Evaluation of Field of View Calibration Techniques for Head-mounted Displays

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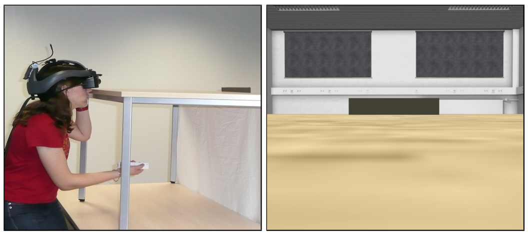
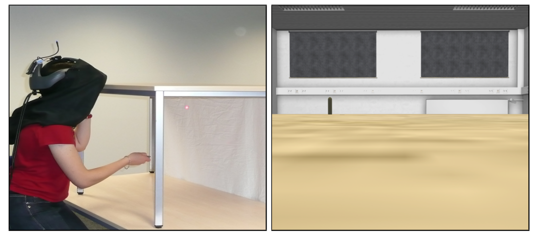


(a)



(b)

Figure 1: *Field of view calibration techniques according to (a) [Steinicke et al. 2009] and (b) [Ellis and Nemire 1993].*

Abstract

In this poster we present a comparison of two calibration techniques that allow to determine the field of view (FOV) for immersive head-mounted displays (HMDs).

Keywords: head-mounted displays, field of view

1 Calibration Techniques

The first approach was proposed by Steinicke et al. [Steinicke et al. 2009], using a psychophysical calibration method based on comparing a real-world object with a virtual object by raising and lowering the HMD. This technique incorporates a psychophysical two-alternative forced-choice task to accurately measure the relation between stimulus intensity and perception reported by a human observer.

The second approach was proposed by Ellis and Nemire [Ellis and Nemire 1993], who displayed vertical poles in the HMD, with the subjects' task to point at the perceived location of the poles in the real world, allowing to compute the angular difference between visual cues and proprioceptive responses for estimating the actual FOV of the HMD.

We performed the calibration experiment for both techniques in a 10m×7m laboratory room with a Rockwell Collins ProView SR80 HMD (1280 × 1024 @ 60Hz, 80° nominal diagonal FOV) for the virtual stimulus presentation. 4 female and 12 male (age 21-55, ∅: 28.2) subjects participated in a within-subject design experiment. The virtual scene was rendered using the IrrLicht engine and our own software with which the system maintained a frame rate of 60 frames per second (see Figure 1).

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2 Results

When using the calibration method described in [Steinicke et al. 2009], the PSE for the left eye approximates $g_F = 1.0023$, and for the right eye $g_F = 0.9924$. The results show that the diagonal FOV judged as correct by the participants approximates the field of view specified by the manufacturers, i. e., $80.184°$ for the left eye and $79.392°$ for the right eye instead of the nominal $80°$.

When using the calibration method described in [Ellis and Nemire 1993], subjects were less accurate at pointing to visually perceived angles in the real-world condition. This is indicated by a large discrepancy of the average slope (right eye $m = 0.89$, left eye $m = 0.9$) from the expected $m = 1.0$, and discrepancy of the average intercept (right eye $b = 2.2$, left eye $b = 3.15$) from the expected $b = 0.0$. In the virtual condition the average slope assumed $m = 1.03$ for the right eye and $m = 1.03$ for the left eye, and the average intercept assumed $b = 1.81$ for the right eye and $b = 0.81$ for the left eye. The observed differences indicate a discrepancy between the actual FOV of the HMD and the nominal field of view used to render the virtual scene. The results show that the diagonal FOV judged as correct by the participants deviates from the field of view specified by the manufacturers: $87.886°$ for the left eye and $88.724°$ for the right eye, instead of the nominal $80°$.

3 Conclusion and Future Work

The visual calibration technique proposed by Steinicke et al. [Steinicke et al. 2009] resulted in a calibrated FOV close to the nominal value provided by the HMD manufacturer, whereas the visual-proprioceptive calibration technique proposed by Ellis and Nemire [Ellis and Nemire 1993] resulted in an increased FOV.

References

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