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GENERALIZATION OF ZERNIKE BASIS FOR COMMON OPTICAL APERTURES

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Abstract

Zernike polynomials are commonly used to represent the wavefront phase on circular optical apertures, since they form a complete and orthonormal basis on the unit circle. Here, we present a generalization of this Zernike basis for a variety of important optical apertures. On the contrary to ad hoc solutions, most of them based on the Gram-Smith orthonormalization method, here we apply a diffeomorphism that transforms the unit circle into an angular sector of an elliptical annulus. In this way, other apertures, such as ellipses, rings, angular sectors, etc. are also included as particular cases. We also consider piece-wise diffeomorphisms that transform the unit circle into more complex geometries appearing, for example, in segmented mirror telescopes. This generalization, based on in-plane warping of the basis functions, provides a unique solution and guarantees a reasonable level of invariance of the mathematical properties and the physical meaning of the initial basis functions.

Keywords: Zernike polynomials, optics, segmented mirror telescopes.
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