Towards Understanding Scene Transition Techniques in Immersive 360 Movies and Cinematic Experiences

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Abstract

Many researchers have studied methods of effective travel in virtual environments, but little work has considered scene transitions, which may be important for virtual reality experiences like immersive 360 degree movies. In this research, we designed and evaluated three different scene transition techniques in two environments, conducted a pilot study, and collected metrics related to sickness, spatial orientation, and preference. Our preliminary results indicate that faster techniques are generally preferred by gamers and more gradual transitions are preferred by participants with less experience with 3D gaming and virtual reality.

1 Introduction

With the recent release of commercial head mounted displays (HMDs) such as Oculus Rift, HTC Vive, Samsung Gear VR, Google Cardboard, and PlayStation VR, interest in virtual reality (VR) for home entertainment is growing faster than ever. Users can experience immersive virtual environments with interactive head-coupled viewing. Creators and developers are taking advantage of the availability of the new medium to create immersive cinematic experiences that allow the viewer to have interactive control of camera rotation within a 3D movie [1, 2].

Many types of narrative experiences traditionally rely on scene transitions to change locations or direct viewer attention. For example, transitions are found in video games to change levels, in movies for cuts and transitions between scenes and locations, and in other applications to show new perspectives within a 3D environment.

While 3D travel techniques involve viewpoint changes that are predominantly under the control of the user, scene transitions are generally initiated and controlled by the system—the viewer typically has no or limited control. And although much work has been done in regards to interactive travel in VR (e.g., [4]), less work has been done for pre-planned scene transitions in directed or scripted experiences where the the viewer does not have control over the change in viewpoint. In our research, we study how different methods of scene transition can influence spatial orientation, sickness, and the general sense of presence in an immersive experience. We conducted a preliminary study to compare three different methods of scene transition in two different VR environments.

2 Transition Techniques

We are exploring different scene transition techniques for viewpoint motion in short distances. Here, we describe the three techniques we have begun studying.

The first technique is *Teleportation*, which involves an instant change in viewpoint position or rotation. The viewer will not see the process of viewpoint motion in this technique and she is instantly translated or rotated. We are studying three different variations of this technique: *Instant Change* where the viewpoint changes state without any delays, *Fade to Black* where there is a fade in/fade out to a black transition scene and then the viewer finds herself in the new state, and *Blurred Fade* where there is also a fade in and out, but this transition is done by blurring the picture and clearing it again.

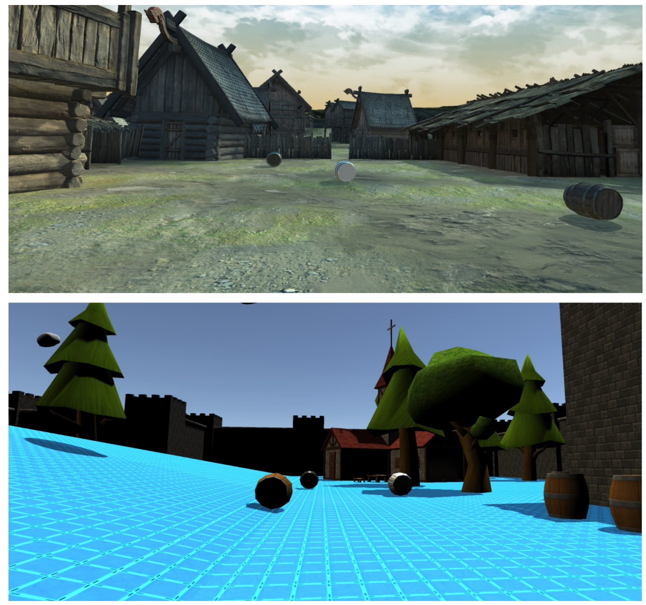

Figure 1: The two virtual environments used in the study.

The second technique is *Animated Interpolation*, which is a smooth viewpoint motion from one state to another. The viewer can observe the process of being translated or rotated to the new state. We are studying three variations of this technique with different speeds for the transition: slow (1 m/s), medium (3 m/s), and fast (5 m/s).

The third technique is *Pulsed Interpolation*. Unlike the constant interpolation like the previous technique, the pulsed view is faded in and out to several intermediate points along the path from one state to another. We are also studying different variations of this technique with varying amounts of intermediate points between the start and end points. The number of intermediate points we tested for were 2 (lowest), 4, and 7 (highest).

We are studying all these techniques in scenarios with three different types of viewpoint changes: (1) only translational motion, (2) only rotational viewpoint motion, and (3) both translation and rotation at the same time.

3 Pilot Study

We performed a preliminary study to compare different scene transition techniques in terms of their effects on spatial orientation, sickness, and preference.

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3.1 Study Design

In our pilot study, participants tested different variations of the techniques in two simple scenes: a viking village with monotonous colors and a cartoonish fort with high color contrast (see Figure 1). We varied three techniques between participants: teleportation, animated interpolation, and pulsed interpolation. Participants also experienced different variations of each technique. Variations included different types of viewpoint motions, speeds, and fade effects (as discussed in section 2). The different variations were tested within subjects.

Participants viewed the environments in an Oculus Rift (consumer version 1.0). Positional and rotational head-tracked viewing was enabled through the Oculus Rift's Constellation tracking system. Participants sat in a rotating chair for the study and they could turn freely. The study application was implemented in Unity3D version 5.4.1f1.

Nine participants completed the pilot study (8 male and 1 female), with ages ranging from 21 to 53. The study was approved by our university's Institutional Review Board (IRB). To test the techniques and allow assessment of viewer ability to maintain spatial awareness during scene transitions, participants had to complete a simple object-tracking task involving three moving barrels. Participants watched the moving barrels and were told to focus on their positions. Then, a scene transition was initiated and the viewpoint state was changed. After the transition, one of the barrels was missing and participants were asked to indicate the last position of that barrel using a red cursor that appeared in front of their viewpoint. They completed this task multiple times using different variations of the specific technique as discussed in section 2.

As dependent measures, we recorded the angular offset between the correct direction of the removed barrel and the direction where participants were looking. We also asked participants to rank sickness symptoms (dizziness, nausea, headache, and tiredness) on a scale from 1 to 10. Lastly, participants completed a post-study questionnaire and informal interview about the scene transitions about the sickness, preferred variations, and ease of task completion.

3.2 Preliminary Results

Based on participants' feedback about the sickness caused by scene transition techniques, we found that the techniques did not cause much sickness in the pilot studies. The average rating for all the sickness symptoms in all the scene transition techniques were never more than a 4 and it usually fell around 1.75 (on a scale of 1–10).

Participants who tested the *Teleportation* technique,reported the *Instant Change* variation was the easiest for completing the task. Also, they felt they were performing better when they only rotated in place. However, *Teleportation* was the only technique with participants reporting that their eyes felt tired after a while.

We expected the *Animated Interpolation* technique to cause the most sickness, but participants in our pilot study did not report any significant sickness for this technique. Generally, they felt most comfortable with the medium speed, but the fastest variation did not bother them. However, they commented that the slowest variation felt too slow and was frustrating. Unlike the *Teleportation* technique, participants reported that it was harder to complete the task when they were only rotating in place.

Participants testing the *Pulsed Interpolation* technique had different feedback about the number of intermediate points. We noticed that those who reported more experience with video games and VR liked the variation with lower number of intermediate points better. In contrast, those with less gaming and VR experience felt more comfortable when completing the tasks with more intermediate transition points.

Regarding participants' performance in the spatial awareness task, the differences between different scene transition techniques and their variations were close to our expectations (see Figure 2). Since the participants could see the other two barrels that were not missing when indicating the position of the missing barrel, even if they lost track of it, they could easily look relatively close to the correct position of the missing object. Therefore, the maximum error one could make was limited to approximately 45 degrees; errors larger than this would mean the participant was looking at an entirely different part of the scene with no barrels (and participants never did this). We observed that when the error was less than 5 degrees, it meant that the participant knew the position of disappeared barrel, and when it was more than 10 degrees they definitely lost track of it. That is how we interpret the angular offset results.

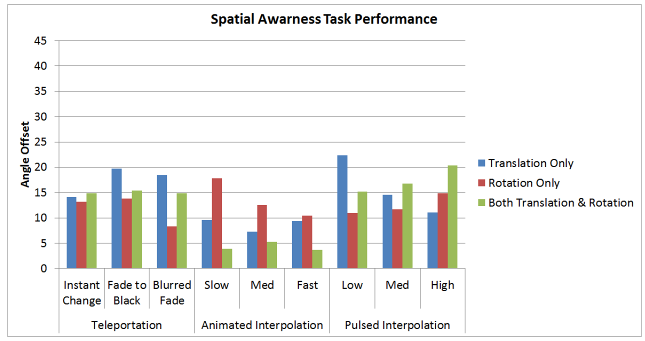

Figure 2: Participants' performance in completing the spatial awareness task.

As expected, errors were high using the *Teleportation* technique. The only acceptable recorded results for angle offsets is for when they were only being rotated and the *Blurred Fade* variation was being used. Also as expected, the *Animated Interpolation* technique showed the lowest error. The only time participants did poorly using this technique was when they were only being rotated in place.

Similar to *Teleportation*, participants performed poorly using the *Pulsed Interpolation* technique, though results were better with more intermediate points. This pilot study showed us that we need to work on some aspects of the *Pulsed Interpolation* technique including the time between stopping at each intermediate point and then moving forward, correct number of intermediate points for each variation, and the fade effect we use moving between intermediate points.

4 Conclusion

Our preliminary results show that the tested scene transition techniques do not cause much sickness. However, they can cause disorientation and make it difficult to track changes going on in the scene. The *Animated Interpolation* technique proved to produce the best results for both sickness and spatial orientation. We believe we can also improve other techniques significantly by enhancing certain aspects of their design. In the future, we will conduct a larger comprehensive study to collect more detailed data about scene transition techniques.

References

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