Projekt-/Vorhabensskizze

Planjahr	Verantwortliches Institut	Projektleiter/Vorhabensverantwortlicher	Datum
2020	SC	Moritz Zeumer	28.05.2020

Finanzierung		Projekt	
Schwerpunkt	Motion Sickness Reduction in VR	Vorhaben	X
Forschungsgebiet	Interactive Visualization	Festpreis	
Teilgebiet	Space Visualization	Erstattungspreis	

Projekt-/Vorhabenstitel

Masterarbeit: Motion Sickness Reduction for 6-DoF-Navigation in a Virtual Solar System	**Dauer**	6 Monate

Beteiligte Institute und Einrichtungen

Institut	Verantwortlich	Kostenstelle	Kostenträger
DLR, SC-SRV - Betreuer	Simon Schneegans		
DLR, SC-SRV - Betreuer	Jonas Gilg		

1 Project-/Description

In DLR's Institute for Software Technology, a virtual-reality simulation of our solar system, called „CosmoScout VR", is being developed. With sophisticated level-of-detail-algorithms, high resolution digital elevation models and satellite imagery, entire planets and space missions can be explored in real-time. This is not only a simulation of space, but also of time since all celestial bodies are constantly moving on their orbits.

When the user navigates to another location in space and / or time (this could be a region on the same planet, on another planet, a moon or a spacecraft) rotations and movements should be limited to an absolute minimum in order reduce any induced motion sickness. Other approaches could involve the provision of a fixed visual reference frame or reducing the field of view.

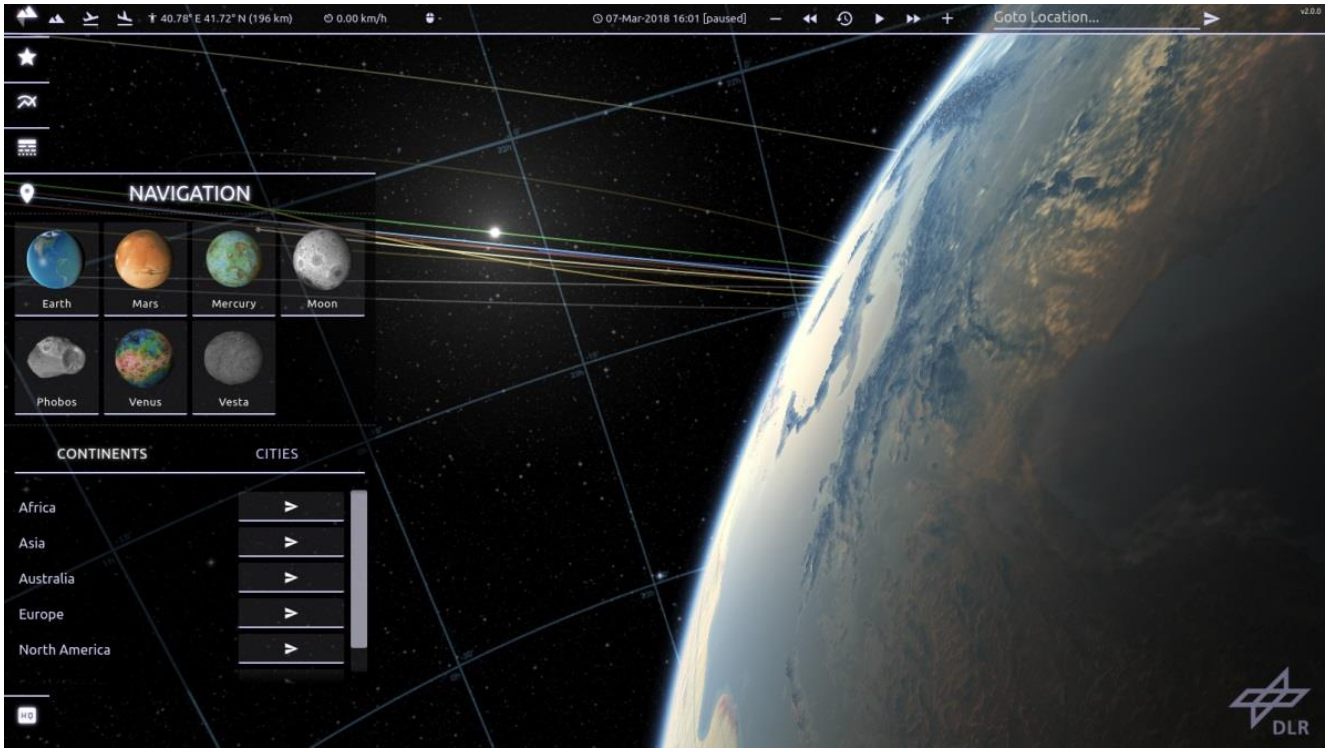

Figure 1: Location Bookmarks in CosmoScout VR.

There are two fundamentally different means for navigation in CosmoScout VR. On the one hand, the user can navigate freely though space, on the other hand she may decide to use an „auto-pilot" which will calculate and follow a trajectory through space to a specific target location. The goal of this thesis is to optimize both approaches in terms of user experience and motion sickness reduction.

Therefore, both navigation systems will be analyzed under several aspects, such as:

- What are common navigation tasks? Can they be categorized according to parameters like the **user** (e.g. a desktop user, an HMD user, or group of users in front of a large-scale projection setup), **travel distance** (time / space), **scale difference** (e.g. planet-to-planet, city-to-planet, sun-to-spacecraft), **target degrees of freedom** (e.g. planet, planet with latitude and longitude, planet with latitude, longitude and height or even a fully specified target transformation with an orientation)
- Which factors are most likely sources for motion sickness?
- What are commonly applied means for motion sickness reduction which could work for the different navigation tasks? This may include restriction of degrees of freedom as well as optimization of the autonomous flight trajectories from A to B. Also visual means to reduce the motion sickness can be implemented.
- How is the user experience affected? Does the system foster location awareness or may it lead to disorientation?

Ultimately, this system could allow for the implementation of a "Space Mission Player" where users can seamlessly observe the different stages of various space missions in time and space. A small user study will be required in order to evaluate the efficiency of different navigation approaches.

2 Goals and Milestones

Rough Timeplan

Tasks	**June**	**July**	**August**	**Septem-ber**	**October**	**Novem-ber**
Literature Research	■	■	■	■		
Thesis Writing		■	■	■	■	■
Optimization of Free Navigation	■	■				
Optimization of Point-to-Point Navigation		■	■	■		
Preparation and Execution of a User Study				■	■	■