European Planetary Robotic Vision Approach: PRoViDE

Monday, April 20, 2015, 3:00 – 4:30 pm,
JPL Conference Room 180-101
Jet Propulsion Laboratory, Pasadena

Leading European scientists & engineers in the field of planetary robotics vision will give talks on their research results in the fields of **3D vision processing, GIS and visualization,** targeted to the European ExoMars Rover 2018 Mission, embedded in work funded by the European Union's research 7th Framework Programme.
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The EU FP7 Project PRoViDE: 3D vision processing from planetary rovers' imagers & their visualization

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The international planetary science community has launched, landed and operated dozens of human and robotic missions to the planets and the Moon. They have collected various surface imagery that has only been partially utilized for further scientific purposes. The FP7 project PRoViDE (Planetary Robotics Vision Data Exploitation) is assembling a major portion of the imaging data gathered so far from planetary surface missions into a unique database, bringing them into a spatial context and providing access to a complete set of 3D vision products. The **processing chain** is shown which is complemented by a **multi-resolution visualization engine** that combines various levels of detail for a **seamless and immersive real-time access to dynamically rendered 3D scenes**. Latest results of **3D fusion between HiRISE and MER/MSL 3D stereo vision products** will be shown in real-time visualizations, as well as **3D vision processing results from multiple rover stations** such as available for MER at Victoria Crater and for MSL at the Shaler site.

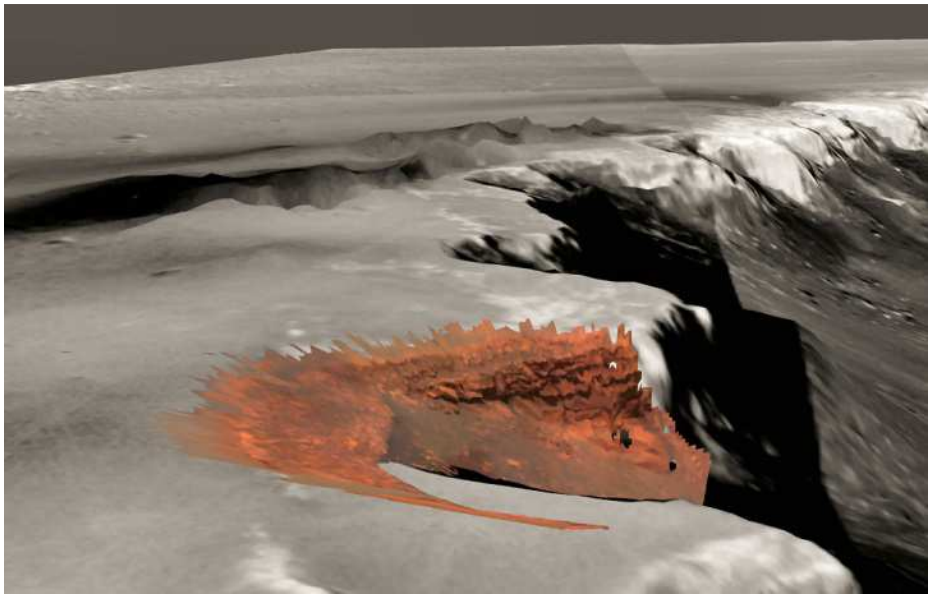

Figure 1. Fusion between MER-B stereo reconstruction and HiRISE DEM at Victoria Crater.

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 312377 PRoViDE

Fusing ground-level with super-resolution orbital views of Mars for visualization and Rover localization

Jan-Peter Muller & Yu Tao Mullard Space Science Laboratory, University College London

Since 2007, the availability of very high resolution imagery of the surface of Mars from orbit (25cm) from the NASA HiRISE instrument allows scientists to determine to high accuracy the location of surface rovers to tens of cm precision within a HiRISE image. This is achieved through the co-registration of common homologous features visible in onboard rover cameras, which can be matched to those visible in orbital images. However, the poor locational accuracy of the HiRISE images meant that the absolute location of any specific point could be hundreds of metres in error. Through the automated co-registration of HiRISE-to-CTX-to-HRSC orthorectified images, the locational accuracy is now within a few metres of the true position. Examples of such optical navigation will be shown for the MER-A (Spirit) and MER-B including a comparison with the best accuracy achievable using incremental bundle adjustment (IBA). Recently, a fully automated method has been developed to generate a rover traverse through successive ground space co-registration which can employ the rover tracks for verification.

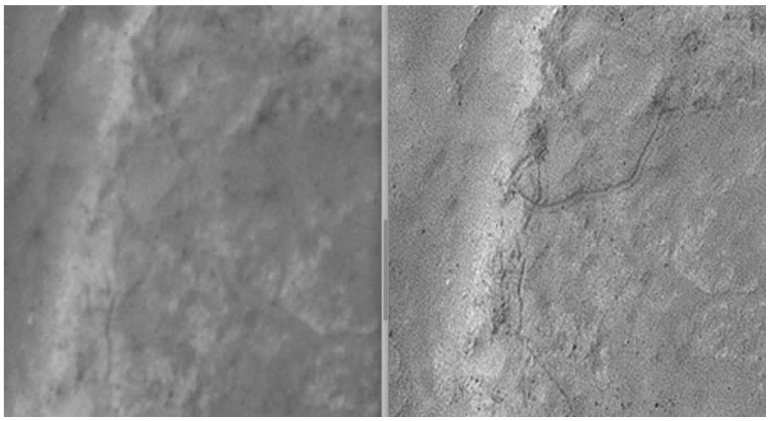

Figure 2. MER-A Homeplate: 25cm HiRISE (left) and super-resolution 5cm imagery generated from a stack of 8 inputs

During the course of working on this automated navigation, a super-resolution restoration (SRR) technique has been developed which allows up to 5cm imagery to be generated from multiple overlapping orbital HiRISE images taken over a large number of years. Examples will be shown of the co-registration of the rover imagery with such SRR images as well as examples of its potential application to the future exploration of planetary surfaces.

Contextualising and Analysing Planetary Rover Image Products through the Web-Based PRoGIS

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The big amount of raw and derived data available from various planetary surface missions (Mars and Moon in this case) needs an integrated GIS to use it for scientific use: we aim not to replicate a desktop GIS with all its complexity but to create a web interface, PRoGIS, with minimal controls focusing on the usability and visibility of data, to allow planetary geologists to share annotated surface observations. Our aim is to use only Open Source components that integrate Open Web Services for planetary data to make available a universal platform with a WebGIS interface, a 3D viewer for derived data and the capability to make and share annotations. We use Python and Django for the server-side framework and Open Layers 3 for the WebGIS client. For good performance previewing 3D data (point clouds, pictures on the surface and panoramas) we employ ThreeJS, a WebGL Javascript library. Additionally, user and group controls allow scientists to store and share their observations. PRoGIS not only displays data but also launches sophisticated 3D vision reprocessing (PRoVIP) and an immersive 3D analysis environment (PRo3D).

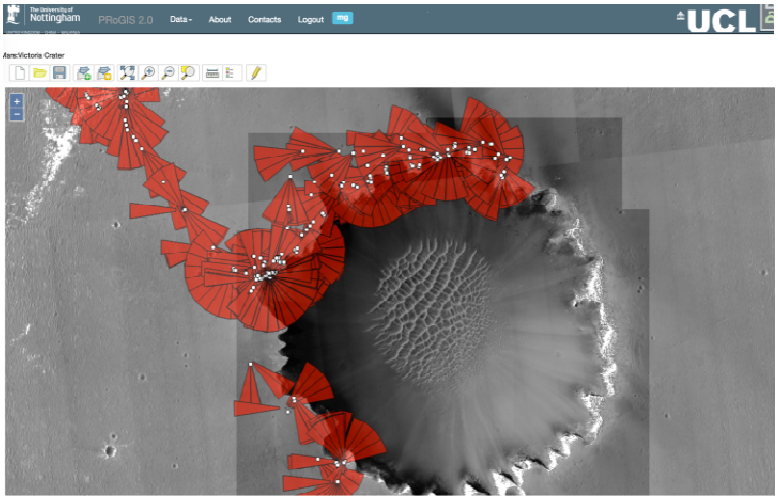

Figure 3. PRoGIS displaying camera footprints.

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