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RE-ASSESSMENT AND CFD ANALYSIS OF MARS AEROSHELL

Abstract

Aeroheating around hypersonic vehicle is a very critical phenomenon and should be taken into account during design of the hypersonic vehicles. High Temperature at high speed reentry vehicles, mars and lunar shuttle is very critical to predict and calculate from the structural and thermal point of view. Mars and Venus exploration programs are under progress. Speed of hypersonic vehicle is very high so causes highly chemically reacting flow which produce some other phenomena in the boundary layers. So heat flux should be taken into account. Entropy layer become very critical in boundary layer. Normally these configurations have cone cylinder and frustum body so recirculation zone and reattachment zone are very important to simulate and calculate the flow parameters. In this paper two dimensional and three dimensional hypersonic viscous flowfield around a half cylinder, cone and Mars Aeroshell have been simulated and analyzed to predict the flow parameters. Boundary layers and wake regions are specially simulated by using very high mesh density in the same region. Different angles of attack are used to study the flow behavior. In the first part of work two-dimensional geometries are simulated to study the hypersonic flows. Mach number 6 and 16.34 are simulated on cone and half cylinder to study the heat transfer and surface temperature variation. Three-dimensional simulations are performed to clarify the effect of high temperature phenomena on the aerodynamic characteristics of Mars aeroshell geometry. The calculated aerodynamic coefficients are compared with the experimental data obtained in the hypersonic wind tunnel test. At very high Mach number the flow is squeezed to the surface with low density flow and high temperature. Boundary layers are very thin and squeezed towards wall so create high temperature flow. Which causes flow species to react chemically and change the aerodynamics of flow and its effect on body.so Mars aeroshell is simulated against frozen flow assumption and chemical reactions are added to study the thermochemical effects on the body. Turbulent models and DES are used to simulate such type of hypersonic flow with chemical reactions.