The Effects of Continued Exposure to Medium Field Augmented and Virtual Reality on the Perception of Egocentric Depth

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Abstract

Research in the perception of depth in augmented and virtual reality has reported a consistent underestimation of egocentric depth with regard to stationary objects located along the ground plane. However, there has been a rather large disparity in the degree of underestimation reported from study to study with some studies reporting as much as a 68% underestimation of egocentric depth while others report as little as 6% [Jones et al. 2008]. The current study investigates the judgment of egocentric distance in real, augmented, and virtual environments and finds that subjects' judgments improve in accuracy as exposure continues in the absence of explicit feedback.

1 Introduction

A commonly observed problem in virtual environments is the misperception of depth. Observers have frequently reported a compression of spatial relationships in virtual environments relative to real-world scenes. This phenomenon has been well documented in virtual reality and to somewhat less of a degree in augmented reality. However, there seems to be little agreement between studies as to the actual magnitude of this perceived depth compression.

Previous work has demonstrated that simply changing from one novel viewing context to another can effect an observer's judgment of depth in real-world environments [Lappin et al. 2006]. It is possible that the same could be true for switching from the real-world to a virtual environment. This effect may, however, resolve itself as subjects adapt to a new viewing context. Such an effect would be easily overlooked if an insufficient number of trials or stimulus repetitions were performed in a given study. Furthermore, the effect of repetition and prolonged exposure is not one that has been thoroughly studied. Since a substantial number of studies fail to report their full experimental design, it is difficult to compare the overall variability of underestimation with the practice, trials, or repetitions experienced by subjects.

2 Experiment

The current experiment was intended to be a between-subjects replication of the within-subjects experiment discussed in Jones et al. [2008]. Jones et al. [2008] studied the effects of augmented reality, virtual reality, and motion parallax on the judgment of egocentric distances and found a substantial lack of underestimation in both augmented and virtual environments as compared to the findings of similar studies. The goal of the current study was to eliminate the risk of transfer practice effects as a possible source of these atypical results. For the current study, motion parallax was not studied since no consistent effect of its addition or restriction was found in Jones et al. [2008].

In this experiment, 47 subjects reported their egocentric depth judgments by performing blind walking tasks in a hallway. Subjects were given five practice trials in a hallway separate from the experimental environment in order to familiarize them with the experimental procedures. During the experimental session, each subject was exposed to only one environment: real-world, real-world viewed through the HMD, augmented reality, or virtual reality. The set of distances studied was 3, 4, 5, 6, and 7 meters. Each stimulus distance was repeated 3 times. Presentation order for the stimuli was determined using a restricted random shuffle which prevented two sequential presentations of the same distance. The stimulus object used for this experiment was a white, wireframe pyramid measuring 23.5cm in height with a 23.5cm square base.

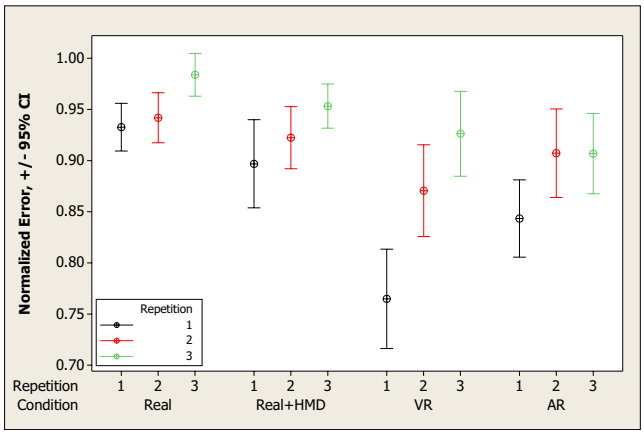

Figure 1: *Noramlized error in each environmental condition seperated by stimulus and repetition*

3 Results

The current study exhibited a similar pattern of reduced underestimation in both the AR and VR conditions as Jones et al.[2008]. However, an additional effect of repetition was found in both the current study and, upon reexamination, in Jones et al.[2008] as well. Within three repetitions of a given stimulus, observers tended to increase in accuracy to the point of being nearly veridical in their responses, as seen in Figure 1. This brings forth the questions of whether or not a large source depth underestimation could be the initial exposure to a novel viewing context and, if so, could it resolve with as little as 20 minutes of continued exposure? This could imply that even though the phenomenon of depth underestimation in virtual and augmented reality is theoretically interesting, it may be less practically significant than previously expected.

References

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