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MODELING THE IMAGE QUALITY ON THE RETINA WITH VARIABILITY OF WAVEFRONT MEASUREMENTS

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Ocular aberrations have been used to describe vision defects caused by refractive errors and measured by aberrometers. In clinical care, these measurements are directly used for wavefront-guided corrections. However, as a single measurement can lead to ambiguous conclusions, multiple measurements are collected from the patient in each sitting. Repeated measurements can induce variations in the readings, potentially resulting in correction errors. In the literature, several studies have therefore been carried out to investigate the importance of variability induced by all sources, and these studies concluded that change in the magnitude of the expansion coefficients of the ocular aberrations is statistically significant. This study aims to provide a more comprehensive and quantitative analysis of the impact of variability in wavefront measurements on retinal image quality (IQ) using the Structural similarity index metric (SSIM), which distinguishes the present study from prior research. For this purpose, as the significance of variations relies on the signal, the variability change is replaced using the signal-to-noise ratio (SNR). In addition, normally distributed small random numbers with different magnitudes have been added to the data sets in such a way that SNR is altered from 24.7876 dB to 70 dB. The SSIM values for each noised data set were calculated using the test images used in image processing. It was observed that the variability reduces the detail of edges in the image. Further, SSIM values against SNR were altered, and a similar pattern was followed for all test images. Particularly, SSIM values were fluctuated up to a certain value of SNR, which is 32.0539 dB for the image of Lena (512×512 pixels). Subsequently, SSIM values gradually increased with SNR and became steady. In this region, the SSIM and SNR were modelled using Gaussian terms up to three with 99.99% accuracy, which can be utilised as a tool to describe IQ on the retina against the variations of measurements.

Keywords: Signal-to-noise ratio, Structural similarity index metric**,** Variability, Vision defects