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Author: Mr. Francesco Cacciatore
SENER, Spain, francesco.cacciatore@aeroespacial.sener

SPACE RIDER RE-ENTRY MODULE PARAFOIL GNC SCALED DOWN FLIGHT TESTS

Abstract

Space Rider is Europe's first reusable space transportation system. The Space Rider Re-Entry Module is a lifting body vehicle that after orbital coasting, hypersonic entry, and transonic flight will perform soft precision autonomous landing under parafoil. Space Rider is developed by Thales Alenia Space Italy for ESA. Sener Aerospace and Defense is the Design Authority of the GNC for the Space Rider Re-entry Module, and developer of the Parafoil GNC. As part of the Space Rider's (SR) verification and validation campaign of the Guidance, Navigation and Control (GNC) system for the flight under the parafoil phase, a series of Scale Down Flight Test (SDFT) are envisioned for phases C/D of the project. These tests have the following objectives for what concerns GNC: increasing the maturity level of the Parafoil GNC (PGNC), de-risking especially its novel terminal guidance approach in view of flight and for drop tests, provide a preliminary assessment of the real-life achievable landing accuracy, test onboard wind estimation, test robustness of GNC to perturbations and modelling errors, ensure predictability of the developed GNC for guiding and controlling a parafoil in real non-modellable conditions, test effect of online wind updates. The scaled test flights will also serve to improve the knowledge of the system's dynamics and, therefore, the representativeness of the mathematical models used in the functional simulators. Due to the scaled nature of the test vehicle, some differences will exist with respect to the full-scale case. Nonetheless, this is not considered a problem since it will be possible to mimic to a sufficient extent the trajectory behavior of full parafoil. The proposed test vehicle will be based on a COTS paramotor, that will be procured and modified to include the required sensors and actuators complying with test range and air safety regulations. The envisioned global vehicle mass is in the range of 100-200kg. The tests shall be carried out in a range of approximately 1500 m maximum altitude; visual range flight is foreseen, with operator always ready and enabled to recover manual control. This paper presents the development, characterization, and performances of the SDFT system, as well as the test campaign execution and results.