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Modeling Stiles Crawford Effect of the First Kind as Pupil Apodization

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Abstract: A beam entering a pupil from the edge elicits a poor visual response in comparison to an identical beam passing axially. This diminution in the effective brightness is a retinal phenomenon known as the Stiles-Crawford Effect of the first kind (SCE I). But in this study, modeling the effect as a pupil apodization, both in coherent and incoherent incident light and evaluating the modulation transfer function (MTF) of a periodic object of infinite cycles like a sine wave transmission profile has led to different degree of modification in the modulation of the retinal light distributions. While the incoherent light shows a modification of as high as 35 % in the modulation over a wide range of spatial frequencies, the modulation remains unmodified in coherent illumination. Various other apodization parameters are also taken to evaluate the MTF to understand its response to spatial frequencies under both coherent and incoherent illuminations. And it is found that for a large value of apodization parameter, the Gaussian character is lost and the modulation assumes a constant value of unity for all values of spatial frequencies for incoherent illumination. But for coherent entering light the SCE I apodized human eye does not show any modification in the modulation thereby pointing to a possibly governing role the formation of an interference pattern on the retina assumes in regulating retinal light distributions besides the traditional influence the Stiles Crawford effect of the first kind has hitherto offered.

[Full Paper]