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Mapping of the Lunokhod-1 Landing Site: A Case Study for Future Lunar Exploration

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Introduction. Luna-17 landed on November 17, 1970 and deployed Lunokhod-1, the first remotely operated roving vehicle ever to explore a planetary surface. Within 332 days, the vehicle conquered a traverse of approx. 10 km. The rover was equipped with a navigation camera system as well as a scanner camera with which panoramic images were obtained. From separated stations, stereoscopic views were obtained. The history of the Lunokhods came back into focus recently, when the Lunar Reconnaissance Orbiter [1] obtained images from orbit at highest resolutions of 0.5-0.25 m/pixel. The Luna-17 landing platform as well as the roving vehicles at their final resting positions can clearly be identified. In addition, the rover tracks are clearly visible in most areas. From LRO stereo images, digital elevation model (DEM) of the Lunokhod-1 landing site areas have been derived [2]. These are useful to study the topographic profile and slopes of the traverse. The data are also useful to study the 3-D morphology of craters in the surroundings.

Methodology. Lunokhod-1 area mapping have been done using GIS techniques. With CraterTools [3] we digitized craters in the Lunokhod-1 traverse area and created a geodatabase, which consists at this moment of about 45,000 craters including their diameters and depths, obtained from the DEM [4]. The LRO DEM also was used to measure traverse. We used automatic GIS functions for calculating various surface parameters of the Lunokhod-1 area surface including slopes, roughness, crater cumulative and spatial densities, and prepared respective thematic maps. We also measured relative depth (ratio D/H) and inner slopes of craters and classified craters by their morphological type using automatic and visual methods. Vertical profiles through several craters using the high resolution DEM have been done, and the results show good agreement with the topographic models with contours in 10cm that have been obtained from the Lunokhod-1 stereo images [5]. The preliminary results of crater morphology show that highest H/D for studied craters of the Lunokhod 1 area is $\sim$0.14, that is noticeably smaller than that for very fresh well studied small craters, for example, in the Apollo 14 [6]. At present more detailed geomorphology analyses using orthoimages with different illumination is in progress and will be shown at the conference.

Conclusions and future works. While new missions to the Lunar surface are being planned, it is of utmost importance to identify and make available for access all Lunar surface data. We show that these data can be used for large-scale mapping and surface studies of landing sites for future lunar missions, for example LUNA-GLOB and LUNA-RESOURCE.

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