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

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AERODYNAMIC ANALYSIS OF EDL PHASE FOR A HUMAN MISSION ON MARS

Abstract

In the coming decades, humanity is poised to become a multiplanetary species. However, because of existing technological constraints, manned missions are currently limited to our own Solar System and

Mars is the most viable candidate for sustaining life. The entry, descent and landing (EDL) phases of human exploration missions to Mars are some of the main challenges related to the development of such an endeavour. Compared with previous robotic missions on the Red Planet, human exploration will be characterized by an increased mass for both payloads and spacecraft. This feature of manned missions, combined with the thin atmosphere makes achieving a significant speed reduction a key technological challenge. The aim of this study is to provide a preliminary design of the descent and landing architecture, consisting of a braking system for the thin Martian atmosphere. Furthermore, a GNC (Guidance, Navigation Control) system, with a specific focus on the guidance phase, and the associated control and navigation sensors will be proposed as it is mandatory to accurately land in the target area on the planet surface. Trajectory optimization will also be taken into account as it is fundamental to maximize fuel efficiency and to perform a soft landing. A guidance, navigation and control algorithm with its simulation describing the final descent and landing phase is provided 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. Within this framework, a multicultural and interdisciplinary team of students worked together to develop the concept of a manned Martian lander.