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The Europlanet RI TransNational Access Planetary Analogue Terrain Laboratory (PATLab)

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ABSTRACT

A proposal entitled Europlanet Research Infrastructure (RI) has been submitted to the EU Seventh Framework Programme (FP7). This aims to "*consolidate the integration of the planetary science community (which started with Europlanet's FP6 Coordination Action), and to integrate a major distributed European infrastructure to be shared, fed and expanded by all planetary scientists". "The research infrastructure needed to address the major planetary science questions extends beyond the space missions per se. It requires a diversity of tools that need to be used with maximum synergy, with numerical modelling and results from laboratory activities being essential to properly interpret observations and propose new theoretical models"*[1]. To address this need, TransNational Access activities have been proposed that will for the first time open to a broad community of users a unique and comprehensive set of laboratory facilities and field sites tailored to the needs of planetary research. One such TransNational Access (TNA) facility is the Aberystwyth University Planetary Analogue Terrain Laboratory (PATLab). This paper presents an overview of the PATLab, and describes the analogue terrain, available robotic, instrumentation, and performance evaluation measurement apparatus, software-based simulation facilities, and PATLab access by the planetary research community.

Background

A new Planetary Analogue Terrain Laboratory (PATLab) has been created at Aberystwyth University (AU) [2]. The aim of the PATLab is to allow comprehensive mission operations emulation experiments to be performed. These trials and experiments are essential when learning how deploy and use a robot science instrument for a given mission, and hence maximise quality scientific data return. Work has resulted in a unique facility that has a terrain region composed of Mars Soil Simulant-D. It includes science target rocks that have been fully characterised, and hence we can compare these results with those generated using the PATLab planetary robotics facilities. The terrain has an area for subsurface sampling.

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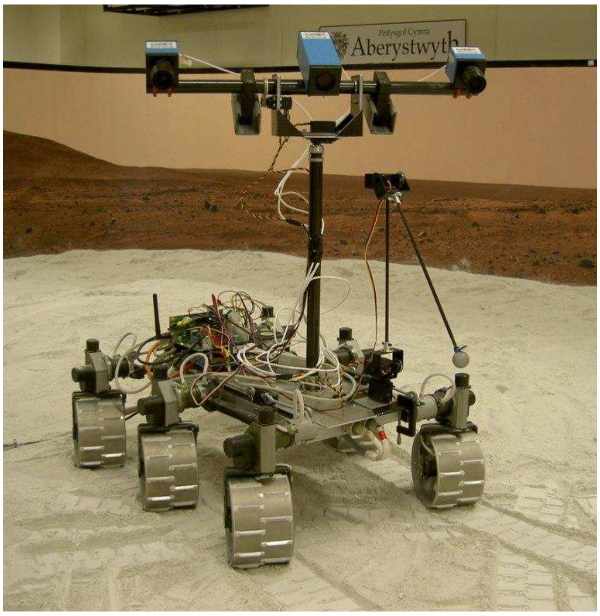

Figure 1: The AU half-scale ExoMars based rover chassis with 3 DoF arm and PanCam instrument.

The total floor area of the PATLab is $100\ m^2$, and half of this has been given over to the terrain region.

PATLab Equipment

The PATLab terrain has been designed to support a new rover chassis which is based upon the ESA ExoMars rover Concept-E mechanics [1], (see figures 1 and 2). The rover has 6 wheel drives, 6 wheels steering, and a 6 wheel walking capability. It is the first rover of its kind to support such functionality. We have mounted an AU designed and built 3 DoF robot arm onto the chassis. The PATLab is heavily instrumented and all data and control facilities are available via high speed links to remote users. Deployment trials have been conducted using the PATLab, for example, using QM versions of the Beagle 2 Rock Corer Grinder, and the Beagle 2 Mole: PLUTO.

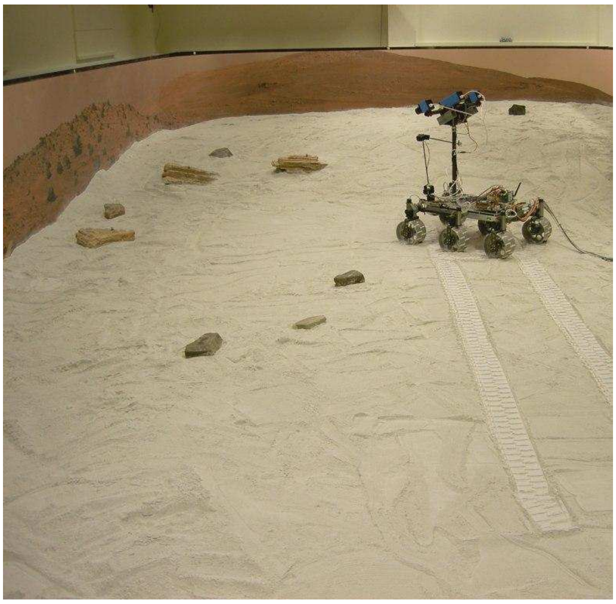

Figure 2: The AU rover undergoing autonomous arm placement trials. Sedimentary science target rocks are being used here.

Based upon COTS cameras we have created a panoramic camera instrument which emulates the proposed ExoMars PanCam [2]. Image capture and machine vision processing algorithms have been implemented and these run on-board a rover chassis small-PC. A pan and tilt mechanism for our PanCam instrument has been designed and built which is attached to a mast structure on our rover chassis. During PATLab. experiments the motion of the rover chassis wheel mechanics, rover attitude, robot arm deployment, and PanCam pan and tilt mechanism can be measured using our Vicon motion capture system. This comprises twelve infrared cameras, and the Cartesian position of reflective markers placed anywhere with the PATLab terrain region can be tracked in real-time (typically 100 Hz) with a resolution less than 0.1 mm. The PATLab has a large selection of software tools for rover, robot arm and instrument modelling and simulation, for the processing and visualisation of captured instrument data, and for simulating planetary environmental conditions (see figures 3 and 4).

PATLab Access

In addition to planetary scientists using our facility in person[3], we have established a PATLab Access Grid Node. Given the size and multi-national composition of many planetary science teams, we believe that Access Grid technology

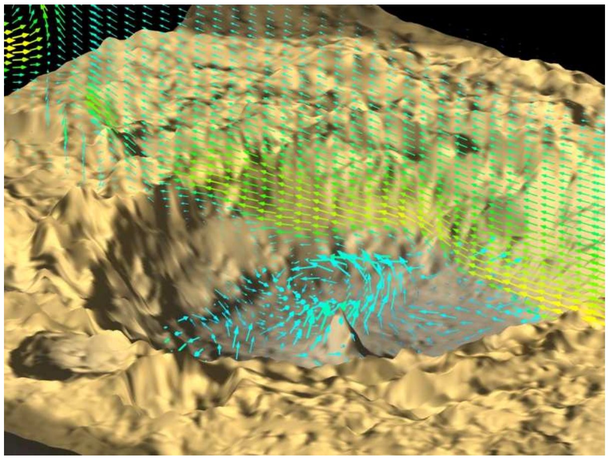

Figure 3: Screen shot from the AU planetary environment simulation software suite (Mamer Vallis crater).

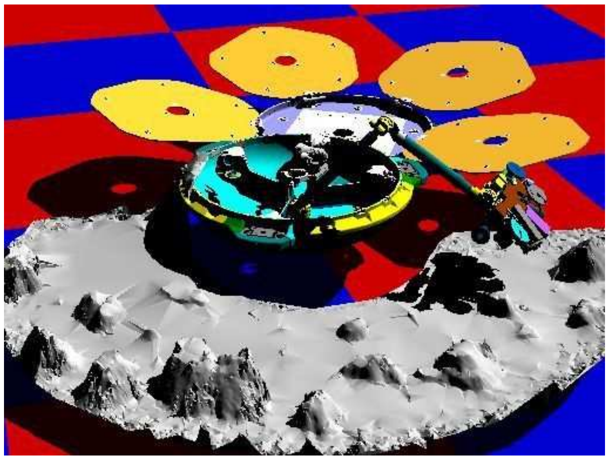

Figure 4: Screen shot from the AU shadow simulation software suite.

will provide an ideal solution to the PI/Co-I travel and onsite availability problems inherent to (extended) mission operations. Not only can this technology be used by research partners at other European sites when evaluating their instruments using the Europlanet TNA PATLab facility, but connectivity to the UK Access Grid Support Centre (AGSC) could provide a number of new exciting science opportunities via the UK e-science Centres of Excellence, the UK National & Regional e-science Centres and EUROAG, the European Access Grid.

[3] At a recent ExoMars PanCam PATLab workshop we had 17 external attendees from MSSL (UK), MCSE (CH), Joanneum Research (A), DLR (D), ESTEC (NL), UofL (UK), EADS Astrium (UK), TUB (D), BIL (UK).

References

[1] Barnes, D. et al. (2006), *IJAsB*, 5, 03, 221-241.

[2] Griffiths, A. et al. (2006), *IJAsB*, 5, 03, 269-275.