

SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 2 (2B)

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THE LUNAR SPACE TUG IN THE FUTURE SPACE EXPLORATION SCENARIO

Abstract

The Lunar Space Tug is a sustainable transportation system able to rendezvous with a target body in the Low Earth Orbits (LEO) environment, assess its current position, attitude and operational status, capture the target and move it to the Cislunar space where a new Deep Space Habitat (DSH) will be settled. Thanks to the adoption of an Electric Propulsion Subsystem based of Hall Effect Thruster (HET) clusters, the LST can save fuel to the detriment of much longer transfer time to deliver the unmanned cargo to the DSH. The LST is design to accomplish several applications, from cargo transfer, to on-orbit assembly and samples return. Being a reusable transportation system, one of the main issue is related to the on-orbit refueling to sustain the LST during its operational lifetime. Each mission scenario must take into account the effects related to refueling operations according to mission requirements and constraints. From a system point of view, considering the whole mission scenario in which the LST will operate, this paper focuses on the interface requirements with respect to the other mission elements involved, e.g. Launch Vehicles, DSH, Re-entry Vehicle. On the other hand, the most critical Subsystems (S/Ss) have been analyzed into the details, focusing on those affected by the adoption of the Electric Propulsion, i.e. the Electrical Power S/S (EPS), the Thermal Control S/S (TCS), and the Attitude and Orbital Control S/S (AOCS). In this work, different mission scenarios and system configurations have been considered and analyzed and the main results have been compared through a multi-level trade-off analysis, in order to define the best mission strategy and system design with respect to the stakeholders' expectations, requirements and constraints. Main results are presented and discussed, and main conclusions are drawn.