Paper ID: 8438
student

SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (5)

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SD2: HOW TO DRILL A COMET

Abstract

Rosetta is an European Space Agency (ESA) mission for the study of a cometary nucleus environment and its evolution in the inner Solar System. To enhance the scientific capability of the mission, the Orbiter spacecraft will carry a probe, which will land on the comet surface for in-situ investigation. One of the key subsystems of the Lander is the Drill, Sample and Distribution Subsystem (SD2), a robotic tool able to collect and distribute cometary samples to the on-board analysis instruments. In particular SD2 is the multifunction device that provides in-situ operations in order to collect and distribute samples. SD2 subsystem that is placed on the lander base plate, supplies comet samples and distributes them for the following scientific analysis. To operate in more realistic way to evaluate the SD2 behaviour in different scenarios, at the laboratory of the Aerospace at the Politecnico di Milano, a dedicated facility has been designed and realized. An external support is built as a "castle" structure made up by four tabular beams, three aluminium planes, SD2 Flight Spare support and a sensors system support. The sensor system is constituted by a strain gauge that measures the normal force and the torque, both transmitted by the drill to the specimen surface during a perforation phase. In the last phase of the test campaign it is added a current sensor that allows measuring the current absorbed by the SD2 FS motors during every phase of a perforation. The sensor system furnishes a way to understand the relation between the measured forces and current and the composition of the drilled specimens. In fact, during the oncoming tests, it will be possible to analyze, in real time and in continuum, the drilling behaviour and its connection with the mechanical characteristics of the specimens. The materials used for the perforation tests are different; in particular a large campaign is made on Gasbeton, which has been supposed the most similar material to the comet soil, but also on Graphitic-Foam and multi-layers specimen. The obtained results are used to identify a working zone in terms of rotation/translation velocity and power consumption related to each considered material, and then to define the optimal strategy (number and type of perforations) to fast identify the drilled material on the comet.