PHOTOMETRIC PROPERTIES OF THE LUNAR SURFACE FROM AMIE SMART-1 SPOT POINTING OBSERVATIONS.

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Introduction :

Access to physical properties of the planetary surfaces such as roughness (at the centimeter to decimeter scale), granulometry or isotropy of particles, is important to improve the understanding of geologic processes such as regolith formation, evolution (maturation), and modification (e.g., lunar swirls), volcanism (degree of anisotropy of volcanic deposits: e.g., pyroclastic units), and cratering process (degree of melting of materials forming crater floor, rims and ejecta).

Physical surface properties can be obtained by observing the surface under different conditions of phase angle, i.e., of illumination (varying the incidence angle to the normal of the surface) and observations (varying the emergence angle) [1, 2]. Photometric models can be applied to these multiangular datasets, with some parameters linked to physical properties of the surface [3, 4, 5].

Multiangular images for some areas of the lunar surface have been obtained in spot pointing mode by the AMIE camera onboard the SMART-1 spacecraft (ESA) [6]. These images (512 x 512 pixels) were taken with the non filter part of the detector.

Study :

Following a preliminary study based on AMIE multiangular images [7], we are currently carrying out the analysis of an area observed under a wide range of emergence angles during a single orbit. Observations from additional orbits for this area provide with a large range of phase angles. Combining both types of observation makes it possible to derive a set of photometric observations both in and out of the principal plane which documents the phase function and enables us to infer some optical properties at the local/regional scale.

Interestingly, this area presents the occurrence of mare basaltic and pyroclastic volcanic materials expected to show differences in physical surface properties. The resolution is 190 meters for the nadir image. However, all the images have been binned by a factor 2 and 4 in order to limit the potential concerns caused by misregistration and topographic effects. The images have been calibrated through the calibration pipeline at Neuchâtel in Switzerland. However, at the present time, both dark and master flat-field files are still under improvement. The reflectance has been obtained through Clementine images at 750 nm (UVVIS camera) of the area of study taken under the same conditions of observation than the AMIE images. The analysis of the calibrated AMIE images is made using phase image ratios [8] and a statistical analysis (PCA) from phase function curves.

Perspectives :

In the region under study, the objectives are to determine and map units having different physical properties. They will be put in relation with their spectral properties, analysed from the Clementine UVVIS and NIR data [9].

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