Multiple ways to visualize planetary image data

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Abstract

At the DLR Institute of Planetary Research, we have many different ways of visualizing planetary image data. From the creation of scientific cartographic products over perspective 3D views to immersive virtual reality environments we apply many different visualization techniques to gain a better understanding of a planet's surface. Processing the data to obtain the best visual and contextual representations for scientific and engineering uses as well as for public outreach is part of our daily routine. We present some of the progress we have made in the field of data visualization during the last decade benefitting from modern techniques.

1. Introduction

Remote sensing data from planetary (e.g. Mars Express, Cassini, Messenger), Moon (LRO), asteroid (Dawn) or comet (Rosetta) missions are among the most exciting image data sets available.

By using stereo-photogrammetric methods image mosaics and digital terrain models for several celestial bodies, e.g. Mars [1], Moon [2], and Vesta [3], have been created to establish topographic data bases for scientific or engineering needs. These data sets, sometimes along with complementary data from other sources, e.g. laser altimetry data, serve as input for the visualization techniques we apply.

2. Mapping

An accessible and versatile way to present extensive image data sets is the use of cartographic products, i.e. topographic and thematic maps (Fig. 1). Geographic information systems (GIS) allow combining data and obtaining derivative information easily. Using Web Map Services (WMS) we can browse the data in a convenient way. Perspective views, often available as anaglyphic 3D stereoscopic images, help to perceive the 3rd dimension and are a staple in public outreach work [4][5].

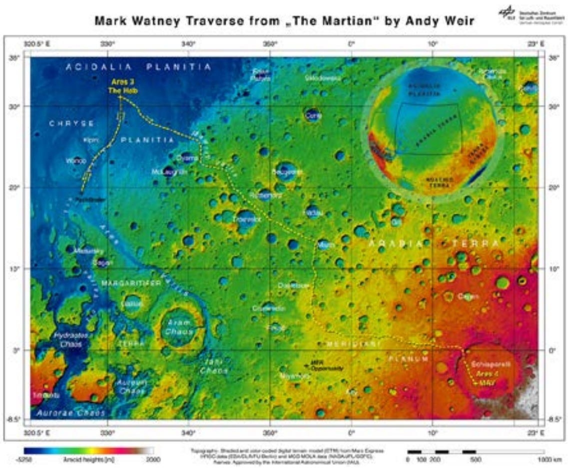

Fig. 1: Topographic map illustrating the protagonist's route from the book "The Martian" [6].

3. 3D Visualization

3.1 Meshes

Another approach is the use of triangulated meshes, which can be visualized with readily available software tools or inside web browsers utilizing WebGL technology. This is especially important for some irregular bodies, e.g. comet 67P/Churyumov-Gerasimenko or the Martian moon Phobos, which cannot be adequately represented in two-dimensional map forms. With the help of 3D printing hardware we can have an easy look at all the facets of a body while experiencing its shape with our own hands.

3.2 Animations

Computer generated imagery in the form of video sequences is an important factor in our public outreach efforts. While earlier examples mostly serve as cinematic overviews showing prominent surface features (Fig. 3) we now also embed more detailed information about the body or the mission to serve educational purposes. By using popular video streaming and social media platforms we can reach millions of viewers [7].

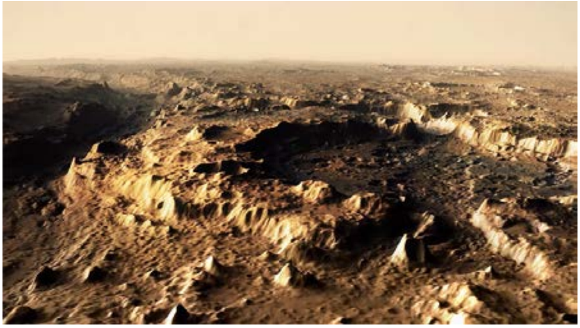

Fig. 3: Still frame from animation showcasing the HRSC MC11-E data set [8].

3.3 Immersive Interaction

Virtual environments have been set up using different software packages to experience planetary surfaces in all three dimensions. We regularly show selected Martian features in 3D flyovers for students or other interested visitor groups in our institute (Fig. 4).

Fig. 4: 3D presentation using stereo projector system showing Valles Marineris on Mars

A trend of the last years and one of the most immersive approaches is the use of virtual reality head-mounted displays. Due to their nature this can only be experienced by single users, therefore this technology is usually applied for individuals or small groups (Fig. 5).

Fig. 5: Screenshot from Vesta VR environment (left), child wearing HMD during public event (right).

4. Summary

During the last 10 – 15 years we have tested and implemented modern visualization techniques to display large image and terrain data sets for scientific reasons and at public events. Our successful transition from analogue to modern digital techniques encourages us to follow that road.

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