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Measurement and Correction of the Eye's Chromatic Aberration

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Abstract

Purpose: To precisely measure the chromatic aberration of the eye using a new objective method. To design and manufacture phase plates to correct the ocular chromatic aberration using chromatic aberration data.

Methods: We developed a new instrument to measure the complete ocular wave-front aberration for a series of different wavelengths. It is based on a Hartmann-Shack (HS) wave-front sensor but uses a Xe white-light lamp together with a set of interference filters as illumination source. By using a high-sensitivity camera, it is possible to record HS images for all visible wavelengths with enough signal-to-noise ratio. From the wavefront estimated for each wavelength, the longitudinal chromatic aberration (LCA) is obtained simply as the defocus difference. Sphero-chromatism, the dependence of spherical aberration with wavelength, is also determined. Phase plates were designed and manufactured to compensate for the LCA in a particular eye.

Results: We measured the wave-front aberration for five different wavelengths (440, 488, 532, 633, 694 nm) in four subjects. The average measured values of LCA and spherochromatism follows the predicted theoretical behavior in a simple water-eye model. The same instrument was used to measure chromatic aberrations of the eye plus the correcting phase plate.

Conclusions: We demonstrated the feasibility of using a white light source for wave-front aberration measurement in the human eye within the 440-700 nm wavelength region. The instrument was also used to control the accuracy of the correction of the chromatic difference of focus by using phase plates. This

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device will be used in the future to further study the impact of correcting chromatic aberration in spatial vision.

Keywords: optical properties • refractive surgery: optical quality



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