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Visualizing planetary data by using 3D engines

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Abstract

We examined 3D gaming engines for their usefulness in visualizing large planetary image data sets. These tools allow us to include recent developments in the field of computer graphics in our scientific visualization systems and present data products interactively and in higher quality than before. We started to set up the first applications which will take use of virtual reality (VR) equipment.

1. Introduction

Two-dimensional maps are a great way to extract and combine information quickly. They also contain valuable quantitative information on the surface geometry, in particular if based on precise geometric information through orthorectification. But maps are by definition only symbolic representations. While this suits a variety of scientific needs, it does not offer an immersive environment for visual inspection. Three-dimensional models though bring the proportions and relations between the individual features on a planetary body to light and allow intuitive interactions with the data.

Visualizations of planetary data are a key element in our public outreach activities at the Institute of Planetary Research of the German Aerospace Center (DLR) in Berlin-Adlershof, Germany. We plan to refresh our setup by using modern 3D gaming engines and integrating virtual reality (VR) equipment.

2. Data

Data sets have been generated from images gathered during various planetary (e.g., Mars Express HRSC [1]), lunar (LRO, [2]), asteroid (Dawn, [3]), and comet missions (Rosetta, [4]) by applying stereo-photogrammetric methods and image mosaicking techniques. From some of these data sets triangulated and textured high-resolution 3D models were created.

We use the open source modelling and animation software *Blender* [5] to generate the triangulated meshes (Fig. 1). If necessary, models with large polygon counts are split into segments. Also, we create several levels of details (LOD) for each mesh with decreasing polygon counts. With increasing viewing distances lower resolution versions of the same model are loaded (and vice versa) which ensures a stable performance in scenes with multiple high-resolution models. The models are exported in Autodesk FBX or Alembic format for further use in 3D graphics rendering software packages.

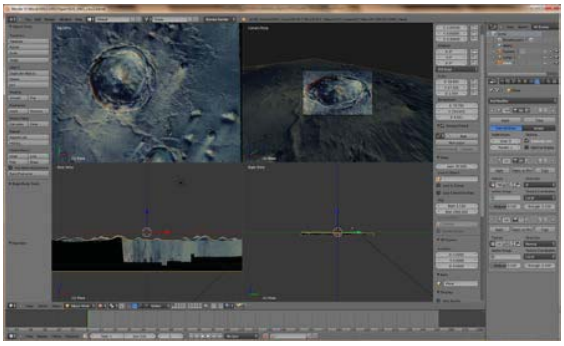

Figure 1: 3D modelling using a HRSC digital terrain and HRSC color ortho-image in Blender.

3. Application

Nowadays several 3D engines are freely available for developers (depending on the licensing terms), e.g. *Unity [6]*, *OGRE [7]* and *Lumberyard [8]*. For our needs we found *Unreal Engine 4* [9] the most promising candidate. It does not only combine a high graphics quality with a superb performance and user-friendliness, it also integrates VR hardware easily and can additionally be used to create simple animated video sequences without the usually long render times of dedicated animation software.

We started a project to visualize the whole HRSC MC-11-E quadrangle [10] as a continuous landmass in high resolution. In preparation we sliced the digital terrain model and color image mosaic into ca. 2,000 single tiles each consisting of several LODs. The whole data set covers an area of 1,300 km x 1,800 km in an image resolution of 12.5 m per pixel (Fig. 2).

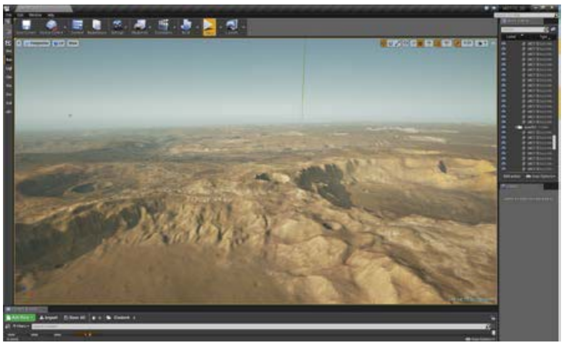

Figure 2: Mars quadrangle MC11-E in the *Unreal Engine 4 Editor*

Another project features Vesta. It allows free roaming around the asteroid as imaged by the Dawn spacecraft. There is also an integrated “Tour Mode” visiting prominent surface features and displaying additional information on-screen automatically in a loop (Fig. 3).

Figure 3: Vesta in *Unreal Engine 4*

4. Outlook

We plan to set up virtual reality systems at DLR Berlin, using *HTC Vive* VR headsets. This approach enables the user to get in a closer touch with the data which could be beneficial when used in scientific analyses where it would improve our understanding of the topography.

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