Skew-Axis Cylinder Lens Optical System: Novel Method of Clinical Optometry of Astigmatism, Characterization, Theoretical Modelling, and Implementation

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Astigmatism is a cylindrical refractive vision defect that affects 30% of the world population. Current subjective optometry of astigmatism is complicated, has low accuracy, and is dependent on verbal interaction. As a result, optometric measurements of astigmatism are often done suboptimally. In this work, a rotatable Skew-Axis Cylinder Lens Optical System (SACLOS) has been invented, designed, and created with a goal to provide a novel, improved alternative to the existing method of optometry of astigmatism. The apparatus enables simultaneous manipulation of 2 independent optical parameters via direct computer-aided patient feedback in physical 2D space. This eliminates the need for verbal interaction and dramatically simplifies the procedure. A prototype apparatus has been built, and physical properties of the optical system have been characterized and optimized. The SACLOS has been demonstrated to accurately measure astigmatic defects. A theoretical model was derived and used to optimize the apparatus and method. Experimental data were compared with theoretical predictions. For further optimization, a novel point light source optometric test target was developed. It provides significant advantages over alternatives, improving measurement accuracy and patient experience. Thus, the developed device paves a way for quick, inexpensive, and accurate optometry of astigmatism, free from communication issues – an improvement over existing solutions.

Awards Won:

First Award of $5,000

Dudley R. Herschbach SIYSS Award

Qorvo: Qorvo Innovator Award - 1st Place

Central Intelligence Agency: First Award: $1000 award