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Author: Mr. Andrea Siena
Politecnico di Torino, Italy, andreasiena97@gmail.com

Mr. Ahmed Mahfouz
University of Luxembourg, Luxembourg , Ahmed.Mahfouz@uni.lu

Dr. Davide Menzio
University of Luxembourg, Luxembourg , davide.menzio@uni.lu

Prof. Holger Voos
University of Luxembourg, Luxembourg , Holger.Voos@uni.lu

Mr. Thomas Passvogel
European Space Agency (ESA), The Netherlands, Thomas.passvogel@esa.int

GNC OF AN CARGO SPACECRAFT ON-ORBIT SERVICING HERSCHEL AT L2

Abstract

In future, space exploration will need to rely on In Situ Resource Utilization (ISRU) in order to extend spacecraft lifetime and/or to reduce the missions cost and/or the cruise time. For the Moon and, in future, Mars colonization, relying on in-situ resources is a necessary step to become independent from the Earth. The possibility to produce resources on the Moon is advantageous for those missions that are too far from the Earth to be resupplied.

At the SnT Research Centre, the Luxembourg Space Agency is supporting a feasibility study to assess the benefit of on-orbit servicing (OOS) exploiting lunar resources for Herschel Space Observatory. Herschel ended its operations in 2013 as a consequence of depleting its coolant and in turn losing the capability of cooling down its instruments. To extend its mission, a resupply mission has been envisaged and relies on an adapted cargo spacecraft employed in lunar gateway operations.

This paper deals with the trajectory design and optimization of the cargo on its journey from the Moon to rendezvous with Herschel and with coupled orbit and attitude control. Considering Herschel's orientation on its orbit, maintaining its sunshield in the direction of the sun, and the need to access to Herschel rear panel to perform the resupply operation, a final approach along the negative x-axis, where the primaries lies, is considered. A multiple shooting technique has been used to perform a flanking manoeuvre. Moreover both a slew and a tracking manoeuvre have been tested for the attitude control to ensure minimum thrusting error of the cargo spacecraft and a continuous visibility Herschel. Different perturbations were considered and angular rates induced by the movement of the robotic arms compensated.