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Automated science target selection for future Mars rovers: A machine vision approach for the future ESA ExoMars 2018 rover mission

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The ESA ExoMars 2018 rover is planned to perform autonomous science target selection (ASTS) using the approaches described in [1]. However, the approaches shown to date have focused on coarse features rather than the identification of specific geomorphological units. These higher-level "geoobjects" can later be employed to perform intelligent reasoning or machine learning. In this work, we show the next stage in the ASTS through examples displaying the identification of bedding planes (not just linear features in rock-face images) and the identification and discrimination of rocks in a rock-strewn landscape (not just rocks). We initially detect the layers and rocks in 2D processing via morphological gradient detection [1] and graph cuts based segmentation [2] respectively. To take this further requires the retrieval of 3D point clouds and the combined processing of point clouds and images for reasoning about the scene. An example is the differentiation of rocks in rover images. This will depend on knowledge of range and range-order of features.

We show demonstrations of these "geo-objects" using MER and MSL (released through the PDS) as well as data collected within the EU-PRoViScout project (http://proviscout.eu). An initial assessment will be performed of the automated "geo-objects" using the OpenSource StereoViewer developed within the EU-PRoViSG project (http://provisg.eu) which is released in sourceforge. In future, additional 3D measurement tools will be developed within the EU-FP7 PRoViDE2 project, which started on 1.1.13.

References: [1] M. Woods, A. Shaw, D. Barnes, D. Price, D. Long, D. Pullan, (2009) "Autonomous Science for an ExoMars Rover–Like Mission", Journal of Field Robotics Special Issue: Special Issue on Space Robotics, Part II, Volume 26, Issue 4, pages 358-390. [2] J. Shi, J. Malik, (2000) "Normalized Cuts and Image Segmentation", IEEE Transactions on Pattern Analysis and Machine Intelligence, Volume 22. [3] D. Shin, and J.-P. Muller (2009), Stereo workstation for Mars rover image analysis, in EPSC (Europlanets), Potsdam, Germany, EPSC2009-390