RESEARCH MASTER INTERNSHIP/ PROJET DE FIN D'ETUDES 2017-2018

Space Systems for Planetary Applications/DEOS

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INTERNSHIP DESCRIPTION

Domains : Mechanics, Physics, Computer Science, Planetary Science, Space Systems

Duration : 5 – 6 months

Title : Feasibility and performance of a wheel on the surface of a small body

Even though observations from the Earth have revealed the great number and diversity of small bodies (asteroids and comets) in the Solar System, only an in-situ exploration of these bodies can answer many of the open questions today about their physical and chemical composition. This explains the resurgence of missions dedicated to small bodies (Osiris-Rex, Hayabusa-2, Mars Moon Explorer, etc.) and the efforts of international space agencies (ESA, NASA, JAXA, DLR, CNES) to explore their surfaces.

Asteroids (e.g. Eros), comets (e.g. Churyumov-Gerasimenko), and small satellites (e.g. the Martian moon Phobos) prove to be difficult candidates for surface mobility due to their low gravity (100 to a million times lower than the gravity of the Earth). In milli-gravity (i.e. around 10-3g), the very low weight of a vehicle means that the traction is 1,000 times lower than that of the Martian and lunar rovers. Additionally, the behaviour of the regolith (the layer of more or less fine grains found on the surface of these bodies) of the small bodies is poorly understood and, therefore, difficult to predict. This is especially true because of the major role played by cohesive forces at these levels of gravity: the behaviour of the regolith is actually expected to be more like that of a cohesive powder than that of a fine gravel. It is, therefore, necessary to explore the feasibility and the expected performance of a wheeled vehicle on the surface of a small body.

The study will be based on soil modeling using discrete element methods (DEM). This approach consists in simulating the detailed interaction between individual regolith grains (friction, rolling resistance, cohesion, etc.). From a pre-existing DEM code, the student will examine and implement the necessary modifications to model the specific interactions of a wheel with the regolith of a small body. After the necessary validation has been performed, the tool can then be applied to study the problem of rolling in different types of regolith, at different levels of gravity.

30 % Theoretical Research	70 % Applied Research	0% Experimental Research

Possibility to go on a Ph.D.: X **YES** o No

APPLICANT PROFILE

Knowledge and required level:

The candidate is in the final year of an Engineering or Master of Sciences/Engineering degree. They must be rigorous, autonomous and have strong competencies in computer science (C/C++/Matlab). A background in mechanics or physics would be an advantage.

Applications should be sent by e-mail to the supervisors.