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Rehearsing ExoMars Geological Assessment of Image Data using Representative Samples and 3D Vision Techniques

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Abstract

PanCam on ExoMars is the primary geological context imaging system. It consists of a stereo pair of wide angle cameras (WAC) with 34° square field-of-view and 12 different wavelength filters, and an RGB narrow-angle High Resolution Camera (HRC). The foreseen layout of the PanCam instrument in terms of filter wavelength distribution, its ability to provide 3D data products, and the designed operational sequences are currently being verified and refined. This paper reports on a geology blind test which was performed applying a geometrically analogous PanCam setup on nine geological samples expressing a variety of generic attributes (i.e. texture, structure, colour, morphology, scale etc). The mission-analogue process of viewing the samples in low resolution by the WAC, decision by an expert geologist on HRC acquisition, and finally the geologist's ability to decide on interest scores for such samples has been rehearsed in the context of a medium sized event. We report on valuable experience from such a blind test and conclude on the direct benefits for the optimisation of the ExoMars Mission.

Objectives

Simulating the features and abilities of scientific instruments is a common technique to optimize their design [3]. The ExoMars mission 2016/17 will contain a payload suite for exobiological and geological investigations of the Martian surface that will rely on the optical in-situ characterization of the landing site, based on remote instruments: The panoramic camera (PanCam) [1] gives access to context (3D by stereo vision, and multi – wavelength imaging in wide-angle), as well as a zooming-in ability by a narrow-angle monoscopic RGB camera. To enhance the PanCam operations planning as well as its ability to provide immediate context during the mission, the design currently undergoes a sequence of refinement and verification steps. The efficiency of its scientific exploitation is an important component of this procedure. Simulating a geologic interpretation sequence is therefore vital for further PanCam development. Although a close-up imager (CLUPI) is no longer part of the ExoMars payload, the inclusion of such a measurement here is essential to emulate the logical progression from remote to macroscopic imaging as used in field geology [2].

Geology Blind Test

On May 19-21, 2009, in the frame of a PanCam data exploitation workshop taking place at Aberystwyth University [3] an experiment was conducted to evaluate the PanCam ability to serve as a near-field remote imaging suite for geological expert characterization: A geologist was presented with images and their derived 3D vision products (Figure 1) at different resolutions to decide on further (hypothetical) scientific sensing operations and priority scoring of samples.

We report on the evaluation procedure, consisting of six steps, namely
1. WAC single view, 2. 3D reconstruction from WAC stereo views, 3. HRC single view, 4. HRC overlay on WAC 3D reconstruction, 5. Close-up-lens (CLUPI-like) view (actually taken by a representative optics & from a representative

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distance), and finally 6. hints from another expert geologist on the hyperthetical results from drilling such a material and compositional data from XRD and Raman spectroscopy.

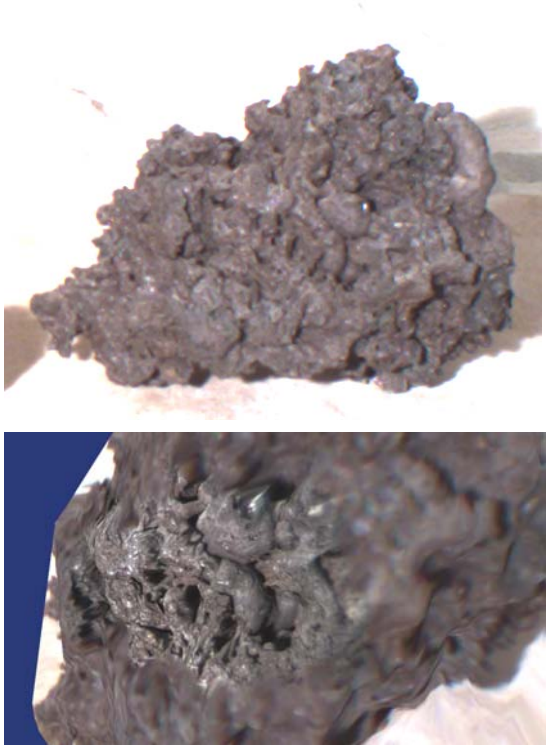

Figure 1: Sample by the WAC, and 3D visualized HRC overlay on WAC stereo reconstruction

Results

It could be shown that the scientific interpretation of each sample significantly improves with the benefit of HRC images. For some samples, especially those with astrobiological significance, close-up imaging revealed key features not visible with HRC.

Beside the operational aspects of in-situ data acquisition, valuable hints for data representation could be collected, such as the need for efficient image data manipulation (2D and 3D), the presence of a virtual ergonomic scale object (e.g. a matchbox for close-range, or a human figure for medium range) in 3D visualizations, the indication of the higher resolution HRC footprint in the lower resolution WAC image, as well as the necessity for a proper stereo display, including basic image manipulation abilities.

The evaluation of the decision making process is still ongoing and the detailed results will be presented at the Conference.

The ExoMars PanCam Team plans to conduct further blind tests in order to understand the field science capabilities of the system. Future tests will be performed remotely (via the web) and involve a multi-disciplinary evaluation team. In addition, the PanCam team intends to further enhance the layout of the instrument, its operational scenario, as well as image data processing and results presentation. The close co-operation between planetary scientists, instrument providers and data processing / visualization experts therewith ensures the optimum exploitation of the PanCam concept.

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Disclaimers