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Author: Mr. Lars Pepermans
Delft Aerospace Rocket Engineering (DARE), Netherlands (Kingdom of the)

Mrs. Esmée Menting
Netherlands (Kingdom of the)
Mr. Mark Rozemeijer
Netherlands (Kingdom of the)
Mr. Thomas Britting
Delft Aerospace Rocket Engineering (DARE), Netherlands (Kingdom of the)
Mr. Derks Peter-Jan
Delft Aerospace Rocket Engineering (DARE), Netherlands (Kingdom of the)

TRAJECTORY SIMULATIONS AND SENSITIVITY FOR THE SPEAR PARACHUTE TEST VEHICLE

Abstract

The Supersonic Parachute Experiment Aboard REXUS, or SPEAR, in short, is a small conical vehicle that is to fly on board the REXUS 28 rocket as part of the REXUS/BEXUS project cycle 12. The objective of the mission is to test the Hemisflo ribbon drogue parachute of the Large Envelope Advanced Parachute System (LEAPS) at supersonic conditions. LEAPS has been developed as the parachute recovery system for the DARE Stratos III and Stratos IV student build sounding rockets. This means that the vehicle shall reach at least Mach 1.5 at parachute deployment in any possible flight case.

The trajectories are simulated using the in house developed ParSim and TumSim tools. These tools can simulate the free fall and parachute behaviour during flight. In order to prove the vehicle complies with the requirements in any possible flight case, several grid searches and Monte Carlo analysis have been performed. During these runs, the initial conditions such as initial altitude and horizontal velocity are varied to simulate variations in launch conditions. The vehicle parameters such as drag coefficient, mass and area are varied to demonstrate sensitivity to errors in production. Finally, the inflation conditions of the drogue parachute are varied to simulate errors in the sensor and actuator subsystems.

All simulations are run separately from each other to identify the largest uncertainty and their respected impact. Finally, one complete run is done showing the total sensitivity of SPEAR. The results of the simulations are used to ensure SPEAR can fulfil the requirements under all possible conditions.