**Lunar Mapping With Digitized Apollo And Lunar Orbiter Imagery**

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We are evaluating the utility of using modern "softcopy" digital mapping techniques for extracting digital elevation models (DEMs) from Lunar Orbiter (LO) and Apollo imagery. This imagery was used in the 1960s-70s for mapping, mission planning, and control purposes. Previous work with LO imagery was difficult due to image artifacts, and the mapping was not controlled to any horizontal or vertical datum [1]. Mapping with Apollo imagery used 2 different control networks. The hardcopy maps that resulted are the Lunar Topographic Orthophotomap (LTO) and Lunar Orthophotomap (LO) map series [1].

Since these maps were produced, the lunar control network has been improved [2] and the LO images are now available as digitized images with the image artifacts greatly reduced [3]. The tools available for "softcopy" mapping permit the generation of DEMs, from which contour maps can be made if desired, but the digital DEMs contain more detailed topographic information that can also be used for image rectification, photometric correction, slope analyses, etc. Use of the current control and datum ensures that the topographic data can be used in conjunction with data from current and future missions. Thus the products enabled by this study supersede earlier maps.

Lunar Orbiter imagery was collected by 5 missions, LO-I through -V, during 1966–1967. Stereo imagery is provided both by the overlap of images for global mapping and by deliberate targeting of specific sites of interest. LO IV coverage of the nearside includes 6°-wide bands of stereo at 0° and ±30° latitude, and from about ±60° to the poles (>25% of the nearside in all). The resolution of the imagery is between 30 and 100 m. The other LO missions returned stereo imagery of spot areas with higher resolution (10 - 40 m) [4]. These images were used for Apollo landing site selection, but the full topographic information was not extracted because errors in reconstructing the images from sections scanned on the spacecraft produced artifacts in the form of linear "cliffs" in the stereomodels.

Apollo 15, 16, and 17 imaged ~20% of the Moon immediately under their orbital tracks using both a frame mapping camera and a panoramic camera. The frame camera was a Fairchild metric camera with a 4.5 x 4.5 in film format. Stereo imagery is obtained by overlapping imagery along the flight line and between flight lines. When digitized at 10 µm, a metric camera image provides a useful resolution of about 15 m/pixel. The panoramic camera was an Itek panoramic camera with 45.24 x 4.5 in film format. Stereo imagery is obtained by using forward and aft looking images acquired along the same flight line. When digitized at 10 µm, a panoramic image has a resolution at image center of about 2 m/pixel and at the edge of the image the resolution is about 4 m/pixel.

The site mapped in this project is the Rima Hadley region, including the Apollo 15 landing site. This area has excellent coverage by LO and Apollo images, and previous mapping products exist to compare with our results. We selected images 4102_H3 and 4103_H1 from LO IV, images 5105_MED, 5106_MED, 5107_MED, 5106_H1, 5106_H2, and 5106_H3 from LO V, images 0583, 0585, and 0587 from Apollo 15 metric camera, and images 9809, 9811, 9814, and 9816 from the Apollo 15 panoramic camera.

We are analyzing our DEMs and will provide estimates of horizontal resolution and vertical precision in our poster. We note here that the LO DEMs do not exhibit the "cliffs" or stripping that was evident when DEM extraction was attempted using the hardcopy images. The Apollo metric and panoramic images provide the highest resolution results.

Softcopy stereomapping techniques can readily be applied to scanned lunar images to produce controlled DEMs, orthoimage mosaics, and other products that will be useful in future mission planning and scientific analysis. The full value of the legacy datasets from LO and Apollo has yet to be exploited.

References: [1] WU, S.S.C. and Doyle, F.J., Planetary Mapping, 1990, pp. 169-207. [2] Archinal, B.A. et all *LPSC 2006.* [3] Weller, L. et all *LPSC 2006.* [4] Hansen, T.P. Guide to Lunar Orbiter Photographs, 1970, NASA SP-242.