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3D IMAGING TOOLS AND GEOSPATIAL SERVICES FROM JOINT EUROPEAN-USA COLLABORATIONS

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Abstract

The EU-FP7 iMars project (http://www.i-mars.eu) developed a completely automated digital photogrammetric processing system to generate DTMs and ORIs from ESA-HRSC and NASA-MRO/CTX and HiRISE called CASP-GO based on the NASA-ASP open source platform. Since the end of iMars, thousands of CTX and tens of HiRISE 3D products have been produced. It is planned that CASP-GO will be integrated into ASP in future releases. The CTX DTM products have been visually assessed and a ≈3000 subset is now available from the new ESA Guest Storage Facility based at the ESAC-PSA. We describe this new distribution mechanism using a new set of single strip and mosaic of 33 HRSC DTMs+ORIs of the SPRC.

1. Introduction

CASP-GO [1] standing for Co-registration ASP-Gotcha Optimised, is based on the open source NASA Ames Stereo Pipeline (ASP) [2], Mutual Shape Adapted Scale Invariant Feature Transform (MSA-SIFT) based multi-resolution image co-registration [3], and the Gotcha [4] sub-pixel refinement method. The implemented system [1] guarantees global geo-referencing compliance with respect to High Resolution Stereo Camera imaging (HRSC), and hence to the Mars Orbiter Laser Altimeter (MOLA), providing refined stereo matching completeness and high accuracy based on the open source ASP platform. CASP-GO has been applied for batch processing of thousands of serendipitous stereo acquisitions from the NASA Context Camera and HiRISE instrument [1]. In parallel, UCL [5] developed a modification of the NASA-VICAR processing system for HRSC [6] which is called the KM processing system. This has recently been employed to generate orbital strip and mosaiced products of the Martian SPRC (South Polar Residual Cap) [7]. We report on how all of these products are being quality assessed, classified and distributed. iMars also developed a web-GIS system for displaying of browse colourised (by height) hill-shaded products and the downloading of original DTM (Digital Terrain Model) and ORI (OrthoRectified Image) [8].

2. Methods

Aside from the ASP core pre-processing, initial matching, subpixel matching, camera triangulation, and DTM generation, five additional workflows are introduced to improve the DTM quality.

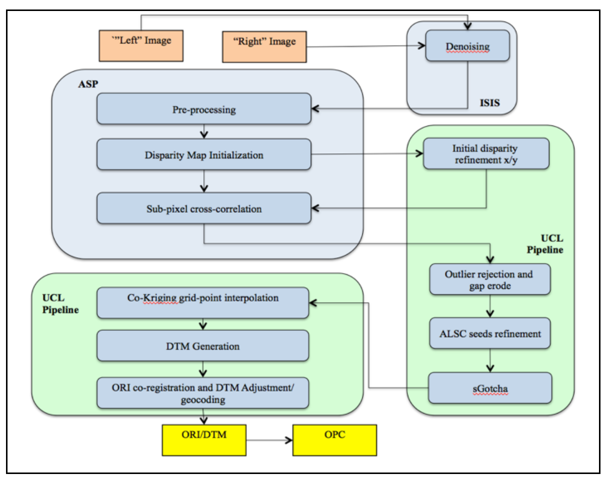

Figure 1: CASP-GO flowchart [4] ASP (blue) & new (green).

Figure 1 shows that these include (a) a fast Maximum likelihood sub-pixel refinement method to build a float initial disparity map; (b) an optimized outlier rejection and erosion scheme to define and eliminate mis-matches; (c) an Adaptive Least Squares Correlation (ALSC) and region growing (Gotcha) based pixel disparity refinement and densification to try to match un-matched and mis-matched area; (d) co-kriging grid-point interpolation to generate DTMs as well as height uncertainties for each interpolated DTM point; and (e) OrthoRectified Image (ORI) co-registration with respect to a given base dataset (in our case level-4 HRSC products).

3. Products

The CASP-GO processing chain was applied to generate ~5,300 NASA Mars Reconnaissance Orbiter (MRO) Context Camera (CTX) stereo-derived 3D imaging products using the MSSL-Imaging processing cluster and the Microsoft Azure® cloud computing platform [1]. These DTMs cover ~18% of the Martian surface at 18m/pixel compared to the current HRSC DTM coverage of around 50% with grid-spacing from 50m/pixel to 150m/pixel. Figure 2 shows their overall distribution when compared against processed HRSC level-4 products [6].

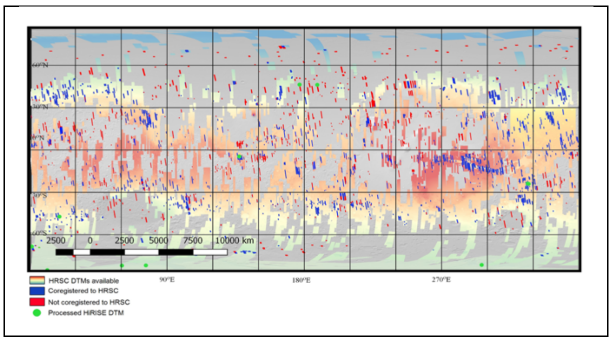

Figure 2: Footprints of the processed iMars CTX blue for HRSC products available and (red for missing HRSC products) and HiRISE (green) DTMs displayed on top of the colourised_by_height hill-shaded HRSC level 4 DTM products and greyscale hill-shaded MOLA DTM.

The resultant multi-resolution co-registered 3D models will allow a much more comprehensive interpretation of the Martian surface, and are available to browse by the international community of planetary geo-scientists through an interactive webGIS system (http://www.i-mars.eu/web-gis) developed at the Free University Berlin [8] available at UCL-MSSL and through the ESA Guest Storage Facility (doi: 10.5270/esa-0j79yk8). Some tens of HiRISE stereo products have also been processed and compared against products from other systems. An example of CTX products from ASP and CASP-GO is shown in Figure 2 along with an example of co-registered HRSC-CTX and HiRISE derived DTMs in Figure 3, viewed within Fledermaus®

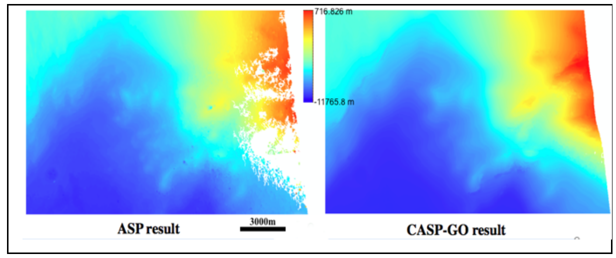

Figure 3: Comparison of CTX DTM products showing the impact of using Gotcha to fill in the gaps as well as the slight reduction in fine-scale detail from smoothing.

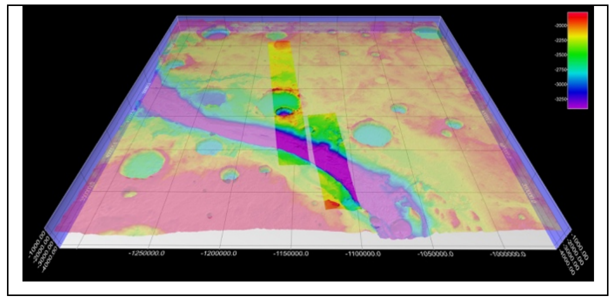

Figure 4: Perspective view of HRSC + CTX + HiRISE (2 strips) DTM products.

4. Summary and Conclusions

Results from CASP-GO are shown as well as the ESA Guest Storage Facility for product distribution.

Acknowledgements

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