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The PRoViDE framework for the quantitative geologic analysis of reconstructed Martian terrain and outcrops

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The EU-FP7 project PRoViDE (Planetary Robotics Vision Data Exploitation) assembled a major portion of the imaging data gathered so far from planetary surface missions into a unique 3D database, brought them into a spatial context and provides access to a complete set of 3D vision products. The processing chain (PRoViP) is able to generate novel 3D fusion products between HiRISE orbiter and multiple-station rover stereo imagery from NASA's Mars Exploration Rover - MER (Pancam, Navcam), and Mars Science Laboratory Curiosity - MSL (Mastcam).
An important tool of the PRoViDE framework, using PRoViP multi-resolution 3D vision processing products, is called PRo3D. It is an interactive virtual environment for the scientific exploration and analysis of reconstructed Martian terrain and digital outcrop models. Data fusion is supported so that multiple models with different scales and geometric resolutions can be combined in one 3D scene. This allows studying both the large geological context, which usually is reconstructed from orbiter imagery, and small outcrop details originating from rover camera imagery.
PRo3D allows the user to fluently move around and zoom to investigate features at different scales and perspectives, as well as providing various interactive analysis tools. Interpretations can be digitised directly onto the 3D surface, and simple measurements can be taken of the dimensions of the outcrop and sedimentary features. The 3D data allows for incorporation of the geometrical features of the sedimentary layers into the measurements to obtain the true dimensions of those features. Dip and strike is calculated within PRo3D from mapped bedding contacts and fracture traces, through which a best fit plane is created to derive the dip and strike vectors. Scientists can organize measurements and annotations according to their geological context in a hierarchical way.
These tools have been tested on two case studies; Victoria Crater and Shaler. Victoria Crater, in the Meridiani Planum region of Mars, was visited by the MER-B Opportunity Rover. Erosional widening of the crater produced <15 m high outcrops which expose ancient Martian aeolian sedimentary strata. Shaler was visited in the early stages of the MSL mission, and provides excellent opportunities to characterise Martian fluvio-lacustrine (ancient river and lake) sedimentary features.

Representative examples and further information about the interactive 3D visualization tool can be found on the FP7-SPACE Project PRoViDE web page http://www.provide-space.eu/interactive-virtual-3d-tool/.
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