

GENERATION OF DIGITAL TOPOGRAPHIC MAPS OF PLANETARY BODIES

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EXTENDED ABSTRACT:

In recent years, the exploration of the solar system was intensified. Several space missions have been planned, launched, or are in operation yet. Some of them carry modern camera experiments, such as the High Resolution Stereo Camera (HRSC) on Mars Express or the Cassini Imaging Science SubSystem (ISS). Especially HRSC data are well suited to derive Digital Terrain Models (DTM) and color orthoimages, which are of high importance for topographic mapping. Consequently, new large-scale mapping programs have been started, e.g. the Topographic Image Map Mars 1:200,000 series as well as systematic mapping of the icy Saturnian satellites – for some of them the first map series ever generated. For supporting these challenges and aiming for automation, at least for parts of the mapping process, the cartographic software package “Planetary Image Mapper” (PIMap) has been developed at TU Berlin.

With PIMap software, digital topographic image maps of planetary surfaces can be generated. Such products are usually based on orthoimages and supplemented with topographic data, in particular consisting of contour lines and named surface features. The topographic content, grids, frame lines, map titles, sheet designations, and further marginal information can be automatically generated with the PIMap software system. Basically, the software was designed for the operational production of the Topographic Image Map Mars 1:200,000, which is the standard map series of the Mars Express mission. But due to its flexibility regarding reference body definitions, projections, scales, and layout specifications, PIMap is broadly applicable in digital planetary mapping. It is developed in ANSI C++ and, therefore, executable under both Microsoft Windows and Linux environments. The software is controlled by solely one initialization file, which contains all parameters (keyword equals value) to define map properties, contents, and layout. Depending on the particular mapping task, further input is required.

In general, any map sheet that coincides with latitude and longitude lines is producible with PIMap by free definition of its center point, dimensions, and map scale. The software handles arbitrary spherical and ellipsoidal reference bodies. Azimuthal, conical, cylindrical, Transverse Mercator, and sinusoidal map projections are supported. The orthoimage basis, as a result of photogrammetric processing, is adjusted to the map sheet by adapting projection and scale. Thus, without prior transformations, image data can be directly processed by PIMap – provided the desired region is covered in appropriate resolution. Contour lines are derived from appropriate DTM data, which are spatially adapted to the map sheet (similar to the orthoimage), and also labeled; topographic names and landing sites could be lettered in PIMap. Marginal information, which can be generated automatically, consists of the title of the map series, a sheet name, its individual designation, and legendary entries, in particular the scale bar and explanations of map projection, reference body, etc. as well as an index map showing the position of a map within the context of its neighboring sheets. All marginal elements, and self-evidently the map surface too, can be freely arranged in the digital sheet in order to achieve different layouts. This enable the generation of different topographic maps or map series for various planetary bodies.

The PIMap output is a digital map sheet, which contains all raster and vector data as described, provided as a PDF. This common output format ensures the possibility to edit each graphical element if desired. This is of special importance for interactive finishing with commercial standard software (Corel Draw, Freehand, Adobe Illustrator), amongst other things with regard to the final placement of topographic feature lettering. However, while only few post processing steps are required to yield high quality topographic maps, the integration of thematic data is subject to an interactive follow-up work.

At present, the software is not only used for topographic mapping of Mars at TU Berlin and in the HRSC CoInvestigator Team but, moreover, it has been implemented at the German Aerospace Center (DLR) for Cassini cartography, i.e. to map the medium-sized icy satellites of the Saturnian system, i.e. Mimas, Enceladus, Tethys, Dione, Rhea, Iapetus, and Phoebe. First experiences in Martian thematic cartography, based on topographic maps generated with PIMap, have been made.

The production of digital topographic maps by utilizing the features of the PIMap software system will be presented. This includes different map examples of various planetary bodies.

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