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Chromatic aberration and polychromatic image quality with diffractive multifocal lenses

Sowmya Ravikumar[1], **Arthur Bradley**[2] and **Larry N. Thibos**[2]
[1]University of California Berkeley, USA
[2]Indiana University, USA

Purpose: To evaluate the impact of target distance on polychromatic image quality in a virtual model eye implanted with hybrid refractive/diffractive lenses.

Setting: Indiana University, Bloomington, Indiana, USA.

Design: The study used a virtual eye model as the primary computational technique.

Methods: A model eye was constructed by incorporating a phase delay map for a diffractive optical element into a reduced-eye model incorporating ocular chromatic aberration, pupil apodization, and higher order monochromatic aberrations. The diffractive element was either a monofocal lens of +3.2D diffractive power, or two types of bifocal lenses (unapodized or apodized) of +2.92D 'add' power. Polychromatic point-spread functions and image quality for white and monochromatic light were quantified for a series of target vergences, wavelengths and pupil diameters, using modulation transfer functions and a variety of image quality metrics.

Results: Ocular longitudinal chromatic aberration was largely corrected by the monofocal design and by both bifocal designs for near targets. In the bifocal design, add-power and the ratio of distance-near image quality changes significantly with wavelength and pupil size. Also, image quality for distance is better with the apodized design.

Conclusions: Achromatization, by the diffractive lens provides significant improvement in polychromatic retinal image quality. Along with apodization and higher order aberrations, it can significantly affect the near/distance balance provided by a diffractive multifocal lens.

Biography

Sowmya Ravikumar completed her optometry training in India at the Elite School of Optometry, Birla Institute of Technology and Science. She did her clinical internship at Sankara Nethralaya Eye Hospital at Chennai, India. Following this she completed her doctoral studies at Indiana University Bloomington at the School of Optometry. Her thesis work focused on the effects of optical aberrations on image quality and visual performance. Since graduation she has pursued a post-doctoral fellowship at the University of California Berkeley under the guidance of Banks. For her post-doctoral work, she has focused on binocular visual performance with presbyopic corrections.

ravikumar@berkeley.edu