Introduction

We investigated humans’ ability to control simulated ego-rotations from optic flow. In general, the literature suggests that visual stimuli alone are insufficient for accurate spatial orientation when rotations of the observer are involved. However, studies so far have confounded different display devices and FOVs, and the data are highly inconsistent.

The present study aims to disentangle the influence of display devices and FOV on the ability to control simulated ego-rotations solely from visual information.

Methods

Participants performed simulated turns under three different visualization conditions.

Results & Discussion

Generally, all target angles were undershot. Performance was best with the full view on the screen and worst with the HMD. Unexpectedly, FOV alone did not affect performance on the projection screen.

The size of FOV on the HMD was largely overestimated.

Display devices were more crucial for turning performance than FOV.

Conclusions & Outlook

The two main findings of the present study are:

First, display devices affected the control of visually simulated ego-rotations differentially.

Second, the FOV unexpectedly did not affect performance on the projection screen.

In line with the literature, large undershooting of intended turn angles was observed for the HMD. The bad performance with the HMD and the fact that the FOV on the HMD was largely overestimated indicate that one has to be cautious when using HMDs to investigate basic perceptual processes.


Figure 1: 180° half-cylindrical projection screen and HMD (FOV: 40°×30°)

Figure 2: Experimental visualization conditions. Left: projection screen (FOV: 86°×64°), middle: blinders (40°×30°), right: HMD (FOV: 40°×30°). Subjects performed visually simulated rotations watching a “star field” of limited lifetime dots on a dark background.

Figure 3: Means of turned angles per visualization condition plotted against the correct target angles. Boxes show one standard error of the mean, whiskers indicate one standard deviation. The slopes of the fitted lines correspond to the gain factors. The different slopes illustrate the interaction between condition and angle. The equations for the linear fit are shown in the inset on top. A gain factor of 1 describes perfect performance.

Figure 4: Left: Mean rated task difficulty. Boxes show one standard error of the mean, whiskers indicate one standard deviation. Right: Mean estimated FOV. The heights of the colored boxes indicate the amount of deviation from the actual FOV.

Table 1: ANOVA results