Data quality in eye trackers: Signal resolution

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SESSION 1: Eye-tracking technology: Latest developments

Data quality in eye trackers: Signal resolution

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For evaluating whether the data from an eye tracker are precise enough for measuring microsaccades, Poletti and Rucci (2016) advocate that the measure "resolution" be used rather than the more established RMS-S2S. Resolution needs to be measured using an artificial eye that can be turned in very small steps, and visual estimation is used to assess whether the movements are visible in the recorded data from the eye tracker. As such, resolution cannot be measured with human data. Currently, resolution has an unclear and entirely uninvestigated relationship to existing RMS-S2S and STD measures of precision (Holmqvist & Andersson, 2017, p. 190). Resolution measurements have only been made on the DPI and one other eye tracker. We do not know resolution values for the most used eye trackers.

In this talk, we present a mechanism – the Stepperbox – for moving artificial eyes arbitrary distances from 1 arcmin and upward. We first present a validation of the mechanism that shows that it is capable of reliably making these movements.

We then use the Stepperbox to find the smallest reliably detectable movement in multiple eye trackers and empirically investigate how resolution relates to the extent (STD) and velocity (RMS-S2S) of noise produced by these eye trackers. Figure 1 shows one of our recordings.

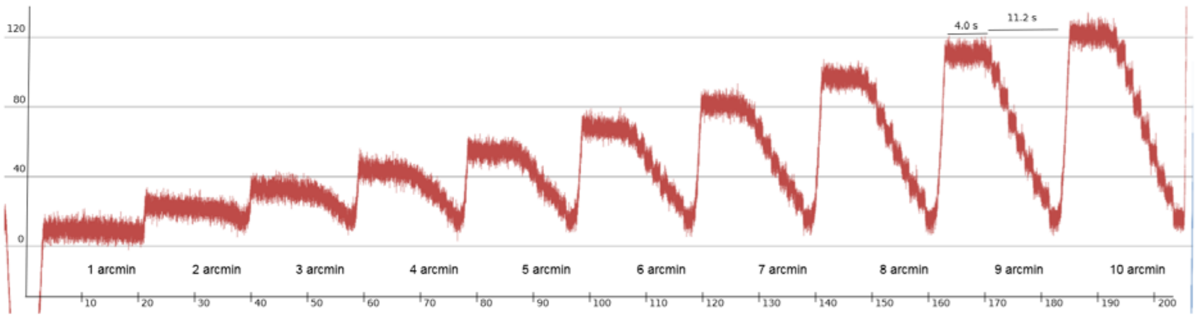

Figure 1. Increasingly larger steps from 1 arcmin to 10 arcmin steps. Each staircase shape involved 10 movements of identical amplitude after a 4 s waiting period. Stops between steps are 1 s long. The smaller movements clearly drown in the noise of this Tobii TX300 eye tracker, and resolution is 6-7 arcmin.

A preliminary analysis indicates that the RMS-S2S values have a *linear relationship* to the resolution values. Eye trackers with filters (coloured noise) differ slightly from eye trackers with no filtering (white noise). We take our results to show that RMS-S2S can be used to assess the minimal amplitude movement that can be reliably detected with an eye tracker. We argue that Poletti and Ruccis' criticism of RMS-S2S hides a conceptual confusion of resolution as the amplitude where events begin to drown in noise vs. resolution as quantization of the measurement space.

References

- Holmqvist, K., & Andersson, R. (2017). *Eye tracking: A comprehensive guide to methods, paradigms, and measures*. Lund, Sweden: Lund Eye-Tracking Research Institute.
- Poletti, M., & Rucci, M. (2016). A compact field guide to the study of microsaccades: Challenges and functions. *Vision Research*, 118, 83-97. doi: 10.1016/j.visres.2015.01.018