Cartography with HRSC on Mars Express

A Specimen Sheet for the New Series "Topographic Image Map MARS 1:200,000"

Stephan Gehrke, Hartmut Lehmann, Tino Schumacher, Jörg Albertz
Technical University of Berlin, Department for Photogrammetry and Cartography
EB9, Str. des 17. Juni 135, D-10623 Berlin, Germany
E-mail: stephan@fpk.tu-berlin.de

Marita Wählisch
German Aerospace Center (DLR), Institute for Planetary Exploration
Rutherfordstr. 2, D-12489 Berlin, Germany
E-mail: marita.waehlisch@dlr.de

The Mars Express mission, which is expected to be launched in May/June 2003, will bring the "*High Resolution Stereo Camera*" (HRSC) into an orbit around the planet Mars. This research program, which is guided by Prof. Dr. Gerhard Neukum (Free University Berlin) as the Principal Investigator, has been particularly designed to meet the demands of stereophotogrammetry and cartography. The camera will provide multispectral digital image data of high resolution (up to 10 m) and systematic stereo coverage of the Martian surface. Thus, the mission will start a new era of topographic and thematic mapping of planet Mars. Furthermore, the "*Super Resolution Channel*" of the camera will acquire image data of extremely high resolution (up to 2 m) from smaller areas of particular interest.

The HRSC image data will be processed systematically at the German Aerospace Center (DLR) in Berlin to various data levels. Amongst other products digital terrain models and orthoimage mosaics in color will be derived. Based on these products, the Technical University Berlin can generate topographic and thematic image maps in large scales. The main goal is the production of the "*Topographic Image Map MARS 1:200,000*", following the principles that have already been designed for the Mars 96 mission.

The map projection will be the *Sinusoidal Projection* because of its useful mathematical and graphical properties and the easy transition between the formats of the digital data and the printed maps. However, the polar regions can not be mapped appropriately by the Sinusoidal Projection. Therefore the *Lambert Azimuthal Projection*, which is also an equal area projection, was selected for mapping the polar regions between 85° and 90° north and south.

The reference system for planimetry is a bi-axial ellipsoid. An equipotential surface (geoid) is envisaged as a reference for the heigths.

The map sheet layout has been designed in such a way, that ease of handling, production costs and technical restrictions in the printing process are considered. The latitude dimension was defined for all the map sheets (the sinusoidal and the azimuthal ones) to be 2 degrees. Considering the scale 1:200 000 for Mars this results in map surfaces of ca. 59 cm in height for the sinusoidal projected sheets, and ca. 62 cm (with curved parallels) for the azimuthal sheets. The longitude dimensions, however, depend on the latitudes and are varying for different latitude ranges. For practical reasons these ranges have been defined such that the map sheet formats do not vary to much (the maximum will be ca. 70 cm in width). Alltogether a total number of 10,372 map sheets is necessary to provide complete coverage of the planet. It is expected, that this layout will not only be applied to map a significant part of the planet's surface within the Mars Express mission, but it will generally be accepted for future mapping of Mars.

The name "*Topographic Image Map MARS 1:200 000*" describes particular features of the map. Conventional line maps can not be useful under the topographic conditions of the Martian surface. Therefore the map is planned to be produced as an image map, i.e. the basic information is the orthoimage, supplemented by topographical names and all necessary specifications with regard to the map frame and the entire marginal annotations. Furthermore, the image map will contain terrain relief information in contour lines and spot heights. The equidistance of the contour lines must be adapted to the regional topographic situations, because the relief energy of the planet's surface shows drastic changes.

Because of the expected number of map sheets the map production must be performed automatically, making use of an especially designed cartographic software system, which is still under development. With this system also larger scale maps can be generated for areas of specific interest.

As a first comprehensive test of the software and the complete production line a particular map sheet of the "*Topographic Image Map Mars 1:200,000*" was produced. This specimen is based on image data obtained during former Mars exploration missions. The image is supplemented by essential cartographic elements, e.g. the graticules, contour lines, and named Martian surface features. The map sheet is completed with its individual designation and several marginal annotations.

Because the software for automatic map production is not yet completed, in this particular case a few of the map components have been added interactively. Nevertheless the generation of the specimen sheet demonstrated, that the software system for the map production works nearly operational.

The authors gratefully acknowledge the cooperation with project group members at the German Aerospace Center (DLR) in Berlin, under the guidance of Dr. Ralf Jaumann.