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

Introduction: Since the launch of Mars Express almost 20 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], (see also C. Gross et al., this conference). 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]. In order to enhance image resolution (approx. 12.5m/pix for HRSC) we also made use of CTX (6m/pix) from MRO, and HiRISE (0.3m/pix) imaginery for this project.

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 explored 'in person' by virtually walking around on the planet's surface and even jumping or teleporting to a desired region for closer inspection.

Data Preprocessing: Based on orthorectified Level-4 data the image strip of an orbit is cut to contain 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 by pan sharpening to obtain best possible 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). Several Mars quadrangles have been produced by the HRSC team at DLR and FUB from automated mosaicking of HRSC data (also see poster from W. Zuschneid et al., this conference). Combining imagery of different resolution as used in this project requires careful image matching to avoid offsets between HRSC, CTX and HiRISE image data.

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. So far we managed to handle 16k by 16k colour image data for the Jezero context (HRSC, CTX) with an HiRISE overlay of 16k by 16k at Jezero Crater's inlet delta region, all in native resolution (Fig. 2).

In the project presented here, we focus on Jezero Crater in Syrtis Major, presently being explored by Perseverance Rover on the Mars 2020 mission. We derived our data from the HRSC MC13 quadrangle mosaic enhanced with high definition co-registered CTX imagery (Fig. 4) and additional HiRISE image and terrain data. The viewer can fly through the crater as (Fig. 3, 4), or teleport 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 geological features.

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-belin.de/en/geol/fachrichtungen/planet/press_media/ index.html. [4] https://www.unrealengine.com/en-US/.

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Fig. 1: VR setup with head-up display and handles

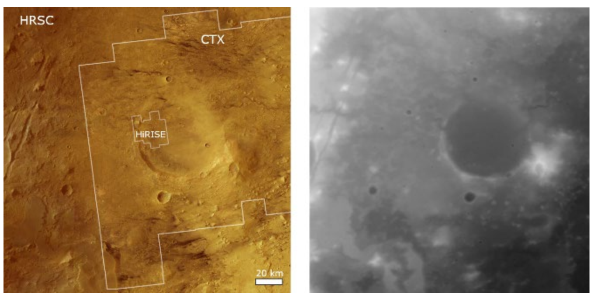

Fig. 2: Jezero Crater. Left: 16k HRSC colour mosaic with CTX and HiRISE inlay. Right: HRSC DTM

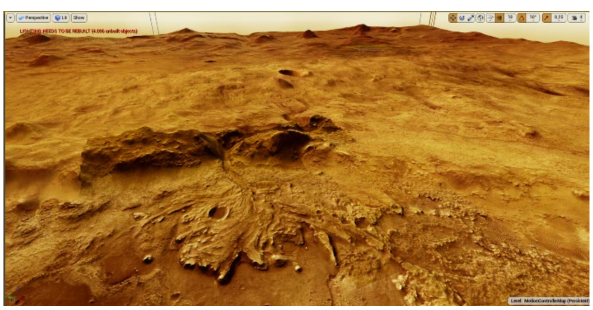

Fig. 3: Jezero Crater delta region in VR (HRSC/CTX/HiRISE)

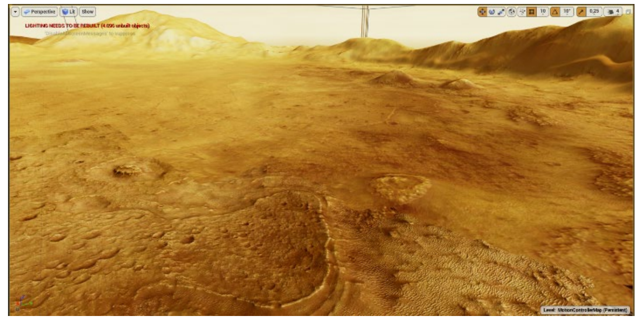

Fig. 4: Jezero Crater from the ground in VR (HRSC/CTX)