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METHODS AND TOOL FOR DETERMINING THE IN-SITU SUN ORBIT AND LONG TERM SOLAR POWER PROFILE FOR THE ROSETTA LANDER

Abstract

On approaching the comet CG/67P in 2014 a lander unit (Philae) will be released by the Rosetta spacecraft. Following a relatively short descent phase it will land on the comet. In order to land at a pre-selected site on the comet, but also for mission analysis, operation scheduling and control after landing, the rotational kinematics parameters of the comet (rotation, nutation, precession) need to be accurately known. The motion of the comet along with the lander at a particular site will determine the Sun and spacecraft orbits wrt. the landed lander, and thus the illumination, thermal, solar power and battery charging profiles during on-comet operations.

The reconstruction of the in-situ Sun orbit in a coordinate system fixed to the landed lander - in particular to its solar panels - is of primary importance both for scientific and technical reasons. However neither the final landing site, - and, due to the local irregularities of the comet's terrain at the achieved lander site - nor the lander orientation and tilt are to predict prior to landing.

An alternative method allows for reconstructing the in-situ Sun orbit posteriorly, during the course of a cometary day, and also determining the in-situ value of the lander orientation and tilt. This method takes advantage of that six solar panels cover the lander's nearly cube-like housing and the generated solar power will be measured and delivered as telemetry data on a regular time basis, panel-by-panel. The time dependent distribution of the series of measured solar power samples along with the known geometrical arrangement of the solar panels allow for reconstructing the in-situ Sun orbit wrt. the solar panels.

Such a posteriorly reconstructed Sun orbit indirectly provides information also about the rotational kinematics properties (axes and periods) of the comet. These comet properties can be extracted from the available data set by means of appropriate fitting methods.

A generalized matrix formula can be constructed for mathematical description of the Sun location vector as function of the time and all other relevant parameters such as the comet rotational kinematics parameters, landing site, lander orientation and tilt. The aim is to calibrate such a formula by the in-situ values of all parameters for the unique case of Philae lander on the comet, so that it can support operation control and scheduling on short-, medium- and long term of comet operations.