Characterizing the 3D Refractive Index Profile of a Contact Lens

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BACKGROUND

- New generations of contact lenses are developed with a bilayer, so it is important to characterize the changing refractive index profile throughout the whole lens
- Optical Phase Computed Tomography (OPCT) could be a possible metrology system, but it assumes parallel ray propagation
- OPCT has been used in past studies, to characterize 3D refractive index profile of optical fibers

RESEARCH QUESTION

Do visible light rays passing through a contact lens deviate from parallel at an angle greater than through a optical fiber where OPCT has been successfully applied?

METHODS

- Ansys Zemax OpticStudio was utilized for raytracing
- An optical fiber and contact lens were modeled
- The contact lens was simulated with several projection angles
- Rays of 543.8nm were traced through
- The maximum refraction angles of the optical fiber and contact lens were determined

Is the parallel ray assumption of Computed Tomography sufficiently satisfied when applied to contact lens characterization using light in the visible spectrum?

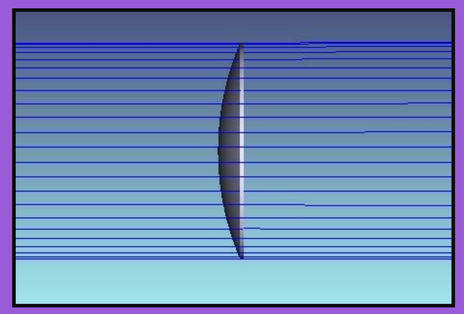

Figure 1: Modeled Contact Lens at 0°.

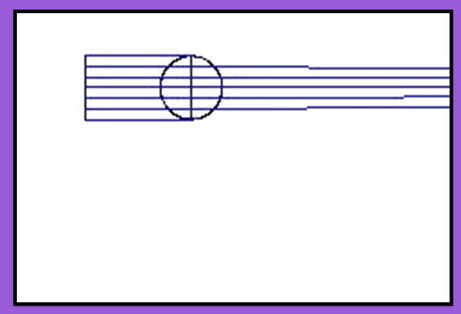

Figure 2: Modeled Single Mode Optical Fiber.

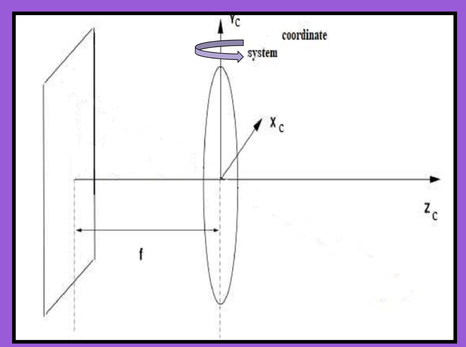

Figure 3: Example lens visualizing the projection angles as tilt about the Y axis.

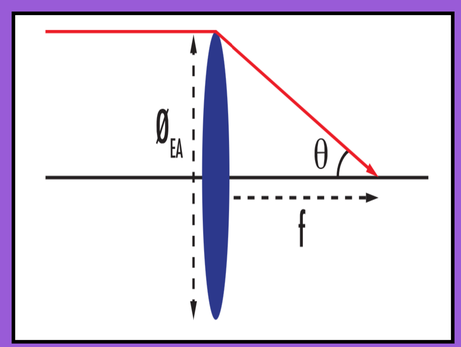

Figure 4: Example lens visualizing maximum angle of refraction Θ.

Lens Analyzed	*Maximum Refraction Angle*
Single Mode Fiber Optic	0.57°
Contact Lens 0°	0.17°
Contact Lens 45°	0.36°
Contact Lens 90°	0.13°
Contact Lens 135°	0.35°
Contact Lens 180°	0.17°

Table 1: Maximum refraction angles for single mode optical fiber and a contact lens at projection angles from 0° to 180°.

RESULTS

When using light in the visible spectrum, the maximum angle of refraction for all significant configurations of the contact lens were found to be smaller than that of the optical fiber. This confirmation of sufficiently satisfied parallel ray assumption allows for further development of a measurement system to categorize the 3D refractive index profile of a contact lens.

FUTURE RESEARCH

- Construct interferometric system
- Acquire interference images
- Process images and obtain phase maps
- Construct 3D refractive index profile

REFERENCES

1. Bachim, B. L., Gaylord, T. K., & Mettler, S. C. (2005). Refractive-index profiling of azimuthally asymmetric optical fibers by microinterferometric optical phase tomography. Optical Society of America.

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