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Analyzing asteroid reflectance spectra with numerical tools based on scattering simulations

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We are developing a set of numerical tools that can be used in analyzing the reflectance spectra of granular materials such as the regolith surface of atmosphereless Solar system objects. Our goal is to be able to explain, with realistic numerical scattering models, the spectral features arising when materials are intimately mixed together. We include the space-weathering -type effects in our simulations, i.e. mixing host mineral locally with small inclusions of another material in small proportions.

Our motivation for this study comes from the present lack of such tools. The current common practice is to apply a semi-physical approximate model such as some variation of Hapke models [e.g., 1] or the Shkuratov model [2]. These models are expressed in a closed form so that they are relatively fast to apply. They are based on simplifications on the radiative transfer theory. The problem is that the validity of the model is not always guaranteed, and the derived physical properties related to particle scattering properties can be unrealistic [3].

We base our numerical tool into a chain of scattering simulations. Scattering properties of small inclusions inside an absorbing host matrix can be derived using exact methods solving the Maxwell equations of the system. The next step, scattering by a single regolith grain, is solved using a geometrical optics method accounting for surface reflections, internal absorption, and possibly the internal diffuse scattering. The third step involves the radiative transfer simulations of these regolith grains in a macroscopic planar element. The chain can be continued next with shadowing simulation over the target surface elements, and finally by integrating the bidirectional reflectance distribution function over the object's shape.

Most of the tools in the proposed chain already exist, and one practical task for us is to tie these together into an easy-to-use toolchain that can be publicly distributed. We plan to open the abovementioned toolchain as a web-based open service.

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References: [1] B. Hapke, Icarus 195, 918–926, 2008. [2] Yu. Shkuratov et al, Icarus 137, 235–246, 1999. [3] Yu. Shkuratov et al, JQSRT 113, 2431–2456, 2012. [4] K. Muinonen et al, JQSRT 110, 1628–1639, 2009.