Shape effects on asteroid spectra

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The objective of this work is to probe how the shape of a body like an asteroid could be modifying its observed spectra and the derived mineralogical interfaces based on spectral modeling. To model this effect, we construct an oblate ellipsoid with triangular facets, where each facet contributes to the overall reflectance. The synthetic spectra is generated by the isotropic multiple-scattering approximation (IMSA) reflectance model of Hapke (1993).

First, we obtained optical constants by inverting the spectra of meteorites, obtained from the RELAB spectral database. These optical constants were found inverting the reflectance bidirectional equation of Hapke; this is made in two steps: (*i*) The first inversion is to find the single-scattering albedo ϖ; (*ii*) in the model of Hapke, this albedo is found under the regime of the geometric optics, where the particle size is much larger than the wavelength of the incident radiation. Here we assumed a constant value for the real part of the optical constant $n = 1.5$. With these optical constants, we can construct synthetic spectra for any particle size. The phase function used is the double Henyey-Greenstein phase function and an accurate expression for the H-functions.

We started with the ellipsoidal shape $a = 1.0$, $b = c = 0.5$ for two particle size 50 and 250 µm, in this part, we found good differences in the BAR parameter between the two geometric models, this was done for 100 Eucrite meteorites spectra. In this first study, we found that the BAR parameter between the two models is bigger when the particle size increases.

In the second part, we started with different ellipsoidal shapes and produced synthetic spectra for material with eucrite and diogenite composition with a phase angle of 20 degrees, incidence and emission angles of 10 degrees, and particle size at 250 µm. All spectra was generated for four parameters of phase angle $b = [0.2, 0.4, 0.6, 0.8]$ taking the empirical relation between the phase constants of Hapke (2012), where, for the ellipsoidal model, we set the rotational phase at 0 degrees. We observed significant differences between the two models for the band-I area and the band-II area but, we did not find significant differences for the BAR parameter. For the spectral slope, we have meaningful differences between the two models, where the variation of the spectral slope is in the first decimal place, and this difference is bigger when we increase the phase parameter b.