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Topography of asteroid (4) Vesta from Dawn FC HAMO stereo images

F. Preusker (1), F. Scholten (1), K.-D. Matz (1), T. Roatsch (1), R. Jaumann (1), C. A. Raymond (2), and C. T. Russell (3)

(1) Institute of Planetary Research, Planetary Geodesy, Berlin, Germany (frank.preusker@dlr.de), (2) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109-8099, USA, (3) UCLA, Institute of Geophysics, Los Angeles, CA 90095-1567, USA

The Dawn mission has completed its Survey and High Altitude Mapping Orbit (HAMO) phases at Vesta and will complete its Low Altitude Mapping Orbit (LAMO) by April 2012. From the Survey orbit (altitude ∼2,700 km) the Dawn Framing Camera (FC) acquired 1,179 clear filter images with a mean image resolution of ∼256 m/pxl whereas from the HAMO orbit (∼700 km altitude) there are 2,674 clear filter images with a mean resolution of ∼63 m/pxl. In both mapping phases the surface was imaged several times under similar illumination conditions (Sun elevation and azimuth), but different viewing conditions (by tilting the spacecraft). This multi-coverage enables stereo-photogrammetric analysis and results in stereo topographic maps.
The stereo-photogrammetric processing for Vesta is based on a software suite that has been developed at DLR within the last decade. It has been applied successfully to several planetary image data sets and covers the entire workflow from photogrammetric block adjustment to digital terrain model (DTM) and base map production.
We constrained all HAMO Dawn FC clear filter images with our stereo requirements (15° < stereo angles < 45°, incidence angles <85°, emission angles <60°, differences in illumination < 10°) and achieved at least triple stereo image coverage for the entire illuminated surface. In total, about 13,500 independent multi-stereo image combinations were used to determine selected image tie points by multi-image matching for the set-up of a 3D control network of ∼30,000 surface points. The control point network defines the input for the photogrammetric least squares adjustment where corrections for the nominal navigation data (pointing and position) are derived. The three-dimensional (3D) point accuracy of the resulting surface points have been improved from ∼60 m to 8 m (0.12 pxl). Finally, 13,500 individual multi-image matching processes at full image resolution were carried out to yield ∼5 billion 3D object points. Finally, we have generated a DTM with a lateral spacing of 100 m/pxl and a vertical accuracy of about 5 m The HAMO DTM covers approximately 80% of Vesta's surface. Based on the HAMO DTM we will update and refine our determination of Vesta's geophysical properties derived from Survey stereo analysis.
A final version of the Vesta DTM and an overall re-assessment of Vesta's geophysical properties can be expected from the analysis of the entire Dawn FC image dataset of Vesta (from Survey, HAMO, and LAMO) when the Dawn spacecraft will have left Vesta, heading towards its next target, Ceres, the largest asteroid in the solar system.

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