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Lunar rovers and archive panoramas: Past for the Future

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Abstract

At MIIGAiK Exraterrestrial Laboratory (MExLab) we have carried out modern processing of lunar panoramic images obtained by Soviet Lunar missions (1966-1973) in the frame of PRoViDE project (www.provide-space.eu/). We have found and collected old schemes, maps, images, documentation and used these data at the beginning of the study. Then we gathered and processed data collected by recent and ongoing missions. These data helped to refine the Lunokhod route, prepare different detailed and thematic maps of the landing sites, and carry out GIS-analysis of the routes and areas.

1. Study of Lunokhod archive data

We have obtained from Russian State Archive lunar panoramic images collected during five Soviet Lunar missions Luna-9,-13,-17,-20,-21 (1966-1973). A special technique has been developed to assemble and process the archive image fragments and prepare them for further scientific use [1]. Based on this technique all Lunokhod-2 panoramas have been processed as well as several Lunokhod-1 panoramas on regions of interest (ROI). Also supplementary information was found or recovered (recalculated) to create metadata for the panoramas.

2. Study of modern data for the Lunokhod areas

Modern LRO data made it possible to study Lunokhod routes and landing sites in more details. So, by means of stereo photogrammetric processing of LRO NAC images we have created high-resolution DEMs and orthoimages with best visibility of rover tracks. Based on these data we have digitized Lunokhod-1,2 routes and verified the covered distances, studied craters along the route, etc. [2]. We also have developed software for artificial modeling of lunar surface images based on orthomosaic and DEM [1].

3. Results

Combination with LRO orbital data helped to determine coordinates of observation points for the Lunokhod archive panoramas. The developed technique for lunar surface image processing helped to perform comprehensive morphologic analyses of the panoramic images and create a descriptive catalog including size and structure of various types of objects (craters, blocks, boulders). All the obtained data were unified and uploaded into Lunar Database, which is available via MExLab Geoportal (http://cartsrv.mexlab.ru/geoportal/). To sum up, main results of the study are the following:
- catalogue of lunar panoramic images collected by 5 Soviet spacecraft (Luna-9, -13, -17, -20, -21), which includes more than 300 assembled panoramas with new or updated archive metadata;
- detailed morphologic description of all panoramas obtained by Lunokhod-2;
- set of fully-processed panoramas on ROI (such as landing sites; areas of old Lunokhod-1topographic plans, published soon after Luna-17 mission; Lunokhod-2 panoramas obtained near the groove Fossa Recta, etc.);
- set of processed orbital data (DEMs, orthoimages, for Lunokhod's landing sites;
- morphologic and geologic assessment of the Lunokhods landing sites [3];
- basic and thematic maps of the landing sites;
- set of layers which include supplementary data (Lunokhod traverses, panoramas points, stops where Lunokhods slept over the lunar nights, etc.);
- techniques and software: for lunar surface image processing and for artificial lunar surface image modeling;
- Lunar database with web-access.

4. Summary and Conclusions

The project helped to bring together old archive and modern Lunar data. Developed techniques can be useful for preparation of future Lunar lander and rover missions, e.g. Luna-Glob and Luna-Resource.

Acknowledgements

References

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