Digital Terrain, Image and Albedo Mosaics from Apollo Metric Camera Imagery.

Ara V Nefian[1,2], Zach Moratto[2], Ross Beyer[3], Michael Broxton[1,2],Taemin Kim[2] and Terry Fong[2], [1]Carnegie Mellon University, [2]NASA Ames Research Center, MS 245-3, Moffett Field, CA, USA (ara.nefian@nasa.gov),[3]Carl Sagan Center at the SETI Institute

The images captured by the Apollo metric camera (AMC), and recently scanned in digital format, contain rich information that supports the creation of accurate digital terrain, image and albedo maps of the Lunar surface. The goal of this paper is to present the most recent results in mapping the Apollo 15 zone using an open source software package developed at NASA Ames. The terrain, image and albedo maps are generated an unprecedented resolution (10m/pixel and 40m/pixel for DTM) for the complete coverage of the Lunar equatorial zone covered by the Apollo 15 mission. The techniques used by our software will be used to complete the maps of the entire Apollo zone including Apollo 16 and 17 missions as well as the more recent Lunar missions.

The AMC stereo pairs [1] generate high resolution digital terrain mosaics (DTM) using the Ames Stereo Pipeline [2]. A robust bundle adjustment technique [3] refines the original estimates for the orientation and position of the AMC and co-registers the stereo image pairs into an accurate digital terrain mosaic. Figure 1 shows the colorized hillshade of the resulting DTM before and after using our robust bundle adjustment technique.

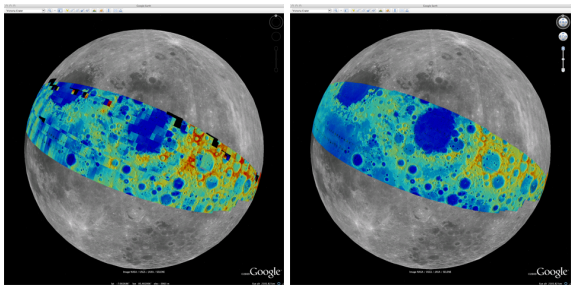

Figure 1: Digital terrain mosaics before (left) and after (right) using our bundle adjustment technique.

Figure 2 shows an image mosaic of the entire Apollo 15 zone and a detail around the landing site using a mosaicking technique that compensates for various levels of exposure and reflectance. The resulting image mosaic is generated at 10m/pixel resolution.

Figure 3 illustrates our preliminary results in reconstruction the Lunar albedo map using a technique described in [4] and that uses the computed DTM and the Lunar-Lambertian reflectance model.

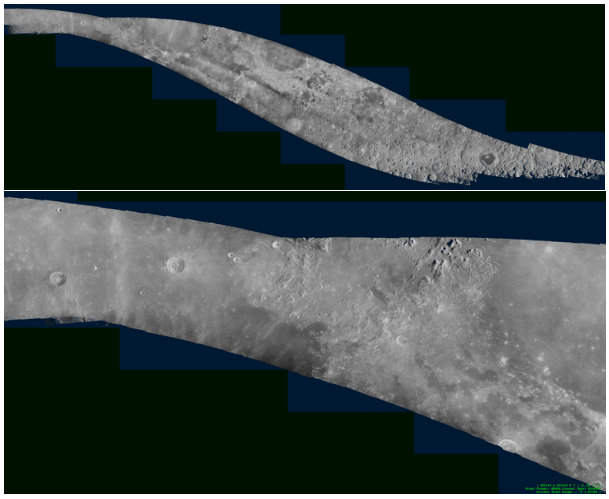

Figure 2: Image mosaic of the Apollo 15 zone (top) and a detail around the landing site (bottom).

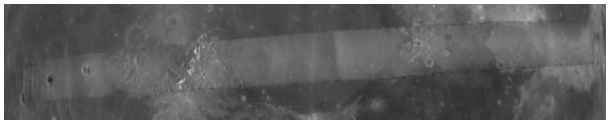

Figure 3: Albedo mosaic of the Orbit 33 of Apollo 15 mission.

References

[1] M. J. Broxton, Z. M. Moratto, A. Nefian, M. Bunte, and M. S. Robinson. Preliminary Stereo Reconstruction from Apollo 15 Metric Camera Imagery. *40th Lunar and Planetary Science Conference*, 2009.

[2] Ara V. Nefian, Kyle Husmann, Michael J. Broxton, Vinh To, Michael Lundy, and Matthew Hancher. A Bayesian Formulation for Sub-pixel Refinement in Stereo Orbital Imagery. *IEEE International Conference on Image Processing*, 85, November 2009.

[3] Michael J. Broxton, Ara V. Nefian, Zachary Moratto, Taemin Kim, Michael Lundy, and Aleksandr V. Segal. 3D Lunar Terrain Reconstruction from Apollo Images. *International Symposium on Visual Computing*, 2009.

[4] Ara V. Nean, Taemin Kim, Michael Broxton, Ross Beyer, and Zach Moratto. Towards Albedo Reconstruction From Apollo Metric Camera Imagery. *41st Lunar and Planetary Science Conference*, 2010.