

THE FIRST QUADRANGLE OF THE MARS EXPRESS HRSC MULTI ORBIT DATA PRODUCTS (MC-11-E)

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1. INTRODUCTION

The High Resolution Stereo Camera (HRSC) of ESA's Mars Express mission (Neukum et al., 2004; Jaumann et al., 2007) is designed to map and investigate the topography of Mars and its satellites. As a push broom scanning instrument with nine CCD line detectors mounted in parallel, its unique feature is the ability to obtain along-track stereo images and four colors during a single orbital pass. The sub-pixel accuracy of derived 3D points allows producing DTMs with grid sizes of up to 50 m and a height accuracy on the order of one pixel on the ground and better (Gwinner et al., 2009, 2010a).

We report on the characteristics of a new HRSC data product, HRSC image mosaics and multi-orbit DTMs, on related methodology aspects, and on the completion of the first regional product dataset.

Panchromatic stereo and color images of the High Resolution Stereo Camera (HRSC) have been used for production of digital terrain models (DTMs) and orthoimages for the surface of Mars from single orbits since several years. As the areas with continuous coverage by stereo data are increasingly abundant, the HRSC team has recently started a coordinated effort for the mapping of Mars by multi-orbit DTMs and image mosaics, using the complete HRSC mission data record. After more than 10 years of operation, HRSC has covered about 70% of the surface by panchromatic images at 10-20 m/pixel, and about 98% at better than 100 m/pixel. Seamless, precisely co-registered data products are thought to provide valuable geodetic reference data and geological context to a variety of other datasets. In particular, HRSC due to its specific spatial resolution provides a unique bridge between global MOLA altimetry and topography data derived from other stereo imaging instruments.

2. METHODOLOGY

Derivation of multi-orbit data products (Gwinner et al., in review) is based on the same set of procedures for image rectification, matching, strip-adjustment, and calculation of 3D points applied also for the production of single-strip HRSC DTMs and orthoimages (Gwinner et al., 2010a). In addition, bundle block adjustment (Spiegel, 2007; Dumke et al., 2008; Bostelmann and Heipke, 2014) and a technique for joint interpolation of multi-scale 3D point sets (Gwinner et al., 2010b) are used. Orthoimages are photometrically corrected

(Lambert model) and normalized to an external brightness standard (Thermal Emission Spectrometer albedo) prior to mosaicking (Michael et al., 2015; Walter et al., 2015).

3. RESULTS FOR QUADRANGLE MC-11-E

The new mapping program adopts the MC-30 global mapping scheme which subdivides Mars into 30 quadrangles. For the HRSC mapping products, each quadrangle is subdivided in two to limit data volumes. MC-11 East is located at the equator and covers an E-W extension of about 1330 km (at the equator) and a N-S extension of about 1780 km. The area includes parts of Arabia Terra, Meridiani Planum and Chryse Planitia and the data products are based on 89 individual HRSC image strips. Comparison with MOLA data and analysis of residual offsets between individual HRSC strips shows that the multi-orbit data product provides the same 3D point precision and the same accuracy of co-registration with MOLA heights as the HRSC single-orbit data products, while, in addition, pixel-scale co-registration accuracy between individual HRSC image strips is achieved using bundle block adjustment, as required for producing image mosaics at the full nadir image resolution (Gwinner et al., in review).

4. SUMMARY AND OUTLOOK

The completion of the first HRSC MC-30 half-tile demonstrates that multi-orbit DTMs with grid spacing of 50 m are feasible for large surface areas in spite of the existing variation of ground pixel size based on bundle block adjustment and joint interpolation of multi-scale 3D points. Likewise, after a photometric normalization and by using an external albedo map as a brightness standard, it is possible to produce visually homogeneous image mosaics although the images (due to orbit constraints) are frequently acquired under very different illumination and atmospheric conditions. Acquisition of additional data for further improving data coverage is one of the priorities for the remaining phases of the mission.

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