SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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DYNAMIC SIMULATIONS OF MATRIX ATMOSPHERIC ENTRY CAPSULE TO MARS

Abstract

MATRIX stands for MARS TRANPORTATION for INNOVATIVE EXPLORATION. For manned missions to the surface of the Moon and of Mars, the operations in the vicinity of the destination planet exhibit strong similarities concerning the required velocity changes, the operational phases, staging options, and the expected duration of landing, ascent and rendezvous activities. Moon and Mars landing systems are therefore likely candidates for extensible design. The objectives for the work in this MATRIX EDLS project are based on the assumption that landing systems are going to be made extensible, at least to a certain degree. The paper deals with the aerodynamic analysis of an unmanned entry capsule system entering the Mars atmosphere with the aim to support planetary entry system design studies. The exploration vehicle is an axisymmetric 70 degree sphere cone shape body with a heat shield and backshell. Several fully three-dimensional computational fluid dynamics analyses have been performed to address the capsule aerodynamic performance. To this end, a wide range of flow conditions including reacting and nonreacting flow, different angles of attack, and mach numbers have been investigated and compared. Some, nonequilibrium effects on the flow field around the entry vehicle have also been investigated. Results show that real-gas effects, for all the angles of attack considered, increase both the aerodynamic drag and pitching moment whereas the lift is only slighted affected. Finally, results comparisons highlight that experimental and CFD aerodynamic findings available for the earlier Mars entry capsule in air adequately represent the static coefficients of the capsule in the Mars atmosphere. The selection of a different aero-shell shape for this Mars entry probe has been discussed. A description of its aerodynamics in hypersonic, supersonic and transonic regimes is verified. CFD is now truly enough for reliable use for entry bodies. It usually gives reduction of Wind Tunnel Testing Costs, Time Savings. In this paper we have utilize CFD-ANSYS for Entry Body Flow Prediction, Static Aerodynamic Coefficient derivation, localized Flow Effects, heat Flux Dynamic Coefficient derivation etc.