IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Upper Stages, Space Transfer, Entry & Landing Systems (3)

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ADVANCED EUROPEAN RE-ENTRY SYSTEM BASED ON INFLATABLE HEAT SHIELDS

EFESTO PROJECT OVERVIEW: SYSTEM AND MISSION DESIGN AND TECHNOLOGY ROADMAP

Abstract

The European Union H2020 EFESTO project is coordinated by DEIMOS Space with the end goals of improving the European TRL of Inflatable Heat Shields for re-entry vehicles (from 3 to 4/5) and paving the way towards further improvements (TRL 6 with a future In-Orbit Demonstrator, IOD). This paper provides an overview of the project, the consolidated results of the detailed design of atmospheric entry missions for Mars exploration and Earth applications and an overview of the technology roadmap. The project includes design and ground tests activities, covering the key subsystems of inflatable structure and flexible TPS that compose a Hypersonic Inflatable Aerodynamic Decelerator (HIAD).

Two key applications, have been identified to enable Mars Robotic Exploration and Reusable Small Launchers Upper Stages. For the Mars Application, the robotic exploration mission design results in a 9m diameter Hypersonic Inflatable Aerodynamic Decelerator (HIAD) class, combined with Supersonic Retro-Propulsion for safely landing the 2.5 ton payload at MOLA +3km target altitude. For the Earth Application, the VEGA upper stage (AVUM) has been selected as baseline case study. The current mission foresees a deorbiting from Polar Orbit followed by a controlled entry phase (Ballistic Coefficient of about

46 kg/m2). Deceleration is achieved using a 4.5m diameter class HIAD combined with parachutes during the descent phase, A parafoil enables Mid-Air-Capturing (MAR) of the entry vehicle with a helicopter.

For the Mars applications, the mission analysis shows that, compared to state-of-the-art technology, implementation of the HIAD efficiently provides larger drag during the entry phase, thus allowing to increase both landed mass and MOLA altitude at which a soft landing is possible. For the Earth applications, the mission analysis confirms the HIAD as an appealing, performing and robust solution for the purpose of safely returning the VEGA upper stage to a targeted recovery area. These results demonstrate that HIAD systems represent an enabling technology for the next class of high-mass Mars exploration missions and this technology can be key in reducing the cost of access to space through upper stage reusability. The need for advancing the TRL of this technology, which is the primary objective of the EFESTO project, is thus confirmed and the relevance of an IOD mission that will enhance the European know-how in the field, of which the EFESTO consortium represents the core, is reinforced.

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