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

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THE DESIGN OF THE SPACE RIDER REENTRY MODULE GNC SUBSYSTEM UP TO CDR

Abstract

The Space Rider programme shall provide Europe with an affordable, independent, reusable end-to-end integrated space transportation system. Space Rider will allow routine access to low orbit and in-orbit operation; at the end of the orbital phase the Re-Entry Module will execute de-orbiting, re-entering and landing on ground. After its mission, the Re-entry module can be re-launched after limited refurbishment. Space Rider will be launched from Kourou on-board the VEGA-C launcher. The target orbits for injection cover from Equatorial up to Sun-synchronous orbits depending on the payload needs. The Guidance, Navigation and Control (GNC) of the Re-entry Module (RM) controls in closed-loop the flight of the vehicle from the separation in orbit from the AVUM Orbital Module (AOM) down to precision landing in a circle with radius 150m. The RM will be deorbited at the end of the operational mission, it will separate from the AOM and perform an orbital coasting and an atmospheric re-entry to decelerate from hypersonic to supersonics in a similar fashion as done in IXV. The vehicle will cross the transonic regime during the TAEM phase, then deploying the subsonic parachute at around Mach 0.75. At an altitude of 6 km the parafoil will be deployed and the vehicle will be actively guided towards a dedicated landing site to perform precision landing within 150m of the target site, with wind knowledge errors up to 5 m/s 3σ. The RM GNC includes Coasting from the AOM separation up to the Entry Interface Point (EIP), Entry for hypersonic entry flight, Terminal Area Energy Management (TAEM) for the transonic pass, targeting the parachute triggering point, Descent under parachute and Landing under parafoil with guided approach flight until touchdown. This paper describes the design of Space Rider Re-Entry Module GNC subsystem, which passed its CDR at the end of 2019. Phase B2C focused on TAEM and Descent and Landing, since those are new with respect to the IXV mission. The FDIR functionality is also new, and its design must cope with the time-critical nature of the reentry mission Heritage in Coasting and Entry from IXV has been maximized. The GNC uses RCS and aerodynamic control surfaces (elevons) as actuators, and IMU + GNSS and altimeter as navigation sensors. The GNC subsystem architecture will be described, and results from the CDR Monte Carlo campaign will be presented and discussed. The compliance of the design with the GNS subsystem requirements will be shown.