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

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STRATEGIES FOR THE SCIENTIFIC USE OF THE SAMPLER, DRILL AND DISTRIBUTION SUBSYSTEM (SD2)

Abstract

Rosetta is the third cornerstone mission of the European Space Agency scientific program "Horizon 2000". Rosetta will be the first spacecraft to orbit around a comet nucleus. It was launched in March 2004 and will reach the comet 67P/Churymov- Gerasimenko in 2014. A lander (Philae) will be released and land on the comet surface for in-situ investigation. Its goals include the determination of the elementary and mineralogical composition of the comet, the identification of traces elements, and isotopic composition of cometary material. One of the key subsystems of the lander Philae is the Sampler, Drill and Distribution (SD2) subsystem. SD2 provides in-situ operations devoted to soil drilling, samples collection, and their distribution to two evolved gas analyzers (COSAC and PTOLEMY) and one imaging instrument (ÇIVA). SD2 was designed to work in very low gravity and wide thermal excursion environment, and to optimize cutting performances with a very low power consumption. Recent studies have proven the existence of a correlation between the drill behavior during perforation and the mechanical characteristics of the cometary soil. This outlines the possibility of using SD2 not only as a tool to support other instruments, but also as a scientific instrument itself. To this purpose, a correlation between SD2 telemetry data and the cometary soil characteristics must be identified. Unfortunately, as the drill rotation and translation are commanded by stepper motors, the variation of power consumption can not be used as an indicator of a variation of the soil characteristics. Consequently, alternative strategies are under investigation, for the use of available telemetry data for the determination of cometary soil mechanical properties. A first strategy is based on the identification of the drill working zones in the space of the drill rotation and translation speeds. More specifically, for each specimen, several perforations with decreasing speed levels are performed. The same perforation strategy will be followed on the comet by the SD2 flight model to obtain the working zone specific to the cometary soil. Information about the mechanical characteristics and inhomogeneity of the soil will then be deduced from a comparison between the soil working zone and the specimens working zones obtained on ground. A second strategy is under investigation aimed at reducing the number of drill operations. The strategy is based on analyzing separately the response of the cometary surface to drill translation and rotation commands, and exploiting failure conditions for soil characterization.