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DEPLOYABLE HEAT SHIELD SOLUTIONS FOR A HUMAN MARS LANDER

Abstract

The successful landing of humans on Mars requires the development of advanced Thermal Protection Systems (TPS) that can protect crew and equipment from the intense heat generated during the entry and descent phases of the mission. The high mass required for a crewed spacecraft, combined with the thin atmosphere makes achieving a significant speed reduction a key technological challenge. Larger TPS solutions have the potential to deliver more payload to the surface of the target destination while also providing accessibility to higher-altitude landing sites. Deployable heat shields have emerged as a promising solution to reduce the overall mass and volume of spacecraft while improving mission reliability and safety. To explore the feasibility and key characteristics of deployable heat shields, a survey of existing literature was conducted. This paper provides an overview of the current state of different projects involving deployable heat shields, such as Hypersonic Inflatable Aerodynamic Decelerators (HIAD), Adaptable Deployable Entry and Placement Technologies (ADEPT), and the European Flexible hEat Shields (EFESTO). Performances of the deployable solutions and rigid aeroshells have been compared, with a focus on feasibility in the frame of a manned Mars Entry Vehicle.
This study has been led as part of the project work for the 15th Space Exploration and Development Systems (SEEDS) Specializing Master's Program, hosted by Politecnico di Torino, ISAE SUPAERO, University of Leicester with the collaboration of Thales Alenia Space Italia, ALTEC and endorsed by ASI and ESA. In this framework, a multicultural and interdisciplinary group of students worked together to develop the concept of a manned Martian lander.