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SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (4)

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DEM SIMULATION OF SAMPLING TOOL MECHANISMS FOR LOW GRAVITY BODIES

Abstract

In future exploration missions to low gravity bodies (e.g. a Mars moon or a near-Earth asteroid) it is planned to collect more than 100 grams of regolith (dust plus cm-sized pebbles) and return them to Earth for further ground-based analysis. In previous -Near-Earth Asteroid and Marco Polo- and current – MarcoPolo-R- studies several sampling tools have been proposed but there is no single sampling technology for low-gravity bodies that has undergone a rigorous engineering assessment, aiming at proving the ability of the sampler to collect material in any envisaged situation. This is the purpose of the subject activity. The use of Discrete Element Methods (DEM) to investigate mechanical properties of geomaterials is growing fast and their applications in geotechnics have become almost systematic. DEM granular approach suites the problem of studying the soil dynamics during the soil-tool interaction; moreover the investigation of the tool effectiveness in sampling under the influence of desired parameters (tool geometry, tool motion, soil properties) can be addressed. On the other hand, the DEM model of the soil needs a lot of effort to set up the particles interaction in order to faithfully represent the real work environment. The DEM is implemented to realize an affordable and reliable tool useful to investigate the sampling device dynamics in soil sampling activities in order to support the sampling tool concepts identification, trade off and selection. The quantitative capabilities of the DEM tool are also supported by comparing real experimental data to numerical models. The implemented tool addresses both the effectiveness evaluation of the sampling device concepts and the main solicitations estimation. This study comprises these main following steps: review of requirements and soil parameters identification, soil specimen modeling, sampling tool concept modeling, dynamic simulation of soil sampling, sensitivity analysis of dynamic simulation to soil parameters and environment variables.