IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

Author: Mr. Samuele Vaghi
Politecnico di Milano, Italy

Ms. Alessia Cremasco
Politecnico di Milano, Italy
Mr. Luigi Vittorio Delfanti
Politecnico di Milano, Italy
Dr. Iosto Fodde
Politecnico di Milano, Italy
Prof. Fabio Ferrari
Politecnico di Milano, Italy

PARAMETER IDENTIFICATION USING MICROGRAVITY EXPERIMENTS ON ASTEROID-RELATED SCENARIOS

Abstract

We present an experimental approach for estimating parameters of a multibody code, with application to asteroid-related scenarios. The context is the ERC-funded project TRACES, whose goal is to characterize granular mechanics in the asteroid environment. This has implications for the dynamical evolution of asteroids, and for characterizing physical processes occurring on their surfaces. Indeed, most asteroids are now thought to be rubble-piles, that is, gravitational aggregates held together by gravity rather than the strength of their bulk material. Their granular nature suggests that their dynamics can be effectively simulated using N-body codes, such as GRAINS, whose contact dynamics is based on Project::Chrono. The main goal of TRACES is to create a framework for asteroids dynamical simulations in which the accurate modelling of the interactions at particle scale is key. To this aim, the validation of GRAINS against experimental results represents the first milestone of the project. The possibility to rely on a code validated at particle-scale is expected to lead to a great improvement in full-scale simulations. We plan to observe the low-speed collision between two 10-15 cm sized cobbles in a micro-gravity, vacuum environment. The experiment will be conducted at the ZARM Drop Tower, in Bremen, where micro-gravity conditions are created by dropping a capsule in a 110 m high quasi-free fall. To validate GRAINS to particle-level, we will reproduce the results of the experiment with numerical simulations. To this goal, we need to acquire and reconstruct with a high accuracy the 6-dof motion of each cobble, before, during and after the collision. A spring-based release mechanism will provide the initial velocity to the cobbles, and their motion will be tracked through a set of high-resolution, high-speed cameras, made available by ZARM facility. We will place markers on the cobbles to facilitate the tracking procedure. The selection of the sensors is driven by the need to reduce as much as possible the interaction with the motion of the cobbles. The shape of the cobbles will be acquired precisely using a 3D scanner, and fed to the multibody model as a realistic mesh. After having reconstructed the trajectory, we will implement a parameter identification technique to estimate the parameters in the multibody code, comparing different contact models. The goal is to achieve an accuracy of 10% of the cobbles' characteristic size on position and within 10% of the typical spin rate on angular velocities.