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AEROSPACE

Student Research Project / Master Thesis

Impact of Fuselage Aerodynamics on the Re-Entry of Reusable Launchers

When reusing the first stages of launch vehicles, precise landing on recovery vessels and precise splashdown in certain recovery areas are an essential part of the rocket's operating cycle. However, excessive deviations from the target trajectory can quickly lead to a loss of the first stage during re-entry. It is therefore essential to identify all disturbance variables that may have an influence on the target trajectory before carrying out such missions. Depending on the type of disturbance, these can then be compensated by using an appropriate control system or actively be used to expand the performance spectrum of the first stage.

One of these disturbance variables is the aerodynamics of the launcher fuselage, where, in addition to the expected drag, potential lift and lateral forces can also lead to a deviation in the flight path. This applies in particular to the case of high angles of attack and sideslip during re-entry. A positive benefit of this can be an extension of the operating envelope. Deviations from the target flight path caused by other factors can thus be compensated by active alignment of the fuselage. For this reason, the active displacement of the recovery point with the aid of a realigned launcher fuselage during re-entry is to be investigated in more detail in this thesis.

The work is divided into the following steps:

1. Literature research on launcher aerodynamics, flight simulations and CFD
2. Definition of re-entry scenarios with the corresponding flow conditions and a reference launcher
3. CAD modelling of the geometry of the reference launcher system
4. Analysis of the aerodynamic properties of the fuselage using CFD based on the defined re-entry scenarios
5. Implementation and testing of the aerodynamic control characteristics in a predefined flight simulation environment in Matlab/Simulink
6. Critical analysis of the control characteristics and the optimization potential of the geometry

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Execution only after consultation of supervising university institute

