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SPACE EXPLORATION SYMPOSIUM (A3)
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ROSETTA PHILAE SAMPLING DRILLING AND DISTRIBUTION SUBSYSTEM: OPERATION AND RESULTS FROM THE FIRST ON-COMET PHASE

Abstract

The lander Philae of Rosetta mission landed on the surface of the comet 67P/Churyumov-Gerasimenko on November 12, 2014. Among the specific subsystems and instruments carried on Philae, the sampling, drilling and distribution (SD2) subsystem has a very important role. SD2 provides in-situ operations devoted to soil drilling, samples collection, and their distribution to two evolved gas analyzers (COSAC and PTOLEMY), and to the camera system ÇIVA. After landing, a first scientific sequence (FSS) of about 3 days was planned, relying mainly on the energy stored in a primary battery. Due to its limited duration and the communication delay, the FSS activities had to be carried out automatically, with a limited possibility of developing and uploading commands from ground. This posed relevant constraints to the management of SD2 operations. As an example, SD2 operation requires moving mechanical components, such as the drill and the carousel, in an unknown environment. This increases the risk of failures and points out the necessity of developing dedicated emergency procedures. Due to the stringent constraints on commands upload, all emergency procedures had to be developed and loaded onboard prior to landing, which required a careful a priori analysis of the most probable failures, as well as an optimal use of the command buffer available onboard. On November 14, 2014 SD2 was decided to be operated on the comet even if the actual operational conditions were far from the reference ones: after three consecutive touchdowns, Philae lander was not anchored onto the surface and leant on the comet surface in precarious conditions, with significant limitation on power availability. SD2 was operated to drill up to a distance of 470 mm from the lander baseplate and to deliver a sample to COSAC. The telemetry shows that SD2 operated nominally. The drill roto-translated to the commanded position with the commanded speed of about 7 mm/min and the position was reached within the stringent tolerance requirements. After sampling, the drill moved back to the initial position and the carousel was correctly rotated to serve COSAC. In addition, power profile and energy consumption matched expectations. The analysis of the images taken by the camera ROLIS is ongoing to reveal whether the distance of 470 mm was sufficient to reach and sample the soil. This paper will provide an overview of the solutions adopted to operate SD2 within the described constraints and will summarize SD2 achievements during FSS.