Paper ID: 45891
oral
student

IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Space Transportation Solutions for Deep Space Missions (8-A5.4)

Author: Mr. Christopher Andrea Paissoni
Politecnico di Torino, Italy, christopher.paissoni@polito.it

Ms. Martina Mammarella
Politecnico di Torino, Italy, martina.mammarella@polito.it
Dr. Roberta Fusaro
Politecnico di Torino, Italy, roberta.fusaro@polito.it
Prof. Nicole Viola
Politecnico di Torino, Italy, nicole.viola@polito.it
Dr. Tommaso Andreussi
Sitael Spa, Italy, tommaso.andreussi@sitael.com
Dr. Angela Rossodivita
Sitael Spa, Italy, angela.rossodivita@sitael.com
Mr. Giorgio Saccoccia
European Space Agency (ESA), The Netherlands, giorgio.saccoccia@esa.int

DEEP SPACE TRANSPORTATION ENHANCED BY 20KW-CLASS HALL EFFECT THRUSTER

Abstract

Deep Space is the new frontier for the human exploration and Moon and Mars are the acknowledged final destinations. Improving the capability of in-space transportation has been recognized as one of the critical enabler for a sustainable and affordable space program, also in the Near-Earth Orbit environment. Envisioning the presence of future deep space infrastructures, cargo transferring becomes a major issue that could be enhanced by improved in-space propulsion capabilities. The turning point could be represented by Solar Electric Propulsion (SEP), thanks to a combination of higher level of available on-board power and extended operational lifetime, exploiting technology advancements such as Magnetic Shielding and cluster configuration. High-power Hall Effect Thrusters (HET) represent the most promising answer for these missions, thanks to a higher thrust-over-power ratio with respect to the Gridded Ion Engines. Reusable HET platforms could represent a valid alternative to the chemical ones in supporting human presence in deep space, delivering food, oxygen, and water, as well as propellant. In this paper, the typical mission and system analysis tools have been exploited to analyze the identified scenarios and emphasize the impact of both SEP and reusability on the scenarios themselves. Then, the corresponding electric platforms have been designed considering the adoption of a 20kW-class HET string, under development at Sitael SpA, sizing those subsystems that are most affected by this critical technology, and providing mission, mass and power budgets as main outcomes. Moreover, the feasibility of each scenario is assessed considering the needs derived from the traffic plan in terms of loading/unloading cargo, transfer duration, and further mission and physical constraints owing to the adoption of high-power electric propulsion. Eventually, the different platforms have been compared with respect to the possible commonalities among their electric propulsion architectures, in compliance with mission guidelines of modularity and affordability. Main results are presented, and main conclusions are drawn.