IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems (4)

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ADVANCEMENTS IN MISSION ENGINEERING FOR SPACE RIDER

Abstract

The ESA Space Rider program is developing a European reusable space transportation system for routine access and return from Low Earth Orbit. The Space Rider system is composed of an expendable AVUM Orbital Module (AOM), and a reusable Re-entry Module (RM) designed to be flown multiple times. The RM must be a flexible system to carry a wide range of payloads, and robust enough to cope with a wide range of flight conditions, in compliance to the applicable safety constraints in case of failure. This is a critical additional challenge for Europe, beyond the current state of the art in re-entry technology represented by the successful flight of the ESA IXV (Intermediate eXperimental Vehicle) on February 11th, 2015. The re-entry mission of the RM starts after the de-orbit manoeuvre and concludes at touchdown. The module is designed purposely to survive the loads of the atmospheric entry, landing at the designated target locations in Kourou (French Guiana) or Santa Maria (Azores, Portugal). This paper presents the status of the Space Rider Mission for the RM module and the Mission Engineering results achieved by DEIMOS Space after the program has entered Phase D. This paper will also highlight the upgrades that have been implemented in the mission analysis toolchain. Mission Engineering is a design process that includes multiple activities in support to the mission and system design: from aerodynamics and flying qualities aspects to End-to-End (de-orbiting to touchdown), reference trajectories optimization, analysis of the vehicle flight capabilities during entry and under parafoil, assessment of the mission performance through Monte Carlo simulation campaigns, visibility, and safety analyses during all phases of the return mission. The main advancements of the mission analysis toolchain include a novel methodology for the determination of the de-orbit opportunities, and a streamlined approach to the reference mission design. In this new process, the optimal control problem formulated is solved with the simulator in the loop using the same models and fidelity of the Monte Carlo campaign.