Remote Manipulation Techniques

In this assignment multiple manipulation techniques such as *Virtual Hand*, *GoGo*, and *HOMER* have to be implemented. An individual class is prepared for each manipulation technique. The *Virtual Ray* technique is already working and can be used as a reference implementation for the other techniques. All manipulation techniques are derived from the base class *ManipulationTechnique* which includes the intersection and dragging functionality. The class *ManipulationManager* initializes all techniques and provides a toggle mechanism to switch between them (keys 1-4). Pressing the space key resets all objects to their initial transformation.

Navigation functionality is provided using a Spacemouse.

The functional principles of the manipulation techniques are explained in the lecture notes (3D Manipulation) and also in the paper of Bowman, D., & Hodges, L. (1997). An Evaluation of Techniques for Grabbing and Manipulating Remote Objects in Immersive Virtual Environments. Proceedings of the ACM Symposium on Interactive 3D Graphics, 35-38. The paper is included in the repository.

How to start?

- Copy the 07_remote_manipulation folder from. /opt/vr_exercises/WS_15_16 to a local repository.
- Execute the application by running ./start.sh in a terminal.
- Start the ART or PST tracking system.
- The Samsung Stereo-TV set has to be set to stereo mode for every session using the remote control (settings are not saved when turning off)
    - o   Menu -> Setup -> DLP 3D / Dual-View -> ON-STD GLS
- Mitsubishi Stereo-TV usually is set to stereo mode (settings are saved between sessions)
    - o   Menu -> 3D Mode -> ON Standard
- Verify functionality of the wired shutter glasses. Perception of flicker when looking into a light source (e.g. room light).
- Proceed with the assignments.
- Turn of displays and tracking systems when finished.

Assignment Tasks (**graded**):

The maximum number of students per group is two. The presentation of the results takes place on **Friday 15.01.2016** in the lab class.

1. **[20%]** Implement the *Virtual Hand* manipulation technique. A hand geometry is available in in the folder data/objects.

2. **[40%]** Implement the *GoGo* manipulation technique. Use a piecewise transfer function with a 1:1 control-display gain for the first half of the arms' reach (35cm) and a non-isomorphic function for the remaining arm range (>35cm). The transition between both mapping types should be G1 or C1 continuous (G0 continuity is not sufficient). Print the combined transfer function with a graph plotter. Choose the type and the parameters of the transfer functions in such a way that all scene objects become accessible from the initial position of the user. Use the x- and z- coordinates of the head node as the reference coordinate system for the arm extension with respect to the users body.

3. **[40%]** Implement the *HOMER* (Hand-Centered Object Manipulation Extending Ray-Casting) manipulation technique. Keep in mind that the scaling factor for the extension of the virtual hand in relation to the user's body is dependent on the distance between the user's body and the tracked physical pointing device at the moment the object is selected. Eventually integrate further nodes in the tool subgraph to separate responsibilities. Two submode functions, the ray and the hand mode, are provided and have to be extended.

4. Prepare a short presentation (10-15min) of your implementation using one of the stereoscopic display environments available in the VR-Lab. Demonstrate the working prototypes in the tracked stereo environment and present relevant code snippets. Speak about advantages and disadvantages of the individual techniques.