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The PRo3D View Planner – interactive simulation of Mars rover camera views to optimise capturing parameters

Christoph Traxler (1), Thomas Ortner (1), Gerd Hesina (1), Robert Barnes (2), Sanjeev Gupta (2), and Gerhard Paar (3)

(1) VRVis Zentrum für Virtual Reality und Visualisierung Forschungs-GmbH, Vienna, Austria (traxler@vrvis.at), (2) Imperial College London, United Kingdom, (3) JOANNEUM RESEARCH, Graz, Austria

High resolution Digital Terrain Models (DTM) and Digital Outcrop Models (DOM) are highly useful for geological analysis and mission planning in planetary rover missions. PRo3D, developed as part of the EU-FP7 PRoViDE project, is a 3D viewer in which orbital DTMs and DOMs derived from rover stereo imagery can be rendered in a virtual environment for exploration and analysis. It allows fluent navigation over planetary surface models and provides a variety of measurement and annotation tools to complete an extensive geological interpretation.
A key aspect of the image collection during planetary rover missions is determining the optimal viewing positions of rover instruments from different positions ('wide baseline stereo'). For the collection of high quality panoramas and stereo imagery the visibility of regions of interest from those positions, and the amount of common features shared by each stereo-pair, or image bundle is crucial. The creation of a highly accurate and reliable 3D surface, in the form of an Ordered Point Cloud (OPC), of the planetary surface, with a low rate of error and a minimum of artefacts, is greatly enhanced by using images that share a high amount of features and a sufficient overlap for wide baseline stereo or target selection.
To support users in the selection of adequate viewpoints an interactive View Planner was integrated into PRo3D. The users choose from a set of different rovers and their respective instruments. PRo3D supports for instance the PanCam instrument of ESA's ExoMars 2020 rover mission or the Mastcam-Z camera of NASA's Mars2020 mission. The View Planner uses a DTM obtained from orbiter imagery, which can also be complemented with rover-derived DOMs as the mission progresses. The selected rover is placed onto a position on the terrain – interactively or using the current rover pose as known from the mission. The rover's base polygon and its local coordinate axes, and the chosen instrument's up- and forward vectors are visualised. The parameters of the instrument's pan and tilt unit (PTU) can be altered via the user interface, or alternatively calculated by selecting a target point on the visualised DTM. In the 3D view, the visible region of the planetary surface, resulting from these settings and the camera field-of-view is visualised by a highlighted region with a red border, representing the instruments footprint. The camera view is simulated and rendered in a separate window and PTU parameters can be interactively adjusted, allowing viewpoints, directions, and the expected image to be visualised in real-time in order to allow users the fine-tuning of these settings. In this way, ideal viewpoints and PTU settings for various rover models and instruments can efficiently be defined, resulting in an optimum imagery of the regions of interest.