Repeatability of retinal curvature estimation on widefield OCT systems

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PURPOSE

Widefield optical coherence tomography (OCT) enables imaging large regions of the retina with the potential to make accurate measurements of the retinal surface profile. However, the apparent curvature of the retina in a conventional OCT image does not represent the actual anatomical shape. Here we test the robustness of a technique for estimating the retinal curvature from data acquired with a Swept-Source OCT system PLEX® Elite 9000, (ZEISS, Dublin, CA).

METHODS

- Measure the surface of constant group delay (GD) for the PLEX Elite 9000 using Zemax
- Transform B-scan images to match the GD surface profile calculated in the Zemax model

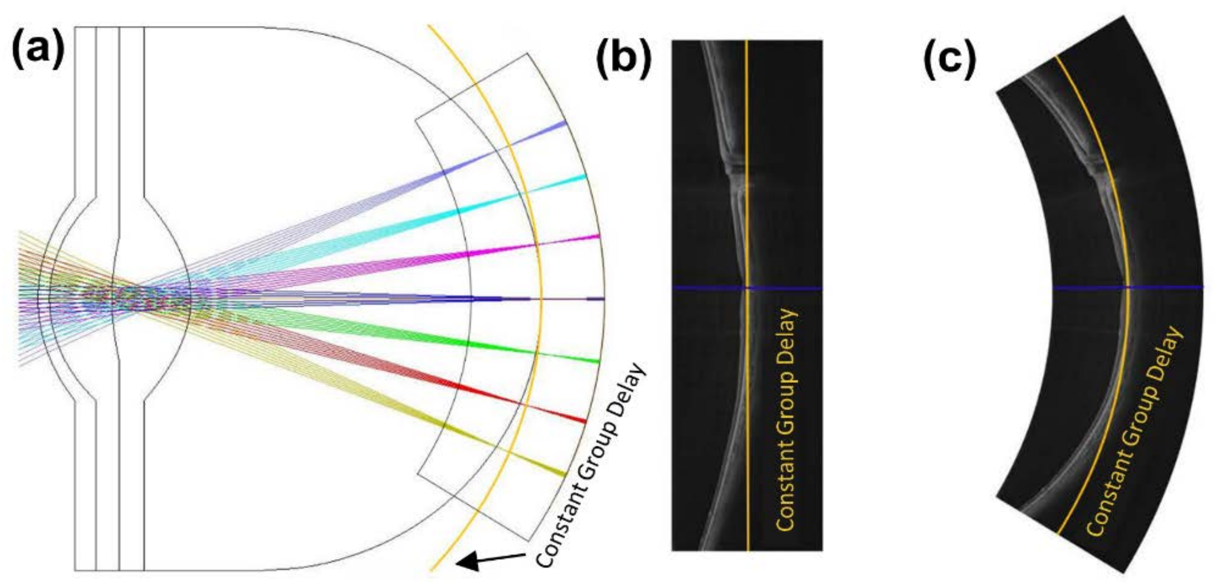

Figure 1. (a) Arizona eye model (b) OCT image of retina collected with PLEX Elite 9000 (c) Corrected OCT image.

- Apply a circular fit to the retinal pigment epithelium to quantify the retinal curvature
- Test repeatability of the retinal curvature estimation:

1. Test eye measurements with varying working distance and decenter (Fig 2-3)
2. Perform tolerance analysis that determines the retinal curvature estimation error as a function of various parameters (Fig 4)
3. A clinical study for which 10 subjects are imaged eight times (Fig 5)

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RESULTS

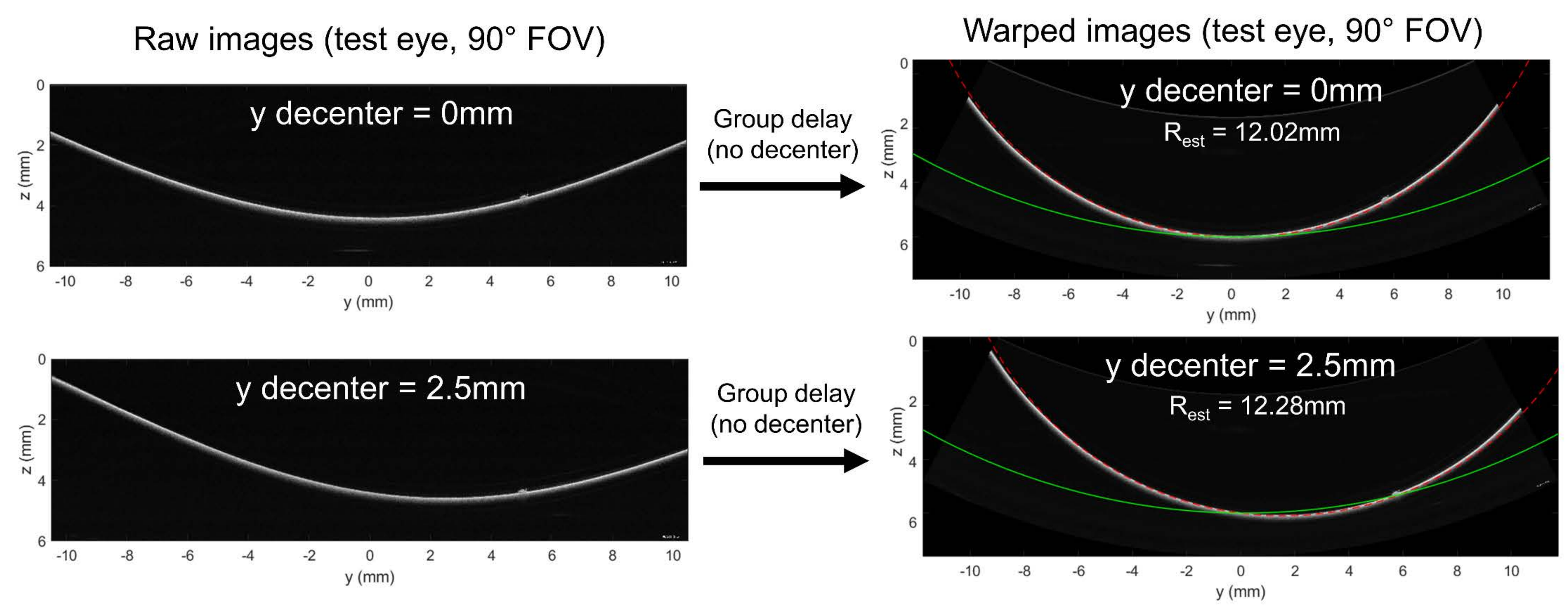

Figure 2. B-scan for test eye with and without decenter. Both images are then transformed using the same GD curve. Retinal curvature of test eye is 11.99mm.

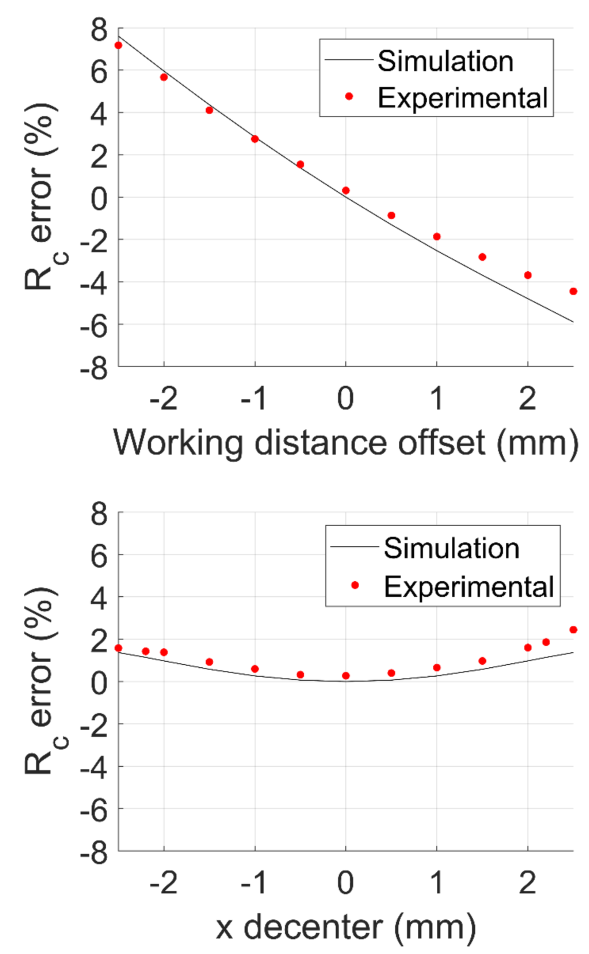

Figure 3. Percent error measurement of retinal curvature of test eye as a function of working distance and decenter.

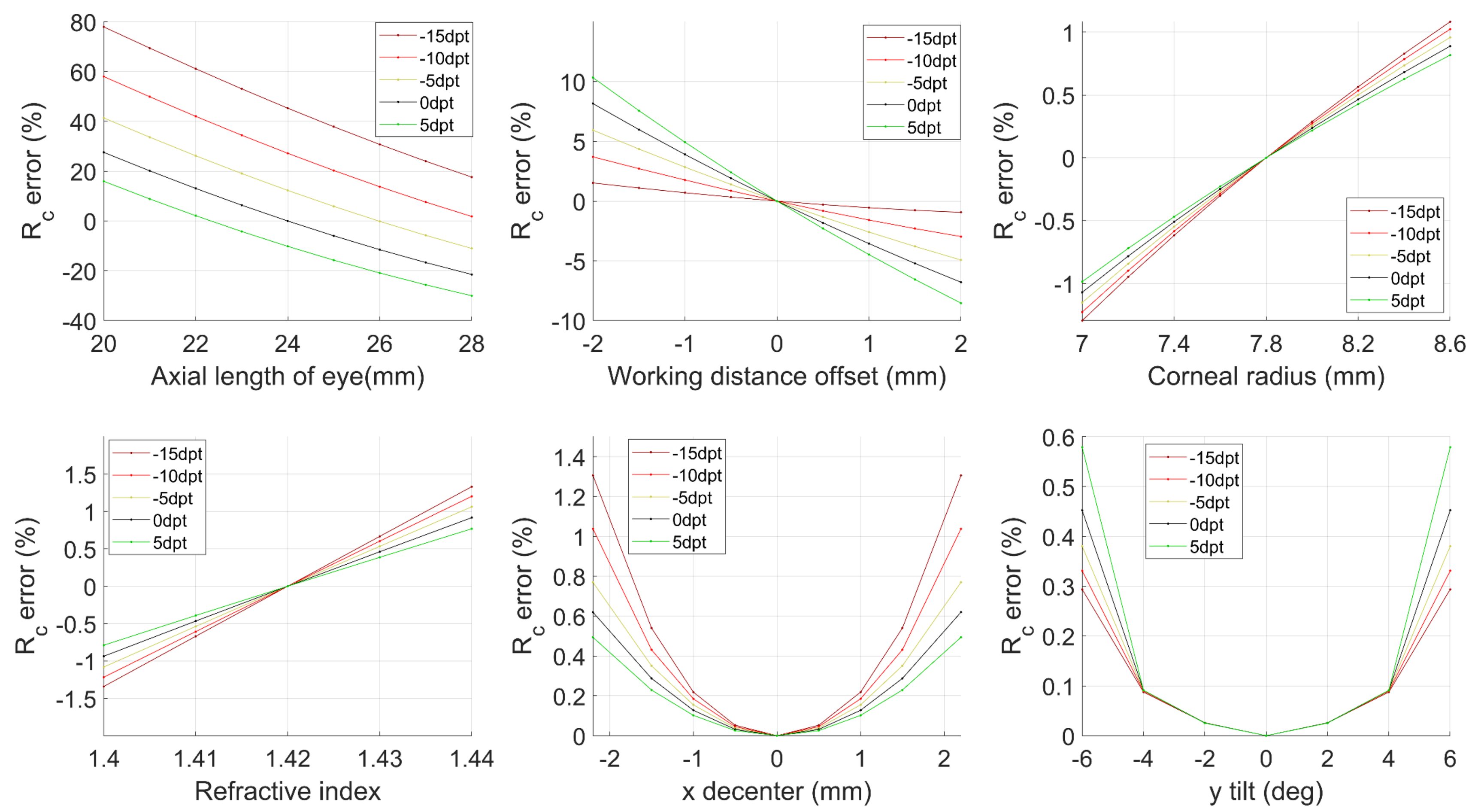

Figure 4. Percent error in estimated retinal curvature as a function of various parameters and refractive error ranging from -15 to 5 Diopter. Results are from simulations conducted in Zemax using Arizona eye model.

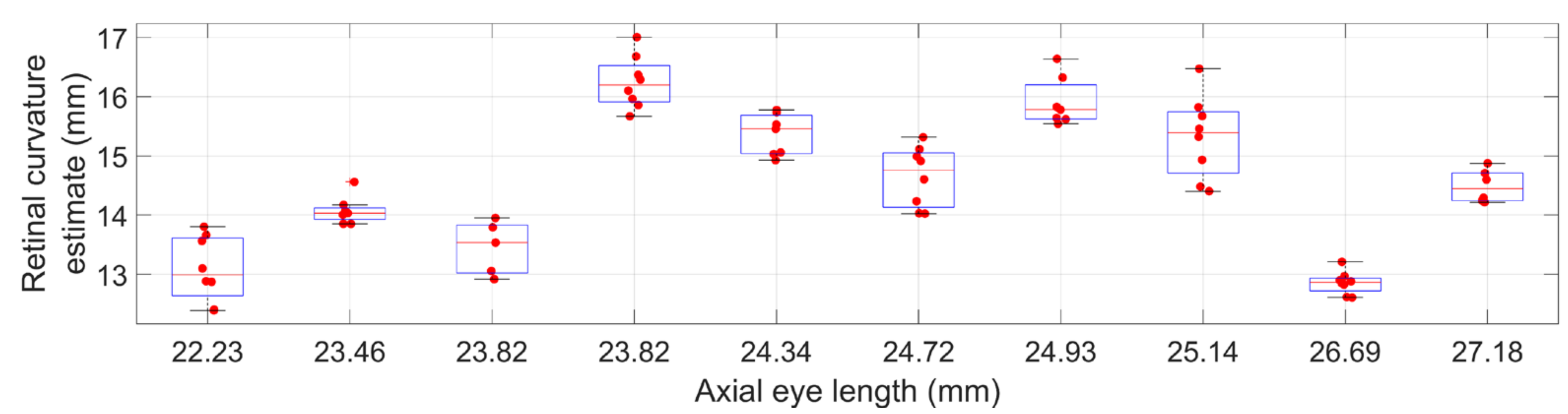

Figure 5. Box and whisker plots of retinal curvature calculations for ten subjects with varying axial eye length. Eight B-scans were acquired for each subject.

CONCLUSION

The axial length of the eye has the biggest effect on errors in the retinal curvature estimation, followed by working distance. The pooled standard deviation of the clinical study measurements was 0.405mm. These results demonstrate the potential this technique has for estimating the curvature of the retinal surface.