SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems (4)

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SYSTEMATIC ASSESSMENT OF REUSABLE FIRST-STAGE RETURN OPTIONS

Abstract

Complex, high-performance, high-cost rocket stages and rocket engines are disposed today after a short operating time. Used components are falling back to Earth, crashing on ground or into the Oceans. Returning these stages back to their launch site could be attractive - both from an economical as well as an ecological perspective. However, early reusability experience obtained by the Space Shuttle and Buran vehicles demonstrated the challenges of finding a viable operational case.

Systematic research in the different reusability options of space transportation is urgently needed to find the most promising concept. A system analysis approach is capable of successfully addressing all key-aspects, mainly finding a technically feasible design for which the performance impact of reusability can be assessed. Non-linear dependencies of multiple-disciplines demand iterative numerical design and simulations. A fast, multi-disciplinary Reusable Launch Vehicle (RLV) pre-design approach is necessary for generating reliable datasets for the evaluation.

The systematic research needs to address first the different possible return modes for different separation conditions of reusable stages. Strongly diverging characteristic flight conditions and loads can be identified after MECO which have a significant impact on cost and operations of the RLV.

The paper compares the characteristic flight conditions of winged gliding stages with those of rocket-decelerated vertical landing vehicles. The focus is on the atmospheric reentry and potentially the return to launch site with evaluation of loads (local heatflux in critical areas, dynamic pressure, accelerations) and necessary propellant as well as dry mass.

Note: This paper is connected to another proposed DLR paper on EVALUATION OF FUTURE ARIANE REUSABLE VTOL BOOSTER STAGES.