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ROSETTA-PHILAE RF LINK: HOW THE RF LINK BEHAVIOUR HELPS THE UNDERSTANDING OF THE PHILAE REBOUNDS AND TOUCHDOWNS ON THE COMET.

Abstract

The ESA/CNES/DLR Rosetta mission was launched in March 2004 with objective to reach the comet Churyumov-Gerasimenko 10 years later. One of its main assignments was to carry out in-situ analysis using a small lander of about 100 kg called Philae and equipped with a dozen of scientific missions.

After separation of Philae from Rosetta, the S-Band RF link was the only means of communication with the lander for the rest of the mission. It was established roughly two hours after the separation and showed its reliability during the whole 7 hour descent. It is based on two redundant transceivers inherited from the Myriade platform. It provided photographs taken before touchdown through CIVA (Comet Infrared and Visible Analyzer) and ROLIS (Rosetta Lander Imaging System) instruments. Analysis of the lander behaviour during the first few hours of the mission was made possible thanks valuable information extracted from the RF link telemetry.

After touchdown, despite the announced activation success of the anchoring system, the received RF link telemetry indicated multiple and regular interruptions during two hours. The investigation carried out helped to establish the failure of the anchoring system, causing Philae to rebound on the comet surface. It lead to a tumbling motion of the lander with dramatic impact on the RF link establishment capacity.

This paper proposes in a first part an analysis of the complex stabilization of Philae on the comet based on the RF link telemetry and particularly on the estimated received power on the orbiter side. This analysis allows understanding the different phases from the initial touchdown to the final landing.

In a second part, the first science sequence of roughly 50 hours after stabilization is studied through an RF point of view. The analysis reveals unexpected interferences on the telemetry signal certainly due to the surrounding terrain. It stems from it some conclusions on the presence of high rocks in the field of view of the lander antennas.

Finally, the cross-comparison of the RF analysis conclusions with other equipment analysis such as ROMAP (Rosetta Magnetometer and Plasma-monitor) allows validating the scenario of Philae comet landing.