GEOMETRICAL ANALYSIS OF AMIE/SMART-1 IMAGES AND APPLICATIONS TO PHOTOMETRIC STUDIES OF THE LUNAR SURFACE. D. Despan (1), S. Erard (1), A. Barucci (1), J.-L. Josset (2), S. Beauvivre (3), S. Chevrel (4), D. Koschny (5), M.Almeida (5), and the AMIE team.
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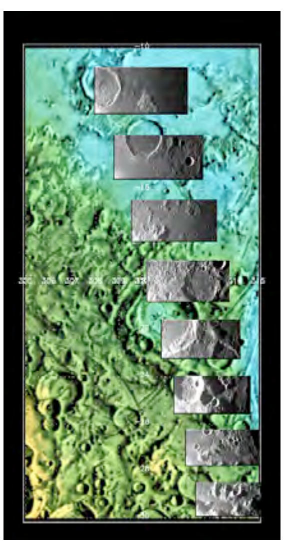
Introduction: The Advanced Moon micro-Imager Experiment (AMIE) on board the ESA lunar mission Smart-1 has performed color imaging of the lunar surface in three filters centered at 750, 915 and 960 nm [1]. The low pericenter, polar orbit, allowed to obtain a complete image coverage with high resolution at low to medium latitudes. From the 300 km pericenter altitude, the field of view (5.3°x5.3°) corresponds to a pixel size of about 30 m, a spatial resolution higher than Clementine [2]. The 1024x1024 pixels images are shared by the various filters, allowing to derive mosaics of the surface in up to 3 colors, depending on pointing mode. In addition, spot-pointing observations provide photometric sequences that allow to study the surface properties in restricted areas. Geometrical analysis of the AMIE images requires the SPICE system: image coordinates are computed to get precise projection at the surface, and illumination angles are computed to analyze the photometric sequences. However, SPICE support was initially limited for a technical mission such as Smart-1. The camera kernels are therefore being refined to automatically process the geometry. In addition, radiometric calibration is also being improved using late measurements in orbit.

Absolute projection accuracy: Fig.1 shows a projection of succesive AMIE images.

Figure 1

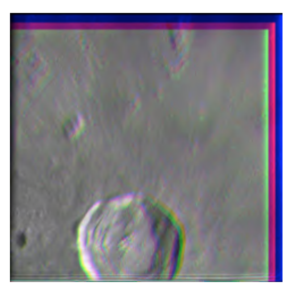


Images are acquired in FeH_X filter during orbit 2821 on the border of Mare Humorum. Images are projected on the Clementine shaded-relief map (colors are from Lidar measurements; Sun direction is opposite for shaded relief and AMIE). Coordinates are automatically computed using newly derived Spice kernels. New kernels account for the nominal alignment of the camera on the spacecraft, and are fine tuned to minimize projection errors at the Moon surface. The accuracy relative to Clementine is currently on the order of 0.2° in latitude/longitude in most situations.

Relative projection accuracy: Figure 2 is a mosaic of Clear filter during orbits 2820 and 2821 in cylindrical projection. This mosaic has been acquired on August 19, 2006 to document the crash site of Smart-1. It ranges from Reiner-gamma (north) to an area near crater Schickard (south). Internal mismatches currently amount to some 0.1° in latitude/longitude in this worse case of relatively high emergence observations (e = 30-50°). Occasional shifts in latitude are related to the uncertainty in acquisition time (~1s), which now appears to be the most limiting factor. No photometric correction is applied. Although the border of the FOV is affected by stray light or diffraction effects on the filter edges, the overall consistency between two consecutive orbits is generally good.

Spot-pointing observations: Spot-pointing observations (EPF sequences) have been acquired in some occasions, potentially allowing to study photometric behavior of different materials. The current Spice kernels allow to superimpose projected images with a 2-3 pixels accuracy in most of the field, as can be seen in these 3 images of Kepler acquired on orbit 1775 (Fig. 3). Spot-pointing sequences will be used to constrain the photometric and physical properties of surface materials in areas of interest, based e.g. on Hapke's modeling [3] [4].

Figure 3



Prospects: On-going activities include 1) refinement of Spice kernels, including precise alignment on the star tracker from stars and Moon observations; 2) refinement of flux calibration, including use of dark currents acquired at the end of the mission, and correction of stray light.

References:

[1] Josset et al. (2006) *Adv. Sp. Res* **37**, 14-20.

[2] Pinet et al. (2005) *Planet. Space Sc.* **53**, 1309-1318.

[3] Pinet S. et al. (2004) *LPSC 35, abstract 1660*.

[4] Chevrel S. et al. (2006) *LPSC 37, abstract 1173*.

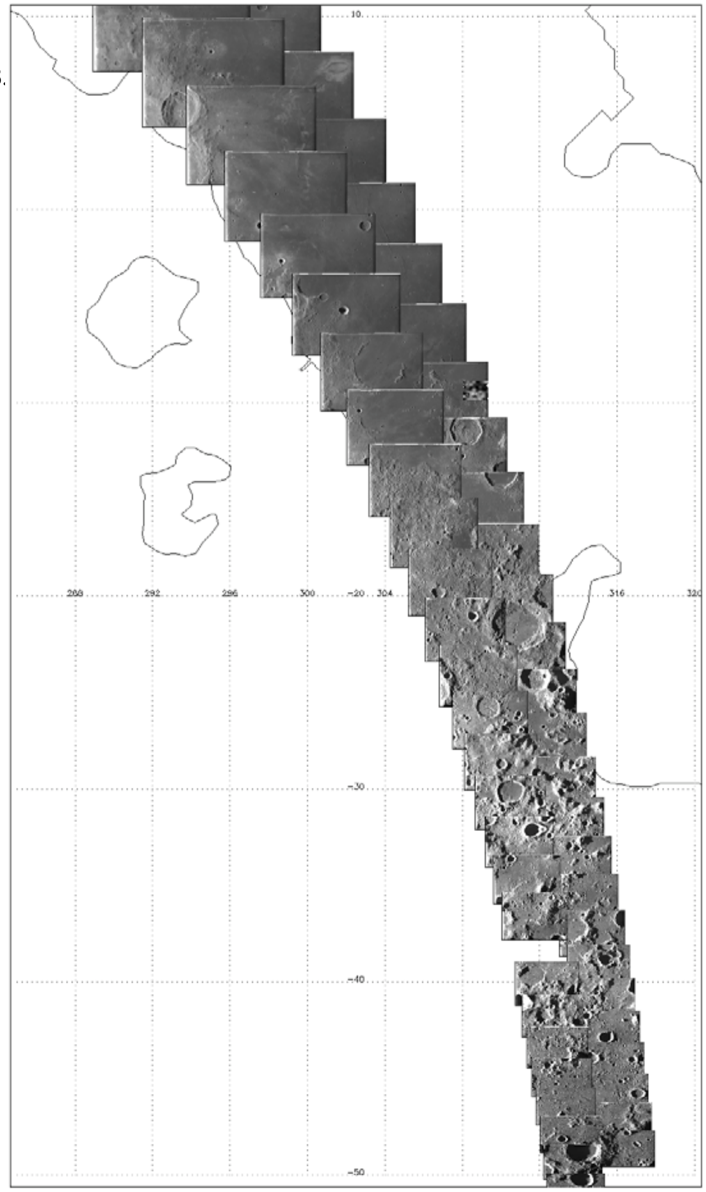


Figure 2