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SPA.2013.2.1-01 - Analysis of Mars Multi-Resolution Images using Auto-Coregistration, Data Mining and Crowd Source Techniques

- Collaborative project -

D8.2

User Consultation Workshop

WP 8 – Outreach

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Dissemination Level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

History table

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V0.1	20.10.2015	K. Willner	First draft of workshop minutes and description
V0.2	10.12.2015	K. Willner	Inputs from DLR internal review
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V1.2	04.01.2016	K.Willner J.-P. Muller	Input from J.-P. Muller

Executive Summary

The iMars project is developing a user platform for Mars surface science, consisting of a collection of co-registered data products from Mars orbital imaging data sets, and specific tools for producing, exploring and analyzing these (WebGIS, Crowd Sourcing). The project applies these data products and tools to studies of surface changes over time, which is a new dynamic field of Mars science. The concept of iMars includes inquiries into user needs, interests and feed-back during the project.

The user consultation workshop was held

a) to further the co-operation with other scientists,
b) to establish, improve and further efficient communication with scientists,
c) to enhance and promote the use and benefit of iMars tools and data, as well as
d) to identify new opportunities that arise as a result of the datasets and the web-GIS and crowd-sourcing mechanisms.

Deliverable D8.2 “User Consultation Workshop” summarises the results of the 2015 User consultation held at the EPSC 2015 in Nantes, France. The User consultation took place in the scope of an EPSC 2015 oral session titled “Zooming in-and-out of Mars: new tools to interact with multi-resolution Mars datasets” and a subsequent demonstration session that was organized as a splinter meeting. The consultation itself was an interactive oral discussion during which the responses by the audience were documented in a meeting minutes style.

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Key word list

User consultation, User Workshop, User Survey, Dissemination

Definitions and Acronyms

Acronyms	Definitions
COSPAR	Committee on Space Research
CrossDrive	Collaborative Rover Operations and Satellites Science in Distributed Remote and Virtual Environments
CTX	Context Camera
DLR	Deutsches Zentrum für Luft- und Raumfahrt
DTM	Digital Terrain Model
EGU	European Geophysical Union
EPSC	European Planetary Science Congress
ESA	European Space Agency
EU	European Union
FUB	Freie Universität Berlin
GIS	Geographic Information System
HiRISE	High Resolution Imaging Science Experiment
HRSC	High Resolution Stereo Camera
MER	Mars Exploration Rover
MEX	Mars Express
MGS	Mars Global Surveyor
MRO	Mars Reconnaissance Orbiter
MSSL	Mullard Space Science Laboratory
PDS	Planetary Data System
PRoGIS	PRoViDE Geo-Information System
PRoViDE	Planetary Robotic Vision Data Exploitation
PSA	Planetary Science Archive
RSL	Recurring Slope Lineae
UCL	University College London
UNOTT	University of Nottingham
VR	Virtual Reality
WebGIS	A software service providing access to GIS functionalities over the web using standard protocols and browsers.
WP	Work Package

1. Introduction

1.1. General context

The iMars project is developing a user platform for Mars surface science, consisting of a collection of co-registered data products from current Mars orbital imaging data sets back to image data sources from the 1970s, and specific tools for producing, exploring and analyzing these data products (WebGIS, Crowd Sourcing). The project applies these data products and tools to studies of surface changes over time, which is a new dynamic field of Mars science.

Planetary surface science has seen a dramatic increase in both the quality and quantity of observations over the last 15 years, especially in 3D imaging of surface shape. This has led to large volumes of high-resolution data, the ability to overlay data from different epochs, and the opportunity to examine time-dependent changes (such as the recent discovery of boulder movement, tracking inter-year seasonal changes and looking for occurrences of fresh craters). Consequently, planetary science studies can be based on complex sets of multi-type observation data, and conversely, new research themes have emerged and capable and rapidly evolving new science tools are in use.

The collection of Mars Science data available today, and relevant to the goals of the iMars project, comprises the following data sources:

- Viking images provided high-resolution as well as (some) stereoscopic views of the surface of Mars for the first time (Kirk et al., 1999).

- The Mars Global Surveyor spacecraft included the Mars Orbiter Laser Altimeter (MOLA), delivering data that have been used to derive an improved global geodetic reference system of Mars. In addition, the Mars Observer Camera (MOC) with its narrow angle device (Malin and Edgett, 2001) delivered meter-scale surface images of the surface for the first time, including some suitable for stereo analysis, although at very limited spatial extent (Kirk et al., 2003).

- The Mars Express (MEX) mission of the European Space Agency (ESA) includes the High-Resolution Stereo Camera experiment (HRSC; Neukum et al., 2004; Jaumann et al., 2007), capable of providing high-resolution digital terrain models (DTMs) at up to ten times higher grid spacing than MOLA, as well as panchromatic and multi-spectral images (Gwinner et al., 2009, 2010). Mapping Mars using such data at the global scale is among the foremost goals of HRSC, but will not be achieved during the lifetime of the iMars project according to the progress of data acquisition.

- Mars Reconnaissance Orbiter (MRO) with its Context Camera (CTX; Malin et al., 2007) is currently acquiring high-resolution images at ground pixel size between 5 m and 12 m at a global scale. MRO also includes the High Resolution Imaging Science Experiment (HiRISE; McEwen et al., 2007; Kirk et al., 2008) which uniquely provides images at sub-meter ground pixel size, although for small parts of the surface of Mars. A fraction of the data of both imaging systems of MRO comprises stereoscopic images.

1.2. Deliverable objectives

The concept of iMars includes inquiries of user needs, interests and feed-back during the project. Tool development was initiated by requirements derived from the user survey (D8.1)

and should be guided by workshops and user consultations. Links to potential user groups should be established and tightened.

To this end, a user requirements workshop and a formalized survey on user requirements and interests were held and implemented during the EGU general assembly in Vienna in the first half of 2014. This was the first of three activities of this type planned for the lifetime of the project under WP8.

While the first event and survey was largely designed to introduce and make the project and its aims known, the second event, reported here, i.e. the first User Consultation Workshop was intended to assess also experiences and feed-back of users applying iMars tools and data.

Furthermore, the iMars project wants to identify new opportunities that arise as a result of the datasets and the web-GIS and crowd-sourcing mechanisms and to evaluate how to best disseminate the produced data and developed tools.

Deliverable D8.2 “User Consultation Workshop” is summarizing the concepts and implementation adopted for the 2015 user workshop and discussion and reports on the execution. This deliverable concludes the activities of Task 8.2 (First User Consultation workshop).

2. Preparation of the Workshop

The workshop was planned to be held in conjunction with or as part of an international meeting of planetary scientists to best advertise the products, inform about the current status of the project, and to consult experts in that field of science about further needs.

An oral session at the EPSC 2015 was organized together with the two EU FP7 projects CrossDrive and PRoViDE. Both projects, similarly to iMars, concentrate on Martian data providing a very good synergy between the projects. While PRoViDE focuses on the processing and visualization of mission data of landed probes for science analysis and display of the results in a regional context, CrossDrive is developing a collaborative virtual environment including Mars data of all scales for scientific use and especially in view of the EXOMARS landing site characterization and rover operations.

To draw the attention of technical and geo-science experts to the session, the session description pronounced the wide range of activities (cf. Figure 1).

During the preparation of the session it was discussed to further arrange for a more interactive demonstration session at EPSC 2015. This was arranged for the same day as the oral presentation session. During this less formal session, all three projects presented the current status of their developments and products. Very short live presentations were given.

While the oral session drew the attention of an audience of about 60 persons, the demonstration session received less attention among the conference attendees.

MT8
Zooming in-and-out of Mars: new tools to interact with multi-resolution Mars datasets

Convener: K. Willner
Co-Conveners: J.-P. Muller , S. Gupta

Oral Program / Wed, 30 Sep, 09:00–12:30 / Room Neptune
Poster Program / Attendance Tue, 29 Sep, 17:45–19:15 / Poster Area

The enormous amount of imaging data sets now becoming available for Mars – both from orbiters and rovers - is transforming our understanding of the surface evolution of Mars through geological time. In order to more effectively analyse the data over the vast range of scales and resolution of the data, there is an urgent need to bring these data into a common co-ordinate reference system and display them in novel ways to enable scientists to fully exploit the wealth of information available.
We solicit contributions that include both the development and application of new tools and techniques, as well as new outstanding 3D imaging data products. Specific topics that we envisage to address in this session include: (1) how do we co-register and merge data across wide spatial scales for scientific interpretations; (2) what new platforms are there for processing, storing and presenting the data to the science community for maximum exploitation; (3) what interactive tools are being developed to exploit these co-registered datasets.
The session will be organized in a workshop style. Beginning with solicited talks on the aforementioned topics followed by a demonstration of results of the EU-FP7 funded iMars, PRoViDE, and CROSS-DRIVE projects – that are bringing together an extensive body of Martian data sets for scientific interpretation. The session will close with an open discussion focused on the scientists' needs for tools and displays to exploit data on a maximum

Figure 1: Session information at the EPSC 2015

3. Methods approach

3.1. User Consultation Workshop

The main purpose of the workshop was to primarily inform the scientific community about the current status of the iMars project – but also about the developments of the PRoViDE and CrossDrive projects, as well as to collect specifications about further needs by the community. The iMars status report included the development of techniques for data processing, derived added value products, and tools to gather information about these products.

Several presentations were given providing insight in iMars' current activities, development status, and results (cf. Table 1).

Table 1: iMars contributions to the EPSC 2015 user consultation workshop.

Presenter	Partner	Title	Link to Abstract
J.-P. Muller	UCL	EU-FP7-iMARS: analysis of Mars multi-resolution images using auto-coregistration, data mining and crowd source techniques: A Mid-term Report	EPSC2015-673
Y. Tao	UCL	Towards a better understanding of Martian surface processes: zooming in for a quantitative assessment of key geomorphological features from super-resolution HiRISE images in comparison to	EPSC2015-359

		overlapping rover Navcam image	
K. Gwinner	DLR	The first Quadrangle of the Mars Express HRSC Multi Orbit Data Products (MC-11-E)	EPSC2015-672
P. Sidiropoulos	UCL	Identifying dynamic features on Mars through multi-instrument co-registration of orbital images	EPSC2015-582
J. Sprinks	UNOTT	Is that a Crater? Designing Citizen Science Platforms for the Volunteer and to Improve Results	EPSC2015-694
V. Yershov (Poster)	UCL	A system for generating multi-resolution Digital Terrain Models of Mars based on the ESA Mars Express and NASA Mars Reconnaissance Orbiter data	EPSC2015-343

In order to structure consultation with the science community, the iMars consortium developed questions to be raised for discussion during the oral presentation session or the demonstration splinter meeting. Based on our prior experience of using a more formal survey using a questionnaire during (and after) the User requirements workshop in 2014 (see D8.1), we established it would be more effective to query the needs and preferences of the science community during an open interactive discussion.

The following questions were identified as relevant for the user consultation workshop:

a) How does the scientific community currently access data? How would they like to access data?
b) Presented GIS and software already provides certain tools for scientific analysis. Are there any tools missing from what has been presented that you feel would help you to exploit the data more easily?
c) Which regions of the Martian surface are of interest to the scientific community?
d) Which data products does the scientific community most commonly combine, and which products should the team prioritize for co-registration?
e) What additional data combinations/derivations are needed for further analysis and in which scientific field would these be applicable?

4. Summary of Activities

Due to the very good response to the session also by other groups dealing with Mars orbital data processing, two slots for oral presentations and a poster session were reserved for this workshop by the EPSC organizing board.

Session Details Poster Program

Wednesday, 30 Sep 2015

Chairperson: K. Willner, S. Gupta

09:00–09:15	EPSC2015-345 | Presentation **PRoViDE: Planetary Robotics Vision Data Processing and Fusion** **G. Paar**, J.-P. Muller, Y. Tao, T. Pajdla, M. Giordano, E. Tasdelen, I. Karachevtseva, C. Traxler, G. Hesina, L. Tyler, R. Barnes, S. Gupta, and K. Willner
09:15–09:30	EPSC2015-673 **EU-FP7-iMARS: analysis of Mars multi-resolution images using auto-coregistration, data mining and crowd source techniques: A Mid-term Report** **J.-P. Muller**, V. Yershov, P. Sidiropoulos, K. Gwinner, K. Willner, L. Fanara, M. Waelisch, S. van Gasselt, S. Walter, A. Ivanov, F. Cantini, J.G. Morley, J. Sprinks, M. Giordano, J. Wardlaw, J.-R. Kim, W.-T. Chen, R. Houghton, and S. Bamford
09:30–09:45	EPSC2015-928 **Collaborative Virtual Environments for Mars Science Analysis and Rover Target Planning** **A. Gerndt**, K. Gwinner, T. Fernando, D. Roberts, I. Musso, V. Basso, M. Giuranna, A. C. Vandaele, and Y. Kasaba
09:45–10:00	EPSC2015-359 **Towards a better understanding of Martian surface processes: zooming in for a quantitative assessment of key geomorphological features from super-resolution HiRISE images in comparison to overlapping rover Navcam image** **Y. Tao** and J.-P. Muller
10:00–10:15	EPSC2015-632 **MarsSI: Martian surface Data processing Application** **L. Lozac'h**, C. Quantin-Nataf, D. Loizeau, H. Clenet, B. Bultel, P. Allemand, P. Thollot, J. Fernando, A. Ody, and S. Harrison
10:15–10:30	EPSC2015-235 **Sharing knowledge of Planetary Datasets through the Web-Based PRoGIS** **M.G. Giordano**, J.M. Morley, J.P.M. Muller, R.B. Barnes, and Y.T. Tao

Chairperson: J.-P. Muller, K. Willner

11:00–11:15	EPSC2015-672 **The first Quadrangle of the Mars Express HRSC Multi Orbit Data Products (MC-11-E)** **K. Gwinner**, R. Jaumann, J. Bostelmann, A. Dumke, S. Elgner, C. Heipke, E. Kersten, G. Michael, F. Preusker, T. Roatsch, R. Schmidt, F. Scholten, M. Spiegel, S. van Gasselt, and S. Walter
11:15–11:30	EPSC2015-582 **Identifying dynamic features on Mars through multi-instrument co-registration of orbital images** **P. Sidiropoulos** and J.-P. Muller
11:30–11:45	EPSC2015-23 | Presentation **PRo3D – a tool for remote exploration and visual analysis of multi-resolution planetary terrains** **C. Traxler**, G. Hesina, and T. Ortner
11:45–12:00	EPSC2015-375 **Geological interpretation and analysis of surface based, spatially referenced planetary imagery data using PRoGIS 2.0 and Pro3D.** **R. Barnes**, S. Gupta, M. Giordano, J.G. Morley, J.P. Muller, Y. Tao, J. Sprinks, C. Traxler, G. Hesina, T. Ortner, K. Sander, B. Nauschnegg, G. Paar, K. Willner, and T. Pajdla
12:00–12:15	EPSC2015-694 **Is that a Crater? Designing Citizen Science Platforms for the Volunteer and to Improve Results** **J. Sprinks**, R. Houghton, S. Bamford, J. G. Morley, and J. Wardlaw
12:15–12:30	**Discussion**

Figure 2: Full schedule of the oral session "Zooming in-and-out of Mars: new tools to interact with multi-resolution Mars datasets" at EPSC 2015.

The oral session started with the introduction of the three EU projects participating in the workshop followed by more specific talks, as can be seen in Figure 2. In the following section a brief summary of the presentations is provided. Some of the presentations are available through the EPSC2015 website (http://www.epsc2015.eu).

4.1. Summary of Presentations

G. Paar - PRoViDE: Planetary Robotics Vision Data Processing and Fusion

Paar reported on the aims, contents and results of EU-FP7 project PRoViDE, in particular results obtained using ProGIS for MER/MASTCAM stereo processing in batch, and rover-orbit image combinations. G. Paar briefly demonstrated the use of the Pro3D tool developed in the project for 3D rendering of precomputed scenes. Intended applications include the Mars2020, and ExoMars rover Missions, and the revision as well as analysis of Lunokhod data. He encouraged audience to contact the project for planned science applications using the tools, as the software is not freely accessible.

J.-P. Muller - EU-FP7-iMARS: analysis of Mars multi-resolution images using auto-coregistration, data mining and crowd source techniques: A Mid-term Report

The major goals of iMars were presented. These focus on the exploration of surface changes documented for Mars since the early Mars exploration Missions in 1976, applying HRSC data products as a base dataset, which stands in contrast to previous attempts. In addition, DTMs and ortho-rectified images from HIRISE and CTX are exploited by applying tools for automatic co-registration of image data and data analysis. Furthermore, web-access to the products will be provided. The adoption of citizen science approaches in this area is also investigated. Specific tools for Mars data analysis and image quality checks were presented. There is a challenging production plan for the remaining project duration, including e.g. processing of 3000 CTX stereo pairs, starting in October 2015; HiRISE stereo processing and citizen science experiments will start in January 2016. The project invites interested scientists to participate on a co-operation basis in a number of planned case studies applying iMars data and tools.

A. Gerndt - Collaborative Virtual Environments for Mars Science Analysis and Rover Target Planning

Gerndt discussed the challenges associated with huge data volumes in planetary exploration and future missions, in particular with regard to ExoMars, and how CrossDrive addresses these in 3 use cases investigated by the project. The three use cases are focused on the topics of landing site characterization, atmospheric science, and rover operations. The first use case on landing site characterization has recently been accomplished. It was executed in the form of a virtual meeting in a shared collaborative environment. VR labs at three partner institutions were involved. In addition to technical developments, planetary scientists in the project supply expertise on data products and are providing guidelines and feed-back for developers, from an application perspective. This has been demonstrated e.g. for the visualization of SHARAD radar data. Use case 2 will involve sparse global atmospheric datasets; use case 3 rover target selection. VR as well as telepresence technology are applied on an experimental basis in all these use cases. The science community was invited to register on the CrossDrive science portal; or send comments via the portal.

Y. Tao - Towards a better understanding of Martian surface processes: zooming in for a quantitative assessment of key geomorphological features from super-resolution HiRISE images in comparison to overlapping rover Navcam image

Tao presented a comparison of "super-resolution" processing results for HiRISE images, leading to 5 centimeter-resolution images, to rover images. Visual comparison, rock size-frequency, and image-based roughness were used as measures to compare results. Statistics of rocks up to 50 cm diameter showed comparable results between "super-resolution" HiRISE and NavCam images. In exceptional cases, this is also the case at smaller diameters. The occurrence of false positive detections has been observed but not systematically checked or cleaned prior to statistical analyses. Examples of the super-resolution imagery can be viewed on the PRoGIS 1.0 web-GIS. There are extensive ideas for application to other planetary missions.

C. Quantin-Nataf - MarsSI: Martian surface Data processing Application

Quantin-Nataf presented the concept and capabilities of the MarsSi service that allows users to process, inspect, and download Martian orbital data through a web-based platform. The ERC project (2011-2016) is staffed by her research group at Université de Lyon. It aims at "GIS ready" products, allows downloads from data archives, launching of instrument specific processing pipelines, and archiving of products. Currently 5-10 users can be supported but the system is planned to be publicly accessible. DTM processing capabilities for CTX and HiRISE apply the Ames Stereo Pipeline, in other cases already completed products are available for download (e.g. HRSC). Methodology and quality aspects are related to the processing standards of the respective software systems and their documentation.

J. Wardlaw - Sharing knowledge of Planetary Datasets through the Web-Based PRoGIS

The presentation began with the presentation of the schema for the WebGIS component of PRoViDE. Wardlaw briefly presented the current implementation of the PRoGIS component and demonstrated capabilities of the web-based GIS, e.g. to display rover scenes in both 2D and 3D with colour coded grid. The HiRISE context images with overlay of rover traverses, rover positions and image footprints were displayed. It was also reported that search tools are available and an upload of individual data can be made.

K. Gwinner - The first Quadrangle of the Mars Express HRSC Multi Orbit Data Products (MC-11-E)

Gwinner reported on the development and status of a new data product level for Mars Express HRSC, regional, multi-orbit DTMs and orthoimage mosaics. The first prototype results have been presented at the EGU General Assembly 2015 and are part of a global mapping project of the Mars Express HRSC Science team. EU-FP7 project iMars is contributing to the definition and validation of the new data products. The progress compared to already existing single-strip HRSC product datasets was highlighted, in particular higher completeness and detail of DTM, improved co-registration accuracy for image mosaics (pixel scale at the highest HRSC image resolution) and production of contrast enhanced panchromatic and colour mosaics. First results of ongoing quality analysis were compared to the well-known quality figures of single-strip results. Some science application aspects related to the provision of homogeneous, high-level HRSC mapping products at regional to (finally) global scales were discussed, in particular

scientific visualization, GIS analysis based on co-registered multi-source data, and landing site characterization.

P. Sidiropoulous - Identifying dynamic features on Mars through multi-instrument co-registration of orbital images

A technique for co-registration of CTX, THEMIS and MOC images to HRSC was presented that applies a SIFT-based algorithm and a novel coupled decomposition technique. An option to process the other data sets Viking or HiRISE images has not yet been implemented. A camera model is applied to parameterize the initial transform, before a fine-scale fit is performed using space resection and the HRSC DTM. UCL is currently starting tests using thousands of images covering MC-11E.

T. Ortner - PRo3D – a tool for remote exploration and visual analysis of multi-resolution planetary terrains

PRo3D as a visualization tool for multi-resolution data was presented (from orbital images to rover images and even microscopic images). Different tools are available for exploring the data, e.g. display and recording of coordinates and distances, including distance of observer to surface. Annotations and simple feature editing are also available, as well as dip and strike measurements. An implementation for remote rendering applications forms the basis to supply PRo3D as a web-service.

R. Barnes - Geological interpretation and analysis of surface based, spatially referenced planetary imagery data using PRoGIS 2.0 and Pro3D.

The usage of Pro3D for geological analysis is demonstrated. Visualization allows to virtually move around an outcrop, similar to a field geologist, or to adopt defined viewpoints. Measurement functionalities with a focus on dimensions and layer dips are interactively demonstrated. An impressive example of grain size analysis from a millimeter resolution MAHLI dataset is shown.

J. Sprinks - Is that a Crater? Designing Citizen Science Platforms for the Volunteer and to Improve Results

Sprinks reported on aspects of the EU-FP7 iMars project dedicated to analysis and design of citizen science projects. The aim is to attract more users and improve the quality of the measurements performed. Both the user interfaces and the specifications can and shall be optimized, based on the test studies performed. Progress will be assessed by analysing expert and non-expert user responses in online case studies including quality differences between datasets from expert and non-expert users.

4.2. Discussion during the Oral Session

An open discussion was held involving all attendants, focused on two central questions proposed by the convener

1. Which tools are missing in the users science applications?

2. Which are the best suited formats and platforms for accessing the data?

Most users are concerned about accessing DTM products for their study from HiRISE, CTX, HRSC, as these are still only partly processed.

One proposal was that instrument teams should offer support in archiving the results in the public science archives (PDS/PSA) to groups that are processing the experiment data in independent labs. The HiRISE team for example, according to its PI, expressly welcomes information on new external DTM results. Also for the iMars coordinator, archiving via PDS and PSA is a preferred option, and some datasets used in the project are already prepared for delivery (HRSC).

The question was raised how a validation for archive release can be organized in a scenario where results from various sources are to be combined in the same archive (PDS standards require to archive fully documented and validated products – tasks that are typically in the responsibility of instrument teams). The HiRISE team, according to the PI, plans to maintain a validation procedure for this purpose. Other suggestions are to provide quality maps, including some quality features that can be traced from already validated products such HRSC. In the case of HRSC, a standardized comparison test including different producers has been performed to this end and outcomes were published in a scientific journal (Heipke et al., 2007) - similar results should also be helpful for other instrument data. It has to be acknowledged that quality layers themselves have to be replicable and fully documented. Their significance for a particular data product has to be investigated.

Another general problem noted was that the projects are funded for only a limited time. However, long term archiving and maintenance requires both a high level of initial investment of time and then a certain level of consistent ongoing effort. Officials from the PDS reminded the discussants that PDS and PSA are exactly supported for this purpose of long-term archiving. There should be cooperation with tool providers, as tools for data exploration and analysis cannot usually be developed by the archives. It should be noted that tools themselves can also be archived, in PDS and PSA, which might be a useful option where maintenance cannot be assured in the long-term. In general it was reflected on that timescale of processes at the science archives may, on occasion, appear slow but that they represent the challenges faced by being the only enduring institutions in place and they are willing to cooperate in tool development and provision within their given scope.

The second question was discussed only briefly and a shared view was that the archives are the usual source of information when it comes to data retrieval. No other options, like GIS systems, were explicitly favored over the archives by the audience since these are not supported by the PDS or PSA. Thus, working with the archives remains a challenge and it was suggested to promote GIS tool setups developed within projects such as iMars or PRoViDE to the archives. It was reported that PDS4 also envisages to improve usability of the archived items, although bureaucratic difficulties may make the transition slower than desired.

There appear to be no portals that are extensively used by a majority of users. A suggestion was made to include existing institutions like RPIFs into the distribution chain for planetary data and products though US colleagues argued that PDS and PSA have the role to archive data, products and tools in long-term archives.

It was also noted that better tools for data storage and retrieval are essential in facilitating improved collaboration between scientists in the future.

4.3. Demonstration Session

The demonstration session included live demonstrations of the tools and the data by the three EU FP7 projects CrossDrive, PRoViDE and iMars. While the first two showed the capabilities of their developed tools, iMars concentrated on the detailed specification of the derived products.

CrossDrive Demo

The project demonstrated a global 3D viewer based on data derived for Mars. A MOLA DTM was used as base information covering the entire globe. For the Gale crater region overlays of HRSC, CTX, CRISM, and HiRISE image data were displayed. Where available, DTMs of higher resolution than the MOLA data were nested into the scene.

Height contour lines, colour bar and exaggeration of the display were changed and a navigation to a preset location was performed. Further features of the software were the change of level of detail (dependent on the distance to the object), activation of the sun in dependence to the set day and time as well as flying along a certain trajectory.

Figure 3: Andreas Gerndt - Project Coordinator of the EU FP7 Cross Drive project - demonstrates the current implementation of the 3D viewer for global data sets.

PRoViDE Demo

Here a short introduction of the Pro3D® component – the expert viewer developed within PRoViDE – was given. In contrast to the CrossDrive viewer regions are not linked with a sphere. More general datasets can be displayed. Features of the viewer include

- Free flying mode
- Bookmarking
- Annotation of regions and features
- Detailed rendering from orbital to microscopic image data

As the viewer is meant to assist in scientific analysis it includes several tools to assist in better understanding of the scene. These include distance measurement, polyline drawing, marking of regions of interest, dip and strike measurement, colour coding of planes and feature marking. The digitization of the scene is supported by a free choice of line or feature colour

and thickness. All operations are performed in true 3D data that also allow the display and analysis 3D features (e.g. overhangs).

Figure 4: Rob Barnes, from Imperial College London, demonstrates the capabilites of the PRo3D® tool that was developed in the scope of the EU FP7 PRoViDE project.

iMars Demo

The iMars project demonstrated achievements in five very short live presentations. The project coordinator started with a demonstration of data sets in a webGIS environment. Here emphasis was given to the good co-registration of data sets with various resolutions and the enhancement of HiRISE resolution by means of super-resolution techniques. This demonstration included exemplary data for the MER traverse areas.

Figure 5: Demonstration of super resolution products by the project coordinator, J.-P. Muller, in the PRoGIS webGIS system. The super resolution technique for HiRISE image data has been developed by MSSL / UCL.

P. Sidiropoulous

Sidirpoulous presented results from the recently developed co-registration method for iMars and explained the characteristics of the approach. Distortions at the edges of an image remain, but for the central parts of an image there is a co-registration accuracy of better than 2 pixels of e.g. CTX images to HRSC image data. This was validated through intrinsic statistics.

J. Wardlaw

Wardlaw presented the project setup on the Zooniverse platform. Here a FAQ page was installed and tools to measure the appropriate feature can be defined. Users can comment on images and add these to a favorite list to work with the images later on. A blog to facilitate communication between the science team and citizen scientists will be installed in the future.

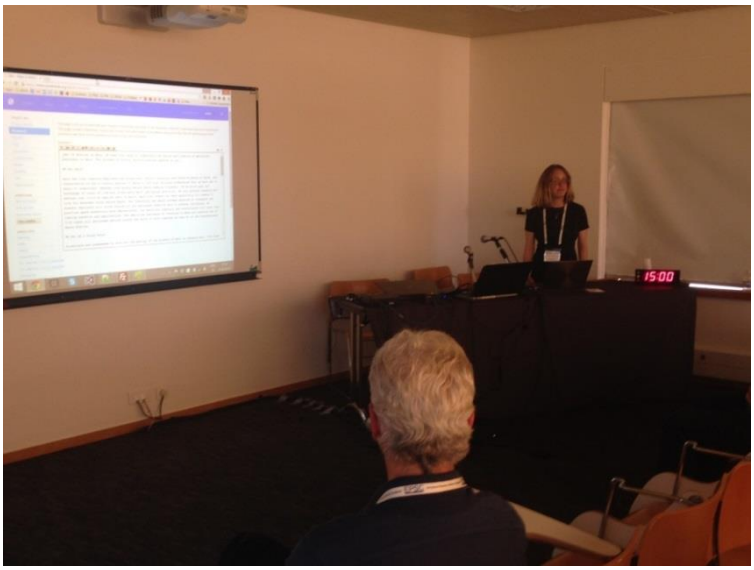

Figure 6: J. Wardlaw of the University of Nottingham presented the citizen science project for Mars orbtial data on the Zooniverse platform that has been implemented in the scope of the EU FP7 iMars project.

R. Steikert

Steikert demonstrated the current implementation of the iMars webGIS. Compatibility with QGIS was demonstrated by opening two layers. To download the image data, a click on a footprint of the respective image is sufficient. Future plans include a metadata query, time scale bar and the display of changes on co-registered data.

B. Schreiner

Current 3D videos as results of the iMars project were shown. The Videos were presented in several different formats: in color, anaglyph, side by side, perspective view and high resolution monochrome. Videos can be screened on any color display when also using glasses for the 3D visualization – including PlayStation. These videos are available from the FU Berlin website

(http://www.geo.fu-berlin.de/geol/fachrichtungen/planet/press/animations/index.html).

Figure 7: B. Schreiner from FU Berlin presents videos of Mars surface 3D reconstructions based on HRSC images data. Annimations have been produced in the scope of the iMars project.

5. Conclusions

The session primarily initiated and organized by the iMars consortium were well visited with approximately 60 to 80 attendees during the oral session and 30 for the demonstration session. The poster session received good attendance whereas it is, due to the general setup, impossible to judge the amount of interest for certain topics by the attendees.

A lively discussion was held in the oral session.

iMars intends to provide all data products produced within the project to the PDS archives through JPL. Therefore, best efforts are being made to provide a quality measure that can be traced to an already archive validated data set – i.e. HRSC.

The discussion about the preferred information source of scientists showed that GIS systems are highly appreciated but not furthered, implemented or adopted by the existing long term archives. A better promotion in front of the archives is desirable.

A short summary of the discussion is provided in Table 2 below.

Figure 8: Audience of the demonstration session watching an anaglyph video.

Table 2: Summary of discussion points during the user consultation and implications for the iMars project. Implications cannot be seen as obligation but as best effort action item to the iMars project.

Questions	Discussion Results	Implication for iMars
Which tools are missing in the users science applications?	The science community desires better access to digital terrain models in high resolution. Many groups engage in efforts to produce such data but results are available for a limited amount of the products. At the same time, for products originating from different sources, validation may impose difficulties.	Make as many data products as possible available to archives by co-operating with instrument teams like HiRISE. Special emphasis on product quality aspects and widely applicable quality standards can further validation, archival and usage of iMars products.
Which are the best suited formats and platforms for accessing the data?	Currently PDS and PSA appear to be the points of access to planetary data, though data access by other means, e.g. WebGIS, would be desirable if supported by the archives.	Actively disseminate results and developments to the science community and the archives to raise attention and potentially provide the developments through an archive.

6. References

Heipke, C., Oberst, J., Albertz, J., Attwenger, M., Dorninger, P., Dorrer, E., Ewe, M., Gehrke, S., Gwinner, K., Hirschmüller, H., Kim, J.R., Kirk, R.L., Mayer, H., Muller, J.-P., Rengarajan, R., Rentsch, M., Schmidt, R., Scholten, F., Shan, J., Spiegel, M., Wählisch, M., Neukum, G., Team, t.H.C.-I., 2007. Evaluating planetary digital terrain models--The HRSC DTM test. Planetary and Space Science 55, 2173-2191.