IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

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

Mr. Giacomo Velo
Politecnico di Milano, Italy, giacomo.velo@mail.polimi.it
Dr. Loveneesh Rana
University of Luxembourg, Luxembourg , loveneesh.rana@uni.lu
Prof. Holger Voos
University of Luxembourg, Luxembourg , Holger.Voos@uni.lu
Dr. John Ellwood
European Space Agency (ESA-ESTEC), Netherlands Antilles, john.ellwood1@btinternet.com

ANALYSIS OF A LUNAR DEPOT TO ON-ORBIT SERVICE OBSERVATORY AND EXPLORATORY MISSIONS

Abstract

The interest in extra-terrestrial resources has seen a significant growth in the last years. In-situ resources utilisation (ISRU) represents an extremely valuable asset to expand our space exploration capabilities. The next step to ensure a constant human presence beyond our planet relies in establishing an outpost on the Moon and exploiting its resources to become independent from Earth. Mining and processing the lunar regolith enable not only to sustain life and generate energy but also to support spaceflight. At SnT Research Centre, the Luxembourg Space Agency is supporting a feasibility study to assess the benefit of on-orbit servicing (OOS) exploiting lunar resources. The objective of the project is developing a know-how of redesigning successful mission of the past to fully profit of ISRU and transferring this knowledge to new one. In the previous years, OOS for Mars Express, Herschel Space Observatory and Rosetta was studied to extend the spacecraft lifetime, or to reduce the mission cost and/or the cruise time. In the considered scenarios, a propellant depot is assumed to be located in the vicinity of the cislunar space. It is replenished with lunar resources from lunar cargos and supply a wide range of satellites. Within this paper a review of different periodic orbits is provided for the depot. Trajectory design and optimisation are employed to assess the delta-v cost of rendezvousing for the servicing cargos and serviced spacecrafts. Observatory missions at L1 and L2 were considered together with interplanetary ones involved in sample returns and envisaged for Mars colonisation. A comparison between distributed and centralized architecture is performed. Finally, interesting insights are given on the impact of OOS based on lunar resources on future observatory and interplanetary missions.