

Subject : Bio-inspired drill for the Moon : numerical simulation with SPH.

General frame of the study:

To prepare tomorrow's solar-system-exploration missions, the European Space Agency (ESA) encourages research teams to develop novel and ground breaking technologies. Rotary drilling is extensively used on Earth but has limited performance in low-gravity environments like the Moon or Mars. Apart from rotary drilling, there are few techniques allowing sub-surface exploration (ultra-sonic drilling, moles). Thus the joint University of Surrey (Guildford, UK) – ISAE (Toulouse, France) PhD project aiming to develop a novel bio-inspired drilling solution for extra-terrestrial applications has received the support of ESA.

To help design choices, a numerical simulation tool must be developed. Indeed, the interaction between the drill head and the soil and the maximum reaction forces available from the soil will drive the drill's performance. These quantities are very difficult to identify experimentally. A numerical simulation tool is thus needed to help design an optimized solution.

Precise Objective

The first goal is to evaluate the capacity and limits of SPH method to model the interaction between a structure and a granular material like the one found on the Moon: choice of material behaviour model, modelling of the compaction, etc. To evaluate the numerical choices, simple experiments will be set up.

Then, the knowledge generated during the first phase of the work will then allow a complete model of the drilling system. The simulation results will be compared to tests done

Finally, if the study has progressed sufficiently, it will be completed with some design work on the drill head. The numerical simulations and the experimental work done will be used to optimize drill head geometry.

Location

ISAE, Toulouse, France

Staffing:

The study will be supervised by Dr Christine Espinosa (ISAE) and will be co-supervised by Thibault Gouache, PhD student working on the bio-inspired drilling system for the University of Surrey and ISAE.

Contact

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