**NUMERICAL SIMULATIONS OF GRANULAR PROCESSES ON ASTEROID SURFACES: A TOOL TO INTERPRET IMAGED ASTEROID SURFACES AND TO HELP IN THE DESIGN OF ASTEROID SPACE MISSIONS**

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**Introduction:** Spacecraft images and indirect observations (e.g., thermal inertia measurements) indicate that most small bodies have surface regolith. Asteroid surface images also show evidence of granular flow. This material motion occurs in very low gravity, therefore in a completely different gravitational environment than on the Earth. Understanding and modeling these motions can aid in the interpretation of imaged surface features that may exhibit signatures of constituent material properties. Moreover, upcoming sample-return missions to small bodies, and possible future manned missions, will involve interaction with the surface regolith, so it is important to develop tools to predict the surface response. In recent years, new capabilities of the parallelized N-body gravity tree code pkdgrav [1,2] have been added that permit the simulation of granular dynamics, including multi-contact physics and friction forces, using the soft-sphere discrete-element method [3], in any given gravitational environment. The numerical approach has been validated through comparison with laboratory experiments (e.g., [3,4]). Several projects are ongoing or recenty completed by our team, aimed at understanding various processes acting on asteroids' surfaces using this approach. Results will be shown concerning our investigations of the possible tidal resurfacing of asteroids during Earth encounters [5], the Brazil nut effect in a small asteroid's gravity conditions [6], and avalanche processes. Moreover, simulations of impacts into granular materials using different projectile shapes [7] will also be presented. These simulations have been compared successfully with experiments performed in the framework of the design of the sampling mechanism of the space mission Hayabusa 2. These simulations can then be used to determine the efficiency of the sampling mechanism as a function of the asteroid surface properties, which can be very useful during the selection of the sampling site.

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