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

Author: Dr. Pierluigi Di Lizia
Politecnico di Milano, Italy

Dr. Roberto Armellin
Politecnico di Milano, United Kingdom
Prof. Franco Bernelli-Zazzera
Politecnico di Milano, Italy
Prof. Amalia Ercoli Finzi
Politecnico di Milano, Italy

MISSION PLANS DEVELOPMENT FOR THE SAMPLER, DRILL AND DISTRIBUTION SUBSYSTEM OF ROSETTA MISSION

Abstract

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. To enhance the scientific capability of the mission, the lander Philae will be released and will land on the comet surface for in-situ investigation. Philae will then act as an independent spacecraft, as it is provided with all subsystems needed to work alone on the comet. The ten scientific instruments onboard Philae will start performing their surface measurements after touch down. One of the key subsystems of the lander 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).

After landing in November 2014, a first scientific sequence (FSS) of activities will be carried out, lasting about 3 days. During FSS, Philae will rely primarily on the energy stored in a primary battery (about 1 kWh). Due to the scarse duration and the communication delay, the FSS activities must be carried out automatically, with a limited possibility of developing and uploading telecommands from ground. Thus, a strong interaction between the SD2 team and the other scientific instruments onboard Philae is ongoing, under the coordination of the Science Operation and Navigation Center, to perform an accurate operation planning. The goal is to define the exact sequence of mission plans to be loaded onboard prior to landing and executed during the entire FSS for all sampling procedures.

To this aim, the typical SD2 procedures for comet sampling have been subdivided in substeps. Not all the substeps are specific to one particular sampling, and some of them can be grouped together to build common elementary blocks that can be repeated identically in any sampling procedure. One mission plan per each common elementary block is prepared and uploaded on Philae to execute the associated activities. Specific mission plans are developed for the remaining blocks of activities depending on sampling requirements. Any sampling and distribution procedure during the FSS will be carried out by properly combining the elementary mission plans. This eases SD2 operation by enabling a more flexible operation planning and optimizing memory allocation on Philae's telecommand buffer. This work illustrates the development of SD2 procedures and the benefits obtained for the ongoing FSS activity planning through the introduction of the elementary mission plans.