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Quantitative analysis of digital outcrop data obtained from stereo-imagery using an emulator for the PanCam camera system for the ExoMars 2020 rover

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A key focus of planetary rover missions is to use panoramic camera systems to image outcrops along rover traverses, in order to characterise their geology in search of ancient life. This data can be processed to create 3D point clouds of rock outcrops to be quantitatively analysed. The Mars Utah Rover Field Investigation (MURFI 2016) is a Mars Rover field analogue mission run by the UK Space Agency (UKSA) in collaboration with the Canadian Space Agency (CSA). It took place between 22nd October and 13th November 2016 and consisted of a science team based in Harwell, UK, and a field team including an instrumented Rover platform at the field site near Hanksville (Utah, USA). The Aberystwyth University PanCam Emulator 3 (AUPE3) camera system was used to collect stereo panoramas of the terrain the rover encountered during the field trials.

Stereo-imagery processed in PRoViP is rendered as Ordered Point Clouds (OPCs) in PRo3D, enabling the user to zoom, rotate and translate the 3D outcrop model. Interpretations can be digitised directly onto the 3D surface, and simple measurements can be taken of the dimensions of the outcrop and sedimentary features, including grain size. Dip and strike of bedding planes, stratigraphic and sedimentological boundaries and fractures is calculated within PRo3D from mapped bedding contacts and fracture traces. Merging of rover-derived imagery with UAV and orbital datasets, to build semi-regional multi-resolution 3D models of the area of operations for immersive analysis and contextual understanding.

In-simulation, AUPE3 was mounted onto the rover mast, collecting 16 stereo panoramas over 9 ‘sols’. 5 out-of-simulation datasets were collected in the Hanksville-Burpee Quarry. Stereo panoramas were processed using an automated pipeline and data transfer through an ftp server. PRo3D has been used for visualisation and analysis of this stereo data. Features of interest in the area could be annotated, and their distances between to the rover position can be measured to aid prioritisation of science targeting. Where grains or rocks are present and visible, their dimensions can be measured. Interpretation of the sedimentological features of the outcrops has also been carried out. OPCs created from stereo imagery collected in the Hanskville-Burpee Quarry showed a general coarsening-up succession with a red, well-layered mudstone overlain by stacked layers of irregular thickness and medium-coarse to pebbly sandstone layers. Cross beds/laminations, and lenses of finer sandstone were common. These features provide valuable information on their depositional environment.

Development of Pro3D in preparation for application to the ExoMars 2020 and NASA 2020 missions will be centred on validation of the data and measurements. Collection of in-situ field data by a human geologist allows for direct comparison of viewer-derived measurements with those taken in the field.

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