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A new control point network of Io

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Abstract

We present a new control point network and topographic model for Io, which have been updated over previous works [1] [2].

1. Introduction

We established a new global control point network of the innermost Jovian satellite - Io. We used recently reconstructed Galileo spacecraft trajectory data, supplied by the spacecraft navigation team of JPL (see http://naif.jpl.nasa.gov/ for details). Based on these data, we estimate the relief of Io, as well as a model of librational motion.

2. Control point network

The control point network is based on Galileo and Voyager images (images taken from http://pds-imaging.jpl.nasa.gov/). While Galileo CCD images are most detailed and geometrically stable, the Voyager Vidicon images are used for gap fill. As the Voyager images suffer from significant geometric distortions, they were calibrated by means of the planetary image processing package VICAR (see http://www-mipl.jpl.nasa.gov/external/vicar.html for details).

We used a subset of 53 among a total of 66 images that were used in the previous DLR network studies [1]. We also used the new Galileo spacecraft trajectory data. All processing, including tie-points measurements and bundle block adjustment, were performed by means of the «PHOTOMOD» software [3] that was especially adapted for this study to accommodate global networks of small bodies, such as Io. As a result, a new catalog of Cartesian three-dimensional coordinates of 502 control points from 5155 measurements was produced with a mean error of 5714.1 m. Individual errors vary, depending on the image resolutions and the number of images used *(Fig.1)*.

3. Topography

Together with the new catalog we have derived a DTM of Io, applying the «PHOTOMOD» module «DTM».

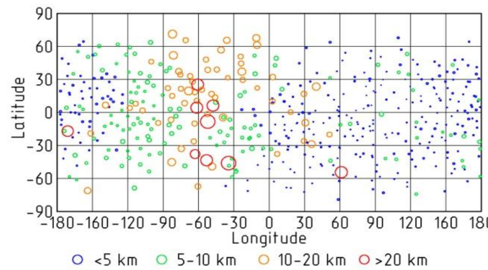

Figure 1. *Distribution of control points. The sizes of the symbols are proportional to the errors in the coordinates, which range from 1.5 km (the smallest symbol) to 31.0 km (the largest symbol).*

As seen in Figure 1, there are many points whose coordinates were determined with an error of less than 5 km, so we suppose that our data are significant and useful for studying topography in a global scale.

On the basis of the DTM we derived a map of heights of control points with heights given with respect to a 3-axial ellipsoid with parameters: a = 1833.2 km, b = 1821.7 km, c = 1819.5 km *(Fig.2)*. [4].

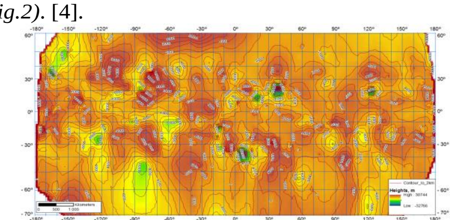

Figure 2. *Global topographic model of Io with a 2-km contour interval in the Cylindrical Conformal projection on a three-axial ellipsoid - Modified Bugayevsky's projection.*

We have also produced a mosaic of Io, applying the «PHOTOMOD» modules «Mosaic» and «Geomosaic». *(Fig.3)*.

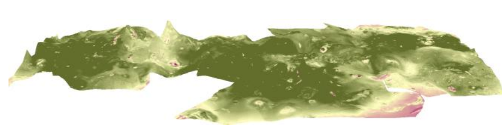

Figure 3. *3D modeling of Io (global relief and mosaic in pseudo colors).*

We can see some outliers in the resulting products and we are analyzing their reasons now. Currently, we are working on densifying the control point network. We plan to add new images with higher resolution, less than 1.5 km. This will allow us to study local topographic features.

4. Librational motion

Io is tidally locked. Owing to its proximity to Jupiter, Io is expected to undergo physical librations. We plan to obtain a librational- motion model of Io, using the new control points network. The results of this study will be presented at the conference.

5. Summary and future activities

We have updated the control point network for Io with new measurements and derived a new catalog of Cartesian three-dimensional coordinates, a 3-D model, a mosaic and a relief map.

It is interesting to verify whether we can ignore the non-spherical form of Io to calculate its attraction potential. We also plan to calculate the gravity on Io's surface by the numerical quadrature method and expansion into a series of spherical functions. Besides, we plan to calculate an ellipsoid in equilibrium and to compare it with our ellipsoid 'in best-fit'.

Acknowledgements

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