

Systematic Bundle Adjustment of HRSC Image Data

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The European Mars Express mission was launched in June 2003 and sent into orbit around Mars. On board the orbiter is the German High Resolution Stereo Camera (HRSC). This multi-line sensor images the Martian surface with a resolution of up to 12 m per pixel in three dimensions and provides RGB and infra-red color information. In November 2011 the HRSC has orbited the planet 10,000 times aiming at a global coverage. As part of the Photogrammetric/Cartographic Working Group of the HRSC Science Team the Institute of Photogrammetry and GeoInformation (IPI) of the Leibniz Universität Hannover is involved in photogrammetrically processing the HRSC image data.

The usage of the stereoscopic image information for the improvement of the observed position and attitude information via bundle adjustment is important to derive high quality 3D surface models, color ortho-images or other data products. In many cases overlapping image strips of different orbits can be used as photogrammetric blocks, thus allowing the adjustment of the exterior orientation data. This reduces not only local, but also regional inconsistencies in the data. With the growing number of HRSC image strips in this ongoing mission, also the size and complexity of potential blocks is increasing and a manual selection and combination of strips becomes unfeasible.

Therefore, a semi-automatic workflow has been built up for the systematic improvement of the exterior orientation using single image strips and regional blocks. For a successful bundle adjustment of blocks using multiple image strips a sufficient number of tie points in the overlapping area is needed. The number of tie points depends mainly on the geometric and radiometric quality of the images. This is considered by detailed analysis of the tie point accuracy and distribution. The combination of methods for image preprocessing, tie point matching, bundle adjustment and evaluation of the results in an automated workflow allows globally for all HRSC images an assessment of the quality and a systematic selection of data for larger blocks. More than 90% of the single strips and several blocks have been successfully adjusted in this way.