

VIRTUAL REALITY: VISUALISATION OF MARS HRSC IMAGE DATA FOR PUBLIC OUTREACH AND RESEARCH. B.P. Schreiner, C. Gross, A. Neesemann, S.H.G. Walter and F. Postberg, Freie Universität Berlin, Institute of Geological Sciences, Malteserstr. 74-100, 12249 Berlin (bjoern.schreiner@fu-berlin.de).

Introduction: Since the launch of Mars Express 18 years ago the Planetary Sciences and Remote Sensing Group of Freie Universität Berlin has been producing public outreach imagery for the Mars Express' High Resolution Stereo Camera (HRSC) [1], [2]. Among these are orthorectified high resolution colour images of selected regions on Mars, colour-coded digital terrain models and anaglyph images. Further we provide perspective colour views and virtual flights over the surface of Mars in plain and stereoscopic high definition video based on HRSC single orbit data or multi-orbit mosaics. These products can be downloaded from our webpage [3].

With Virtual Reality (VR) becoming more popular and affordable, we decided to explore a new interactive 3D approach as colour image data and a corresponding terrain model is available for large areas waiting to be visited 'in person' by virtually walking around on the planet's surface and even jumping or teleporting to a desired area for closer inspection.

Data Preprocessing: Based on orthorectified Level-4 data the image strip of an orbit is cut to include the area of interest. From the red, green and blue channel a colour composite is derived which is then merged with the high resolution nadir channel ('pan sharpening') to obtain best detail. Within the standard product line all non-colour channels (stereo, photometric, nadir) contribute to the calculation of the digital terrain model, which is needed for virtual perspective views of a scene. To cover a larger area of the surface it is necessary to combine two or more adjacent orbits if available. The challenge with this so-called mosaicking is to adjust the corresponding images, which spotted the surface at different daytimes and seasons, with different illumination angles, different atmospheric conditions and different ground resolutions, to result in an overall uniform representation. This means local colour and contrast balancing between and within neighboring orbits, and careful orbit selection and sequencing. Due to slight uncertainties in camera position and resulting geometric offsets between orbit images, overlapping regions are essential for processing seamless mosaics (bundle block adjustment).

Virtual Reality: Prerequisites for a Virtual Reality System is a fast computer with a stereo graphics card, a headset, a base station for orientation, hand controllers and a VR software (Fig. 1): We chose Unreal Engine/SteamVR as it is free and very powerful, in conjunction with a Valve Index Set (headset, controllers

and base station). Generally, Unreal Engine (UE4/5) [4] is intended to provide an interactive gaming environment with mainly algorithmically generated mid-sized landscapes and a variety of acting objects. For our purpose we had to deal with large image mosaics and terrain models which require tiling and adaptive loading to fit into the workspace.

Several scenes have been prepared, and among these is Jezero Crater in Syrtis Major (Fig. 3), right now being explored by Perseverance Rover on the Mars 2020 mission. We derived our data from a HRSC mosaic enhanced with very high definition co-registered CTX imagery (Fig. 4). The viewer can walk or jump through the crater as if being on the spot, then teleporting himself to a place he chooses with a virtual laser pointer. For the geoscientist this free choice of viewpoint can be helpful to find ancient coastlines i.e. of a crater lake or to investigate the geology of a layered body or other difficult structural conditions on a possible future landing site [see poster by Chr. Gross]. We also provided a large mosaicked area around Mawrth Vallis in Arabia Terra (MC11E) with an image size of 24k x 32k pixels divided into 12 tiles.

For a global view (Fig. 2) we have set up a spinning full Mars globe model based on a Viking image mosaic now being updated by only recently acquired global HRSC images merged to a global mosaic and with elevation information from the MOLA terrain model.

Furthermore we are also working on including recent new high-level data products of Ceres (DTM's, orthoimage mosaics) into our VR routine [see Poster by A. Neesemann].

References: [1] Neukum, G. and Jaumann, R. (2004) ESA SP, 1240, 17-35. [2] Jaumann, R. et al. (2007) PSS. 55, 928-952. [3] https://www.geo.fu-berlin.de/en/geol/fachrichtungen/planet/press_media/index.html. [4] <https://www.unrealengine.com/en-US/>.

Acknowledgements: We acknowledge funding by the Space Administration of the German Aerospace Center (DLR) with means of the Federal Ministry for Economic Affairs and Energy (grant 500O2204). We thank the HRSC experiment team at DLR Berlin and the HRSC operations team at ESOC for their successful planning, acquisition and processing of the HRSC data. We would also like to thank A. Dumke and D. Neu for providing Level-4 data.



Fig. 1: VR setup

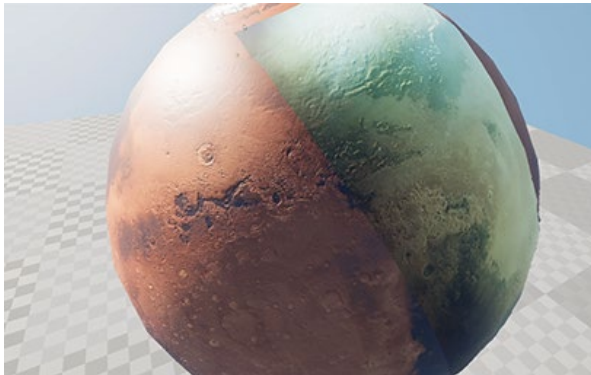


Fig. 2: Mars globe in VR (Viking/HRSC)

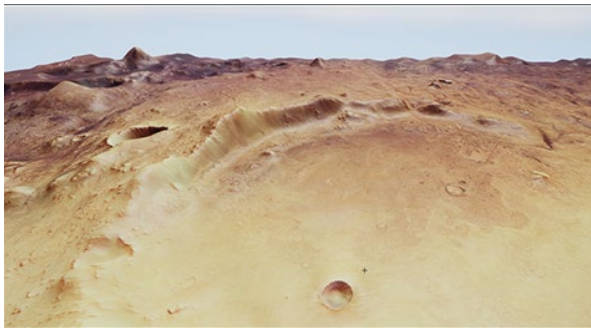


Fig. 3: Jezero Crater in VR

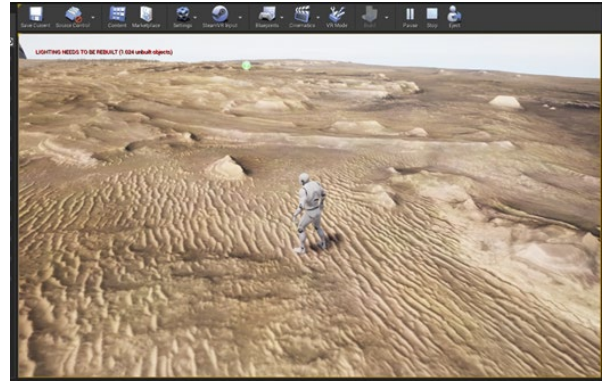


Fig. 4: Jezero Crater on the ground (HRSC+CTX)