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AEROTHERMODYNAMICS AND EDL PERFORMANCE OF AN OPTIMAL DESIGN OF MANNED MARS ASCENT VEHICLE: A PLAN FOR SENDING HUMANS TO MARS

Abstract

This is an advanced optimal design of extensible manned Mars reentry vehicle under MATRIX project which stands for MARS TRANPORTATION for INNOVATIVE EXPLORATION. The project includes design phase, Mars atmospheric analyses phase, EDL Performance phase and safe landing phase of which only two phases have been discussed here. Interest in Mars Exploration receives increasing attention following the success of missions that implement the cheaper, faster and better design philosophy. The objectives for the work in this project are based on the fact that Red Planet is much more earth like than any other planet and is currently the best candidate for future human exploration and colonization which will make landing systems extensible, at least to a certain degree. The paper deals with the aerodynamic analysis of an optimal design of a manned entry capsule system entering the Mars atmosphere with the aim to support planetary entry design studies. The exploration vehicle is an axisymmetric 70 degree optimal spherically blunted cone shape forebody and specially designed aftbody with at least a space for three to four crew members. 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 non-reacting flow, different angles of attack, and Mach numbers have been investigated and compared. As aerodynamic heating is strongly influenced by real-gas thermochemical non equilibrium processes and surface catalytic effects, some non-equilibrium 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 design for this Mars entry probe has been discussed. A description of its aerodynamics in hypersonic, supersonic and subsonic 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 MATLAB and CFD-ANSYS for reentry trajectory, Entry Body Flow Prediction, Static Aerodynamic Coefficient derivation, localized Flow Effects, heat Flux Dynamic Coefficient derivation etc.