SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems Concepts (1)

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ARMADA: AUTOROTATION, FEASIBLE ALTERNATIVE TO TRADITIONAL MARTIAN ENTRY, DESCENT AND LANDING

Abstract

The Entry, Descent and Landing System (EDLS) is one of the main system drivers for an interplanetary mission aiming at landing a payload on a planetary surface. The ultimate goal is to land safely the payload onto the planet surface. Towards that end, different constraints must be fulfilled in order to achieve a successful landing.

In the frame of an ESA's GSP study, GMV, in collaboration with the University of Bologna and EADS-Astrium (France), is carrying out a 18 months project whose main objective is to assess the feasibility of using an autorotation system, named ARMADA, as a component of the entry, descent and landing system. Even though Mars is assumed as the main planetary target, a preliminary assessment for landing on Venus or Titan is also made.

ARMADA replaces all deceleration systems for the Descent Module (DM) (parachutes, airbags, and retrorockets) except for the heat shield. In consequence, the Entry, Descent and Landing scenarios used for past missions cannot be applied to ARMADA directly, but have to serve as a starting point for deriving a mission scenario suitable for an autorotation landing. For the scope of this project the ARMADA reference scenario is primarily based on an Exomars scenario.

Eventually, the study aims at assessing the performance of the ARMADA concept with respect to flight proven, traditional EDL systems. To that end, a set of criteria relevant to the EDLS performance has been derived. A systematic survey/identification of potential ARMADA concepts has been carried out. This identification has been followed by an assessment of the suitability of each concept for the reference scenario and a trade-off analysis that concluded with a proposal on the best-estimated concept and a backup option. A performance database (EDLPD) and an integrated parametric design tool (IPDT) for the main concept, including all the required models, have been developed. Both provide the theoretical justification and simulation of the selected autorotation concept, as well as help in the identification of the optimum configuration.

This paper gives an overview of the project, starting by the system concepts trade-off, followed by the description of the EDLPD & IDPT, and summarizing the optimum configurations according to the Technology Readiness Level (TRL) timeline, together with the steps that led to them.