Technical Report on Parallax Correction of Tobii Glasses Eye Tracker

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July 12, 2014

Date Performed:	June 24, 2014
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1 Objective

To determine that the effectiveness of the parallax correction as the post calibration procedure.

1.1 Definitions

Calibration The calibration procedure manually moved the calibration point for the acquirement of the accurate gaze points. This internal calibration point is only valid while the glasses are not removed from the participant's head. Accuracy depends on the variety factors, which are right distance, exact points and light conditions, during the calibration procedure.

Recalibration Tobii Glasses eye tracker, which is used by our experiment, provides the post calibration which can be conducted the calibration procedure after the eye movement recording. This is called as *Post calibration* or *recalibration*. In this technical report, we specifically define the *Post calibration* or *recalibration* as the procedure for the parallax correction.

Gaze Point Gaze point means literally the location that the participant gazes.

Fixation Point Fixation point means the location that the participant fixes his or her gaze point for some time. Because the gaze points are always changing subtly even in the voluntary fixation state, the definition of the fixation is defined by the fixation filtering method. We used the system default fixation filter, I-VT fixation filter (Salvucci and Goldberg, 2000).

2 Experiments

To verify the improvement of the measurement of gaze points after the parallax correction, we used the gaze accuracy test in advance of the watching the video. The gaze accuracy test will show us how much accurate before and after the recalibration.

2.1 Gaze Accuracy Test

For the measurement of the accuracy of the gaze point, we prepared the test video which has the moving dot on the lattice background. Participants are instructed to patiently fixate on the dot while it is stationary. You can check the video on YouTube at Kim (2014).

2.2 Material

We used the portion of episodes in the kids video, *Pororo Season 3*, as the material to get the median point of fixations. The playing time is approximately 30 minutes, which yields about 3,000 to 6,000 fixations.

2.3 Method

Before the recording of the participant's eye movements, we took the snapshot from the eye tracker. This snapshot contains the information of the IR makers' location and its identities via the function of the device. For this, we can obtain coordinates of gaze points on the snapshot image. After applying the affine transformation featured by the snapshot, finally, we can get the media coordinates, which represents the positions on the video screen. The coordinates on the snapshot image $\mathbf{x}$ is transformed to the coordinates on the video screen $\mathbf{x}^*$ via the affine transformation matrix $\mathbf{A}$ is defined as the algebraic equation,

$$\mathbf{x}^* = \mathbf{A}\mathbf{x},$$

and the affine transformation matrix $\mathbf{A}$ is defined by the salient positions $\mathbf{X}$, for example, the positions of four corners, and its corresponding coordinates on the video screen $\mathbf{y}$ as

$$\mathbf{A} = \mathbf{y}\mathbf{X}'pinv(\mathbf{X}\mathbf{X}').$$

3 Results and Conclusions

We recorded eye movements during 45 seconds for the Gaze Accuracy Test. All five locations, four corners of a quarter sized square centered in the screen and the center point, are visited three times each, and each visit holds three seconds to fixate on it. Through this, we got 1158 fixation points in the test. Figure 1 shows the parallax correction (blue circles) improves the accuracy in comparison with the not applied one.
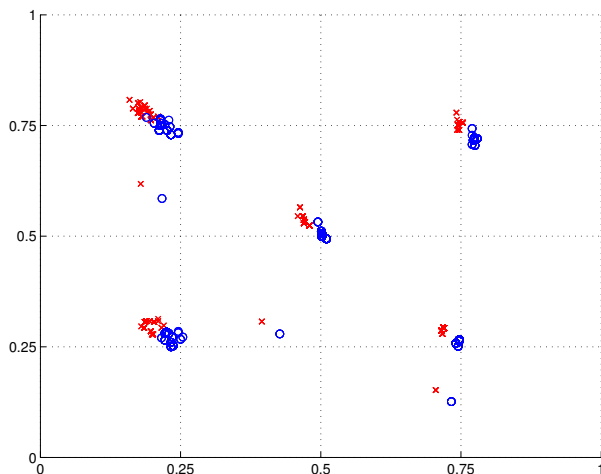
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Figure 1: *Parallax Correction* improves overall accuracy. We recorded 45 seconds of eye movements on the Gaze Accuracy Test. All five locations are visited three times, and each visit holds three seconds to fixate on it. Through this, we got 1158 fixation points in the test. Red crosses mean the fixation points without the parallax correction, which are recorded at 170 cm in front of the screen. Blue circles are with the parallax correction.

4 Discussion of Experimental Uncertainty

The accepted value (periodic table) is 24.3 Smith and Jones (2012). The percentage discrepancy between the accepted value and the result obtained here is 1.3%. Because only a single measurement was made, it is not possible to calculate an estimated standard deviation.

The most obvious source of experimental uncertainty is the limited precision of the balance. Other potential sources of experimental uncertainty are: the reaction might not be complete; if not enough time was allowed for total oxidation, less than complete oxidation of the magnesium might have, in part, reacted with nitrogen in the air (incorrect reaction); the magnesium oxide might have absorbed water from the air, and thus weigh "too much." Because the result obtained is close to the accepted value it is possible that some of these experimental uncertainties have fortuitously cancelled one another.

5 Answers to Definitions

a. The *atomic weight of an element* is the relative weight of one of its atoms compared to C-12 with a weight of 12.0000000..., hydrogen with a weight of 1.008, to oxygen with a weight of 16.00. Atomic weight is also the average weight of all the atoms of that element as they occur in nature.

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b. The *units of atomic weight* are two-fold, with an identical numerical value. They are g/mole of atoms (or just g/mol) or amu/atom.

c. *Percentage discrepancy* between an accepted (literature) value and an experimental value is $\text{experimental } result - \text{accepted result} \frac{}{\text{accepted result}}$

References

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