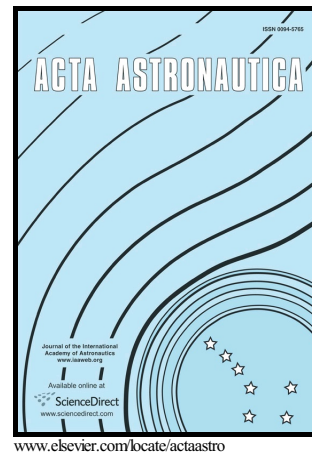


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Rosetta Lander Philae : Flight Dynamics analyses for Landing Site Selection and Post- Landing Operations

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Abstract:

On the 12th of November 2014, The Rosetta Lander Philae became the first spacecraft to softly land on a comet nucleus. Due to the double failure of the cold gas hold-down thruster and the anchoring harpoons that should have fixed Philae to the surface, it spent approximately two hours bouncing over the comet surface to finally come at rest one km away from its target site. Nevertheless it was operated during the 57 hours of its First Science Sequence. The FSS, performed with the two batteries, should have been followed by the Long Term Science Sequence but Philae was in a place not well illuminated and fell into hibernation. Yet, thanks to reducing distance to the Sun and to seasonal effect, it woke up at end of April and on 13th of June it contacted Rosetta again. To achieve this successful landing, an intense preparation work had been carried out mainly between August and November 2014 to select the targeted landing site and define the final landing trajectory. After the landing, the data collected during on-comet operations have been used to assess the final position and orientation of Philae, and to prepare the wake-up. This paper addresses the Flight Dynamics studies done in the scope of this landing preparation from Lander side, in close cooperation with the team at ESA, responsible for Rosetta, as well as for the reconstruction of the bouncing trajectory and orientation of the Lander after touchdown.

Introduction

Rosetta is a cornerstone mission of the European Space Agency (ESA) Horizon 2000 program. It reached its target comet 67P/Churyumov-Gerasimenko in August 2014 after a 10 years cruise in the Solar System. Its scientific payload consists of 11 instruments including the Philae lander. Rosetta is currently observing its icy nucleus and coma, and when the mission will come to an end in September 2016, the comet will have passed the perihelion and will continue on its way in the Solar System. One of the objectives of the mission was to deliver the Philae lander to the surface of the comet nucleus. This objective was reached on 12th of November 2014, when the spacecraft achieved the first-ever soft landing on a comet nucleus. Due to a double failure of the hold-down thrust and of the anchoring harpoons, Philae bounced off the comet surface and came to rest only

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