SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

Author: Dr. Luigi Ansalone
Agenzia Spaziale Italiana (ASI), Italy, luigi.ansalone@est.asi.it

Ms. Samantha Ianelli
Italian Space Agency (ASI), Italy, samantha.ianelli@asi.it
Mr. Roberto Formaro
ASI - Italian Space Agency, Italy, roberto.formaro@asi.it

ENABLING A VERY LOW EARTH ORBIT MISSION, A CONTROL STRATEGY WITH ELECTRIC PROPULSION

Abstract

Several applications benefit from low altitude satellites: communication, optical observation for civil and military application and science. The atmosphere in very low Earth orbit hugely limits the lifetime of a satellite, thus making necessary a propulsion system. An electric propulsion system can give the solution to continuously counterbalance the dissipative effects of the atmospheric drag thanks to: very high specific impulse, very high total impulse and high thrust modularity. This paper presents a preliminary mission analysis for a satellite with a mean altitude of 220 km, pushing down the limit established by the ESA satellite GOCE. The identification of a favorable period for the mission is a key factor to maximize to lifetime of the satellite. The environmental effects, especially the solar activity, have a strong influence on the density of the upper layers of the atmosphere, moreover they are very difficult to foresee on a long time period, so the mission analysis needs to take into account the uncertainties of the models. The paper presents the results of a simulator especially designed for low Earth orbit missions, with a careful estimation of the density of the upper layers of the atmosphere. The control strategy applied forces the satellite to be above a fixed altitude of 210 km, applying a fixed thrust with the electric propulsion at the maximum available thrust up to a maximum altitude of 230 km. The simulator shows the results of the spacecraft orbital parameters varying with this strategy between free fall phases and powered phases. The cross section and the drag coefficient of the satellite have to be minimized to increase the possible lifetime. Two different thruster technologies have been considered: the Hall Effect Thruster and the Gridded Ion Engine, the two thrusters have different performance parameters, so a careful trade-off is needed.