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Selection, calibration and mosaicing of AMIE images to build a Moon Atlas as seen by SMART-1

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Abstract

In mid 2010 the European Space Agency opened the SMART-1 data to general public. The free access to these data opened new possibilities for its exploitation and use. In this dataset, there are data from the three instruments carried on-board: an ultra-compact electronic camera to survey the lunar terrain in visible and near-infrared light (AMIE), an infrared spectrometer to analyze the Moon's minerals (SIR) and an X-ray spectrometer to identify key chemical elements in the lunar surface (D-CIXS). This work is focused on the AMIE captured images, that are used to produce a complete high-resolution atlas of the Moon. During the SMART-1 mission from 2004 to 2006, the onboard AMIE camera collected 31947 start-of-the-art (at the time) resolution and coverage images from lunar surface. However, a considerable number of images were contaminated with noise or suffered from transmission errors, being unusable for any purposes. Also, during the Earth escape phase the radiation damaged significantly the AMIE sensor invalidating the laboratorial flat field correction algorithm. This malfunction was compensated by a new calibration procedure based on in-flight images and theoretical models that will be presented on this paper. After flat field compensated, all images were also calibrated to compensate the sensor color filters at 750, 915 and 960 nm, designed for multi-spectral analysis, although now we use them as full-frame gray scale images. The resulting 1024x1024 images were geographically referenced using the in-board data and mosaiced considering illumination angle and image quality, in order to produce 88 lunar surface maps with lower resolution on the North Lunar pole (spacecraft apolune altitude of 3000Km) and higher resolution on the South Lunar pole (perilune altitude of 27Km). The final maps achieved a coverture of approximately 96% of the Lunar surface. For the latitudes higher than 60ºN and lower than 75ºS polar projection was used with a resolution of 300m/pixel on the North and 85m/pixel on the South. For the remaining latitudes, the Mercator projection was adopted with resolution varying from 300m/pixel to 75m/pixel increasing from North to South. In this paper we will present all the techniques adopted for the selection, calibration and mosaicing of the AMIE images. The resulting maps will soon be available online for scientific purposes on a dedicated website that is currently under development.