IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Upper Stages, Space Transfer, Entry & Landing Systems (3)

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THE SPACE RIDER REENTRY MODULE GNC DESIGN AND DEVELOPMENT UNTIL FLIGHT QUALIFICATION

Abstract

This paper presents the ongoing work of TASI, SENER and Deimos for the design and development of a new Guidance, Navigation and Control (GNC) system for the Space Rider Re-entry Module (RM) that controls in closed-loop the flight of the vehicle from the separation in orbit from the AVUM Orbital Module (AOM) down to landing. The Space Rider program shall provide Europe with an affordable, independent, reusable end-to-end integrated space transportation system allowing 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. The RM will be deorbited at the end of its operational mission, it will separate from the AOM and perform an orbital coasting and an atmospheric re-entry to decelerate from hypersonic to supersonic speed. 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 5.5 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. In the current Bridging Phase, the end-to-end design from Separation to landing is being completed. The Coasting phase has been updated to be able to cope with different orbital inclinations, upgrading it from a ground-predefined attitude profile to an onboard computed attitude guidance. The flight proven IXV Entry phase GC is reused, and is being tuned for the new dynamic properties of the vehicle. The Entry to TAEM transition is being refined and tuned, and the DRS and parafoil triggering algorithms have been tailored for the SR flight conditions. The parafoil phase GNC (PGNC) has been updated for the new parafoil aerodynamic database and landing site conditions for improved robustness, mission versatility and operation. The navigation function for the whole flight has been updated to use the selected navigation unit and allow an improved management of the Drag Derived Altitude measurements for the GNSS blackout phase. The Flight Manager function has been implemented and the complete GNC integrated and tested in the Functional Engineering Environment (FES). The GNC development will conclude Bridging Phase in Spring 2022, and will continue in phase D with validation and ground-based drop test campaigns, followed by flight qualification.