

Improving the Exterior Orientation of Mars Express Orbiter Using MOLA Data in Bundle Adjustment

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In December 2003, Mars Express entered orbit and began surface mapping. The onboard HRSC (High Resolution Stereo Camera) is equipped with nine sensor lines which provides stereo images in high resolution and color. The Institute of Photogrammetry and GeoInformation (IPI) of the Universitaet Hannover and the Department Photogrammetry and Remote Sensing (FPF) of the Technische Universitaet Muenchen are jointly processing the data for improved exterior orientation of HRSC and reference to MOLA. This goal is reached with a photogrammetric approach using bundle adjustment with the auxiliary condition of best fitting the HRSC data to the MOLA data. The improved exterior orientation supplies the base to derive high quality products such as DTMs, ortho images and shaded reliefs from the imagery.

The concept of FPF in bundle adjustment is based on the use of so called "orientation images" [1]. The standard photogrammetric approach requires ground control points (GCP) for determination of exterior orientation parameters. In case of HRSC there are no GCPs available, but observed parameters of exterior orientation. Obviously they are not precise enough for a consistent photogrammetric point determination on a global level. Therefore, additional control information is necessary to fit photogrammetrically derived object points onto an existing reference system. The particularity using the MOLA data is that the grid points can not be identified in the images like GPPs. Hence, at locations where HRSC points are available a local surface by four neighboring MOLA grid points is defined. The constraint in the bundle adjustment is that HRSC points have to lie on this local surface [2]. With this approach, the HRSC data acquired during the first six months of the mission have been computed. The height differences between HRSC points and MOLA data can be reduced by a factor of 2-3 after bundle adjustment. Finally, a high consistency between HRSC points and MOLA data is reached.

References

- [1] Hofmann, O. et al. (1982) *IntArchPhRS, Vol. 24 Part B3*, 216-227.
- [2] Ebner, H. et al. (2004) *IntArchPhRS, Vol. 35 Part B4*, 852-857.