Geophysical Research Abstracts
Vol. 18, EGU2016-13951, 2016
EGU General Assembly 2016

MRO CTX-based Digital Terrain Models

Alexander Dumke

Freie Universitaet Berlin, Institute of Geological Sciences, Planetary Sciences and Remote Sensing, Berlin, Germany (dumke@zedat.fu-berlin.de)

In planetary surface sciences, digital terrain models (DTM) are paramount when it comes to understanding and quantifying processes. In this contribution an approach for the derivation of digital terrain models from stereo images of the NASA Mars Reconnaissance Orbiter (MRO) Context Camera (CTX) are described. CTX consists of a 350 mm focal length telescope and 5000 CCD sensor elements and is operated as pushbroom camera. It acquires images with ∼6 m/px over a swath width of ∼30 km of the Mars surface [1]. Today, several approaches for the derivation of CTX DTMs exist [e. g. 2, 3, 4]. The discussed approach here is based on established software and combines them with proprietary software as described below.

The main processing task for the derivation of CTX stereo DTMs is based on six steps: (1) First, CTX images are radiometrically corrected using the ISIS software package [5]. (2) For selected CTX stereo images, exterior orientation data from reconstructed NAIF SPICE data are extracted [6]. (3) In the next step High Resolution Stereo Camera (HRSC) DTMs [7, 8, 9] are used for the rectification of CTX stereo images to reduce the search area during the image matching. Here, HRSC DTMs are used due to their higher spatial resolution when compared to MOLA DTMs. (4) The determination of coordinates of homologous points between stereo images, i.e. the stereo image matching process, consists of two steps: first, a cross-correlation to obtain approximate values and secondly, their use in a least-square matching (LSM) process in order to obtain subpixel positions. (5) The stereo matching results are then used to generate object points from forward ray intersections. (6) As a last step, the DTM-raster generation is performed using software developed at the German Aerospace Center, Berlin. Whereby only object points are used that have a smaller error than a threshold value.

References:

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