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Inversion of lunar surface topography from SMART-1/AMIE -images

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SMART-1/AMIE -images provide high-resolution information of the lunar surface with good coverage of different latitudes/longitudes. Together with a global topographic map derived from Clementine LIDAR-measurements [1], the images can be used to map the lunar surface topography in a resolution better than before. Currently, thousands of AMIE -images are available with a resolution of 30-270

m/pixel. Compared to the Clementine topographic map with a resolution of 500-1900 m/pixel, the increase in the resolution is significant. Also, because certain areas on the lunar surface have multiple images taken in different lighting/viewing geometries, a photogrammetric inverse method is possible.

A method for inverting the surface topography from single visual images combined with lidar/radar topographic data is presented. The inverse method uses a Lommel-Seeliger scattering law for calculating the local surface slopes and assumes nadir riewing geometry. For individual images, the method generates a number of different surface profiles/strips with a statistical error. The profiles are then fitted to gridded lidar/radar topographic data using the weighted least-squares technique and combined to produce a topographic map of the surface.

A statistical photoclinometric method was previously used by Muinonen et al. [2] for images of Phobos. For the lunar images, albedo variations have to be taken into account. The inversion model uses local slope and brightness statistics to identify albedo changes in the images and derive the albedo map from the images. Because the

method cannot distinguish between albedo features and brightness variations caused by big craters, a shape-recognition algorithm has to be used to identify big craters in the images. The Hough Transform for ellipses combined with the Canny edge-detector algorithm are implemented to map craters in an image.

[1] Archinal, B. A., Rosiek, M. R., Kirk, R. L. and Redding, B. L., Space Resources Roundtable VII (2005), Abstract 2060

[2] Muinonen, K., Lumme, K. and Irvine, W. M., Planet. Space Sci. 39 (1990), 327