CS 490 590 VR

Midterm Practice Questions

1. Consider two conventional, i.e. planar pinhole camera, photos of a real world scene that were taken from the same location and whose fields of view overlap. Given a point in one photo, how does one find the corresponding point in the other photo? Do all points in one photo have a corresponding point in the other photo? Can a point in one photo correspond to two or more points in the other photo? Write the equations that, given a point in one photo, are sufficient to derive the corresponding point in the second photo. A point in a photo can be thought of as a pixel, or as the projection location of 3D point in the scene.
2. Same question as question 1, but now the photos are in the equirectangular format.
3. Same question as question 1, but now the photos are taken from different location, i.e. they have different pinholes, a.k.a eyes or centers of projection. The scene geometry is known, modeled with a set of 3D triangles.
4. You are given two photos taken with conventional planar pinhole cameras, from different locations, with cameras in known poses. Given a point in one photo, describe a method for searching for the corresponding point in the second photo.
5. Consider two photos of a real world scene that were taken from the same location and whose fields of view overlap. Given a point in one photo, how does one find the corresponding point in the other photo? Do all points in one photo have a corresponding point in the other photo? Can a point in one photo correspond to two or more points in the other photo? A point in a photo can be thought of as a pixel, or as the projection location of 3D point in the scene.
6. It is often the case that the virtual environment (VE) shown to the user in a virtual reality (VR) application is considerably larger than the real world space hosting the application. What are approaches for overcoming this limitation? For each approach, describe the approach, discuss its strengths, and discuss its limitations.
7. What are the approaches for provide haptic feedback in a virtual reality (VR) application? For each approach, describe the approach, discuss its strengths, and discuss its limitations.
8. Before a user can interact with a virtual environment (VE), the user has to be able to select VE objects. Describe a method for selecting VE object. How can the method be enhanced to help the user select in cluttered VE’s, where there are many objects?
9. Consider a mentoring virtual reality (VR) application, where both the mentor and the mentee wear a VR headset, and they both look at the same workspace. The mentor and mentee stand about 1m from each other, shoulder to shoulder, and the workspace is about 1m in front of them. Because of their different positions, the mentor and mentee have different views of the workspace, which can lead to communication challenges when, for example, the mentor refers to a part of the workspace not visible to the mentee due to occlusions. Draw a 2D diagram to illustrate the problem. Describe an approach for overcoming this problem.
10. The extended use of a virtual reality (VR) application requires the user to be able to interact with the real world. Consider the example of a coworker entering the lab where the user is involved in the VR application. The coworker needs the attention of the user for a few seconds to ask a question and receive an answer from the user. One option is for the user to remove the headset and talk to the coworker, but this is tedious, and it amounts to a serious interruption of the VR application. What are other approaches that allow the VR user to pay attention to their real world interlocutor, without removing the VR headset? What are the challenges of such approaches, and how can they be overcome?
11. Virtual reality (VR) applications can show the user video panoramas, which let the user experience the environment or event captured by the video, in any direction they choose. One challenge is to provide to the user correct stereopsis, i.e. to show the left and right eye slightly different images, based on the inter-pupillary distance, and based on the scene geometry. Describe approaches for alleviating this challenge, together with their challenges, and possible solutions to their challenges.
12. A cube map captures a room with four walls, a ceiling, and a floor. The room is not a cube, nor are the walls of the room aligned with the faces of the cube map. A user explores the room with a virtual reality (VR) headset, from the center of the cube map, in any direction desired by the user. When the user orients the virtual reality (VR) headset towards the corner of the cubemap, will the user see a discontinuity in the room, as the output image pixels are selected from the three faces of the cube map that meet at the corner? Why?