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ANALYSIS OF NOVEL CONCEPTS FOR THE RETURN OF UPPER ROCKET STAGES

Abstract

With the significant rise in the number of orbital rocket launches by about 15

A shift to non-destructive, controlled re-entry of spacecraft systems after use by using appropriate entry, descent and landing systems (EDL) represents a solution to the aforementioned problem. In addition, this would also be a first decisive step towards at least partial reusability, which is of great economic importance especially for upper stages.

One approach for such a non-destructive system is a deployable entry system, that uses deployable surfaces to generate air resistance for controlled entry and as a heat shield. Deployable systems allow for new trajectories with reduced maximum loads, improved decent control and low power consumption. Additionally, they provide high flexibility for integration into existing transport system. While inflation-deployable systems such as HIAD or KLAUS are relatively well developed and are also being researched for the return of upper stages, rigidly deployable systems such as ADEPT have not yet been investigated for disposal missions. However, the deployement of rigid structures may have advantages through potential synergies with existing structures or successive unfolding processes for trajectory optimisation. This study discusses, based on a technology review, the suitability of rigid deployable entry systems for such disposal missions. Existing approaches for rigid deployable entry systems are analysed and system- and design-parameters are discussed, that may be beneficial for optimising the trajectory. Furthermore, the review results are used in the development of a numerical tool for mission analysis of deployable entry systems for disposal missions. Based on this study, the potential of rigid deployable entry systems for disposal missions can be evaluated and possible design approaches can be identified.