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COMPUTATIONAL ANALYSIS OF THERMAL AND STRUCTURAL LOADS ON RE-ENTRY VEHICLES AND A CONCEPTUAL SSTO MODEL USING AN IN-HOUSE SOLVER CODE.

Abstract

It is known that during the re-entry phase of any launch vehicle maximum thermal and structural loads and stresses are experienced by the vehicle. This paper is about thermal and structural analysis and computation of re-entry vehicles using CFD (computational fluid dynamics) and using an in-house developed code for simulation purposes. Firstly the analysis is carried out by using RANS/LES hybrid model. After that the developed code was applied to RLV and SSTO. The code was developed using TAYLOR-GALERKIN method for discretization of the NAVIER-STOKES equations. The code was validated against different ideal situations like flow over a rotating cylinder, flow between a stationary plate and a moving plate. For real life conditions RLV configuration used is the Generic Spherical Capsule (GSC) re-entry configuration and an SSTO configuration is used. The SSTO design is a conceptual one and was developed keeping in mind two main functions, namely, for launching multiple satellites and also to take humans to space. In this code a new method has been incorporated for calculating the heat fluxes and thermal stresses. The conclusions reached from the analysis are:

1. The aerodynamic parameters obtained by using the code as the solver are in nice agreement with the values obtained from RANS/LES hybrid model. 2. The results obtained for the GSC using the in-house code was compared with established literature and were found to be within an acceptable range. 3. Further refinement of the code needs to be done for more complex problems and also for obtaining more accurate values.