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Contribution of multiangular geometry conditions on the photometric characterization of granular surface samples

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The present work aims at assessing the consequences and limitations on the determination of the photometric properties of granular samples in the visible domain when considering a restrained multiangular dataset versus a dense set of reflectance measurements spanning the whole bidirectional space. This is of particular interest for orbital spectrophotometric studies, given the limited number of multiangular observations that a spaceborne optical instrument is usually allowed to make.
For this purpose, comprehensive sets of multiangular configurations measured on several materials have been inverted by means of Hapke's modeling, then progressively depleted and inverted again. The materials were selected from Shepard and Helfenstein's work (2007) and chosen for their variety in terms of photometric behaviors (backscattering and forward-scattering), reflectance levels, grain sizes and shapes.
This study shows that, for a given range of angles, the factor that appears critical to constrain photometric inversions is the regular coverage of the bidirectional space in incidence, emission, azimuth, and consequently phase angles. Provided this condition is met, the number of considered configurations is not of the essence and reliable photometric estimates can be produced with a limited set of angular configurations. However, one must bear in mind that the present conclusions are reached with a range of phase angle comprised between 25 and 130° and for a given set of particulate materials, which despite its diversity is likely not representative of all situations. While there clearly are naturally occurring geological samples for which it is possible to retrieve meaningful information with the photometric angular range considered here, types of samples may exist for which this range is not adequate to properly reveal the physical characteristics of the constitutive particles.
More laboratory work is currently underway (see Souchon et al., this workshop) with the support of the ISEP facility (Imaging Spectrogoniometer for Planetary Exploration) operating at the Midi-Pyrénées Observatory, Toulouse, France and documenting the optical and photometric properties of natural rocky surfaces and soils on their reflectance properties, when measured from the crystal to the macroscopic scale (200 x 200 mm).