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AERODYNAMIC STATIC STABILITY ANALYSIS OF MARS ENTRY VEHICLE

Abstract

Considering the Mars entry environment, an aerodynamic force prediction method was developed for blunt-body entry vehicle at different points of Mars entry orbit. The aerodynamic force prediction methods of different flow regimes were estimated, the numerical solution of the Navier-Stokes equations was employed in continuum flow regime, the equation of Maxwell balance distribution was adopt in free-molecule flow regime, and the aerodynamic forces in transition flow regime were estimated by using the bridging function technique. The aerodynamic force characteristics and flow fields of the Mars entry vehicle were calculated and analyzed in the Mars entry environment. The results indicated that the aerodynamic characteristics of the blunt-body basic shape of Mars entry vehicle is related to the Kn number of Martian atmosphere. In the higher altitude regime where Kn number is greater than 0.001, the variation of the aerodynamic characteristics is significant. In the low altitude regime, the Mars entry vehicle was longitudinal static stable when angle-of-attack is equal zero degree, and near angle-of-attack equal to one hundred and eighty degrees, along with the decreasing altitude the reversed static instability changed to reversed static stability.