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FLIGHT SIMULATIONS OF THE STRATOS III PARACHUTE RECOVERY SYSTEM

Abstract

Stratos III is a rocketry project led by students from Delft University of Technology. The goal of this project is to reclaim the European student altitude record for a sounding rocket, which is currently set at 33.2 kilometres. The flight data of this rocket has to be retrieved to definitively prove the altitude at apogee. As not all data is sent down and the risk of losing contact with the rocket is sufficiently high, a parachute recovery system is required. To predict the performance of this system the team developed two simulation tools. ParSim is a tool for the conceptual design of the recovery system and TumSim for the detailed design. The input parameters for both simulations are the aerodynamic coefficients, masses, moments of inertia, and initial conditions. These are gathered from literature and experimental research.

The first tool, ParSim, has been designed as a conceptual design tool to analyse the freefall velocities and parachute inflation effects during the mission. The drag of the parachute is superimposed onto the body drag and taken into account for the altitude-velocity profile. The second tool, TumSim, has been developed to predict the dynamics of the payload during descent. The tool simulates the coupled transitional and rotational motion of the nose cone during the free fall. TumSim is therefore capable of determining the aerodynamic stability necessary for understanding the behaviour of the body during descent. The article will give insight in the assumptions and equations used in both tools.

The tools have been verified using simple numerical cases as well as ASTOS. The tools have been validated using the Stratos II+ flight data and previously published DLR results. The verification and validation results will further be discussed in the article.

The tools have been used to predict the Stratos III flight profile and the team is confident that these results are representative of the actual flight. The article will give the flight simulations of the Stratos III

flight and compare these simulations to the actual flight data from July 2018. After the Stratos III flight, the simulations can be further modified and used for future DARE missions. The nature of these tools allows them to serve as a baseline model for future tool for entry, descent and landing systems.