

Phoria measurement with an automated and objective cover test

Clara Mestre¹, Carles Otero¹, Fernando Díaz-Doutón^{1,2}, Josselin Gautier³, Jaume Pujol¹

¹ *Davalor Research Center (dRC). Universitat Politècnica de Catalunya, Terrassa, Spain.*

² *Center for Sensors, Instruments and Systems Development (CD6).*

Universitat Politècnica de Catalunya, Terrassa, Spain.

³ *Inria, Sophia Antipolis, France*

Abstract: In this study, the repeatability of an automated and objective method to measure phoria and its agreement with the prism cover test and the modified Thorington test are analyzed. The highly repeatable results obtained together with an agreement level between tests comparable to the one shown by other clinical tests represent additional advantages of using eye-trackers to measure phoria accurately and objectively.

The main purpose of this study was to compare an automated and objective method to measure near phoria using an eye-tracker with the prism cover test (CT) and the modified Thorington test (TH) [1]. The asymmetry of phoria between eyes and the effect of ocular dominance on the magnitude of phoria was also analyzed.

Thirty non-presbyopic adults with a mean age \pm standard deviation (SD) of 27.9 ± 4.6 years and phoria ranging from 14 prism diopters (PD) esophoria to 14 PD exophoria participated in the study. Horizontal phoria at near vision (40 cm) was measured with the CT, the TH and an automated and objective cover test using the eye-tracker Eyelink 1000 Plus (SR-Research) (ET). In the latter method, two pairs of crossed polarizers driven by stepper motors were used to cover the right and left eye alternately while participants were asked to fixate a 20/50 Snellen E letter placed at 40 cm. The cover test sequence consisted of three repetitions of binocular fixation, left eye occlusion, binocular fixation and right eye occlusion. Phoria was computed at each occlusion as the deviation of the occluded and fixating eyes from their positions in the previous binocular period. The ET measurement was repeated after a rest of 40 minutes. Ocular dominance was assessed with the Hole-in-the-Card test.

An example of ocular traces during the ET measurement is shown in Figure 1.

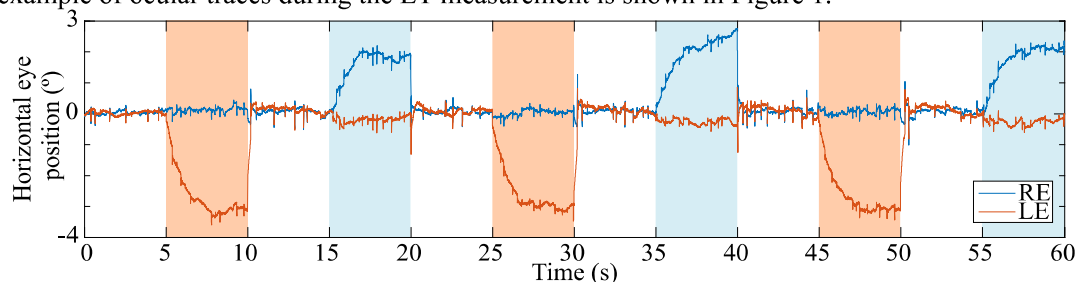


Figure 1.- Horizontal right (blue) and left (orange) eye positions. Periods of left eye occlusion are shaded in orange and periods of right eye occlusion are shaded in blue. The non-shaded areas correspond to binocular fixation periods.

The mean difference of the magnitude of phoria between sessions \pm SD was 0.15 ± 0.79 PD ($p=0.32$). Concerning the agreement between methods, repeated measures ANOVA showed no significant differences between the measured magnitude of phoria ($p=0.71$). The 95% limits of agreement of the ET method were ± 7.47 PD and ± 5.23 PD compared with the CT and the TH, respectively. There was no significant effect of ocular dominance on the differences of the magnitude of phoria between eyes ($p=0.20$).

The proposed automated and objective cover test showed considerably better intersession repeatability than the reported for the conventional clinical methods [2]. Moreover, the use of eye-trackers to measure phoria offers other advantages such as the possibility to record the movements of the occluded eye and to have an objective measurement with better resolution and accuracy. The ET method cannot be used interchangeably with the CT nor the TH, as well as the conventional methods do not agree [2-3]. However, as eye-trackers become common tools in clinical settings, their use should be the new gold standard for the measurement of phoria.

References

- [1] Scheiman M, Wick B. *Clinical management of Binocular Vision. Heterophoric, Accommodative, and Eye Movement Disorders*. Lippincott Williams & Wilkins (2014).
- [2] Antona B, Gonzalez E, Barrio A, Barra F, Sanchez I, Cebrian JL. "Strabometry precision: intra-examiner repeatability and agreement in measuring the magnitude of the angle of latent binocular ocular deviations (heterophorias or latent strabismus)". *Binocul Vis Strabol Q Simms Rom*. **26** 91 (2011).
- [3] Sanker N, Prabhu A, Ray A. "A comparison of near-dissociated heterophoria tests in free space". *Clin Exp Optom*. **95** 638 (2012).