IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

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MISSION ANALYSIS AND FEASIBILITY ASSESSMENT FOR THE SYSTEM DROP TEST OF ESA SPACE RIDER RE-ENTRY MODULE

Abstract

Current paper focuses on Deimos Space Romania's role in providing support to ESA's Space Rider Programme, in the framework of Space Rider full-scale System Drop Test, working together with the Italian Aerospace Research Centre (CIRA) and Thales Alenia Space Italy (TAS-I) for the preparation and execution of the Drop Test mission. Deimos's activities span various areas, including: (1) assistance in defining the mission profile, (2) conducting pre-flight analyses to assess feasibility of the flight test, (3) supporting operations including GO/NO-GO decision for flight-test execution through forecasting/now-casting flight predictions and (4) integrating lessons learned into the Space Rider Programme. To facilitate these responsibilities, an ad-hoc environment called the Space Rider Drop Test Mission Analysis Functional Engineering Simulator (SRDTMA-FES) was developed to analyse operational and safety aspects for the designated test site, incorporating Guidance, Navigation, and Control (GNC) algorithms to ensure accurate trajectory profiles during the Descent and Landing phase under the parafoil. An operational perimeter has been established, based on the local geographical area characteristics and limitations, where mission operations and execution must comply rigorously to safety requirements. An optimization process has been implemented to enhance mission feasibility and safety, identifying optimal locations for

key decision points in the GNC logic. This process utilizes the SRDTMA-FES in multiple Monte Carlo campaigns to assess various combinations of Drop Point (DP), Way Point 1 (WP1) and Way Point 2 (WP2), with the objective to identify an optimal WP1-WP2-DP combination that satisfies the flight test requirements as well as the safety and operational constraints. Furthermore, a comprehensive software tool named 'Entry Module Mission Analysis' (EMMA), has been designed, developed and tested. The tool, featuring a Graphical User Interface (GUI), provides visualization of the actual and predicted trajectories of the Descent and Landing Test Model (DLTM), integrated into the geographical environment for the test site. EMMA tool offers the needed information to allow for mission monitoring as well as decision making process during the flight test, including activation of the Flight Termination System (FTS), and relies on specific functionalities of the SRDTMA-FES to perform periodic trajectory predictions based on live telemetry and meteorological data, including winds. The EMMA tool has been validated with respect to results, propagated trajectories and associated key information in the GUI, showcasing its capacity to predict in real-time and visually represent the actual flight of the DLTM vehicle during the execution of the Space Rider System Drop Test.