courtial, Opt. Lett. 24, 430 (1999); G. S. Agarwal, J. Opt. Soc. Am. A 16, 2914 (1999); T. Alieva and M. J. Bastiaans, Opt. Lett. 34, 410 (2009)] to the characterization of intrinsically anisotropic Gaussian-type modes. Recently [M. J. Bastiaans and T. Alieva, “Signal representation on the angular Poincaré sphere, based on second-order moments,” J. Opt. Soc. Am. A (2010), accepted for publication] we have proposed to use this formalism for the description of an arbitrary, scalar, two-dimensional signal, which might be completely or partially coherent. In this paper, based on the analysis of the beam’s second- order moments expressed as a series of Hermite-Gaussian (HG) modes, we analyze the movements on the angular Poincaré sphere during beam propagation through an isotropic ABCD system.
Two second-order moments invariants allow to divide two-dimensional signals into two classes: isotropic and anisotropic. Using the Iwasawa decomposition of the ray transformation matrix and bringing the second-order moments matrix to its diagonalized form, we are able to associate the signal with a certain point on the sphere similar to the one applied for Gaussian mode representation. The latitude of this point describes the vorticity of the signal, while its longitude corresponds to the orientation of the beam's principal axes. The propagation through the isotropic ABCD system modifies the diagonalizing matrix; consequently, the point on the Poincaré sphere is moving, which corresponds to a change of the vorticity state. We analyze these movements using the HG modes composition of the signal. In particular we confirm - as expected - that stable modes do not change their position on the Poincaré sphere during beam propagation through an isotropic system.
The proposed approach is useful for beam characterization, analysis and synthesis.

Keywords: Wigner distribution moments, beam characterization, optical vortices.

PHOTONIC APPLICATIONS OF BACTERIORHODOPSIN

D.V.G.L.N. Rao
University of Massachusetts. USA.
raod@umb.edu

Bacteriorhodopsin (bR) is a photodynamic protein complex found in living systems. The unique feature is its flexibility. Upon absorption of a visible photon, within the broad absorption with a maximum at 570 nm, the bR molecule goes through short lived intermediate states and transforms to relatively long-lived M state (with an absorption peak at 412 nm). Molecules in the M-state can be thermally transformed into the initial B state or they can go back directly to B state within 200 ns upon shining blue light. It can be approximated as a two level system. The process of switching between B and M states (trans-cis photoisomerization) can go in both directions depending on wavelength, intensity and polarization of the incident light, opening a variety of possibilities for manipulating amplitude, phase, polarization of the incident light and the index of refraction. It is a nontraditional nonlinear optical material with exceptionally high values of nonlinearity. A significant advantage of this system is that it is environmental friendly. Over the years we studied the basic nonlinear optics (four-wave mixing, phase conjugation, z-scan, and photoinduced anisotropy using microwatt power lasers) and successfully exploited the unique properties for a variety of photonic applications – all-optical switching, modulation, bistability, logic gates,

ISBN 978-612-4057-21-2