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The PanCam instrument on the 2018 Exomars rover: Scientific objectives

Ralf Jaumann (1,2), Andrew Coates (3), Ernst Hauber (1), Harald Hoffmann (1), Nicole Schmitz (1), Laetitia Le Deit (1), Daniela Tirsch (1), Gerhard Paar (4), Andrew Griffiths (3), and the The PanCam Team

(1) German Aerospace Center (DLR), Institute of Planetary Research, Berlin, Germany (Ralf.Jaumann@dlr.de, +49-30-67055400), (2) Institute of Geological Sciences, Free University Berlin, Germany , (3) MSSL/UCL, London, United Kingdom, (4) Joanneum Research, Graz, Austria

The Exomars Panoramic Camera System is an imaging suite of three camera heads to be mounted on the ExoMars rover‘s mast, with the boresight 1.8 m above ground. As late as the ExoMars Pasteur Payload Design Review (PDR) in 2009, the PanCam consists of two identical wide angle cameras (WAC) with fixed focal length lenses, and a high resolution camera (HRC) with an automatic focus mechanism, placed adjacent to the right WAC. The WAC stereo pair provides binocular vision for stereoscopic studies as well as 12 filter positions (per camera) for stereoscopic colour imaging and scientific multispectral studies. The stereo baseline of the pair is 500 mm. The two WAC have 22 mm focal length, f/10 lenses that illuminate detectors with 1024 × 1024 pixels. WAC lenses are fixed, with an optimal focus set to 4 m, and a focus ranging from 1.2 m (corresponding to the nearest view of the calibration target on the rover deck) to infinity. The HRC is able to focus between 0.9 m (distance to a drill core on the rover‘s sample tray) and infinity. The instantaneous field of views of WAC and HRC are 580 µrad/pixel and 83 µrad/pixel, respectively. The corresponding resolution (in mm/pixel) at a distance of 2 m are 1.2 (WAC) and 0.17 (HRC), at 100 m distance it is 58 (WAC) and 8.3 (HRC). WAC and HRC will be geometrically co-aligned.
The main scientific goal of PanCam is the geologic characterisation of the environment in which the rover is operating, providing the context for investigations carried out by the other instruments of the Pasteur payload. PanCam data will serve as a bridge between orbital data (high-resolution images from HRSC, CTX, and HiRISE, and spectrometer data from OMEGA and CRISM) and the data acquired in situ on the Martian surface. The position of HRC on top of the rover‘s mast enables the detailed panoramic inspection of surface features over the full horizontal range of 360° even at large distances, an important prerequisite to identify the scientifically most promising targets and to plan the rover‘s traverse. Key to success of PanCam is the provision of data that allow the determination of rock lithology, either of boulders on the surface or of outcrops. This task requires high spatial resolution as well as colour capabilities. The stereo images provide complementary information on the three-dimensional properties (i.e. the shape) of rocks. As an example, the degree of rounding of rocks as a result of fluvial transport can reveal the erosional history of the investigated particles, with possible implications on the chronology and intensity of rock-water interaction. The identification of lithology and geological history of rocks will strongly benefit from the co-aligned views of WAC (colour, stereo) and HRC (high spatial resolution), which will ensure that 3D and multispectral information is available together with fine-scale textural information for each scene. Stereo information is also of utmost importance for the determination of outcrop geometry (e.g., strike and dip of layered sequences), which helps to understand the emplacement history of sedimentary and volcanic rocks (e.g., cross-bedding, unconformities, etc.). PanCam will further reveal physical soil properties such as cohesion by imaging sites where the soil is disturbed by the rover‘s wheels and the drill. Another essential task of PanCam is the imaging of samples (from the drill) before ingestion into the rover for further analysis by other instruments. PanCam can be tilted vertically and will also study the atmosphere (e.g., dust loading, opacity, clouds) and aeolian processes related to surface-atmosphere interactions, such as dust devils.