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Safe Transportation Systems for Sustainable Commercial Human Spaceflight / Small Launchers: Concepts and Operations (Part II) (9-D6.2)

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INVESTIGATION ON REENTRY AND RECOVERY SCENARIOS OF A SUBORBITAL ROCKET FOR REUSABILITY PURPOSES

Abstract

Reusability of space launch vehicles is a trending topic within the space industry nowadays. This comes mainly to the late success of Orbital and Suborbital launch vehicles to reach space and recover back most of the vehicle's platform. Cutting costs, providing reliability on repeatability and accelerating the launch manifest are strong reasons to sell the resuability idea widely as the future of space flight.

So far space rocket's reusability usually was focused on the booster segment or the 1st stage of the rocket. That come as no surprise as these parts of the rocket are counted not only to be the most valuable part of the launcher but also designed to carry enough loads on ascent to handle the reentry, recovery and landing forces with few improvments.

However, this approach doesn't have a strong influence on high altitude sounding rockets or small suborbital launchers. Despite the fact that the loads and velocities these rockets experience are incomparable to the orbital/heavy suborbital launchers. Sounding rockets are usually built for a single use with recovery capabilities only for the payloads launched onboard in some cases.

The investigation carried out and presented in this paper was done as part of the resuability plan for the Suborbital Inexpensive Rocket SIR which is expected for its maiden flight in 2019. SIR is a small suborbital rocket under development to serve the market providing access to the upper layers of atmosphere and to space as it serves altitudes up till 200 km.

This work also illustrates the analysis and experimental results done for various reentry configurations and recovery system deployment sequences during different flight scenarios. As the effects on the vehicle's structure may cause sever damage or fatigue that leaves it in a condition for no further use upon recovery, the scnerios analyzied from the aerodynamic point of view reflecting on the stress and heat loading on the rocket upon reentry. Parachute design, deployment method, conceptual design theories, analytical, numerical analysis and experimental test data are presented with explaination and comments.