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Aerodynamic Prediction and Performance Analysis for Mars Science Laboratory Entry Vehicle

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Abstract : Complex lifting entry was selected for precise landing performance during the Mars Science Laboratory entry. This study aims to develop the three-dimensional numerical method for precise computation and the surface panel method for rapid engineering prediction. Detailed flow field analysis for Mars exploration mission was performed by carrying on a series of fully three-dimensional Navier-Stokes computations. The static aerodynamic performance was then discussed, including the surface pressure, lift and drag coefficient, lift-to-drag ratio with the numerical and engineering method. Computation results shown that the shock layer is thin because of lower effective specific heat ratio, and that calculated results from both methods agree well with each other, and is consistent with the reference data. Aerodynamic performance analysis shows that CG location determines trim characteristics and pitch stability, and certain radially and axially shift of the CG location can alter the capsule lifting entry performance, which is of vital significance for the aerodynamic configuration des0ign and inner instrument layout of the Mars entry capsule.

Keywords : Mars entry capsule, static aerodynamics, computational fluid dynamics, hypersonic
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