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

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DESIGN OF THE BALLUTE INFLATION SYSTEM OF THE MIRIAM-2 SERVICE SPACECRAFT.

Abstract

MIRIAM-2 is the acronym of 'Main Inflated Re-entry Into the Atmosphere Mission test' and describes an atmospheric reentry flight test of an innovative ballute spacecraft that is scheduled for launch in October 2015 with a two-stage Taurus-Improved Orion rocket from Esrange. MIRIAM-2 is a validation concept designed for the Mars ballute technology development programme ARCHIMEDES (Aerial Robot, Carrying High resolution Imaging, a Magnetometer Experiment and Direct Environment Sensors). The project is conducted by several partners, namely three institutes of the Bundeswehr University Munich in cooperation with the Mobile Rocket Base (MORABA) division of the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR), the Mars Society Germany (Mars Society Deuschland, MSD) and several other research institutes throughout Europe. The MIRIAM-2 spacecraft comprises three modules:

- the ballute spacecraft that carries an instrument pod including the scientific payload and necessary electronics to measure, save and send flight data;
- the service spacecraft that contains the ballute until the launcher reaches an appropriate altitude, inflates and ejects the ballute spacecraft;
- and a dedicated camera module, that gathers visual data during the ejection and inflation process of the ballute.

The main mission objectives of MIRIAM-2 are testing the ejection and inflation mechanisms as well as obtaining flight data of the reentry of a low ballistic coefficient design like the ballute spacecraft proposed. Those flight data will be used e.g. to validate already conducted theoretical aerothermodynamics studies of such reentry vehicles into the Earth's atmosphere. The results of the MIRIAM-2 mission will lead to a detailed design of the ARCHIMEDES ballute mission headed for Mars in order to investigate the Martian atmosphere. This paper first gives an overview of the overall mission: operations, architecture and design. Subsequently, the results of mission analysis including the analysis of separation and attitude dynamics of the service spacecraft and the ejected ballute spacecraft are presented. Requirements regarding the ballute inflation subsystem of the service spacecraft are derived. The inflation system is crucial to mission success: if the ballute is not inflated as required, the MIRIAM-2 mission will fail. The technical solutions for the ballute inflation subsystem including configuration, analysis and test results to meet the requirements are presented and discussed.