

MATERIALS AND STRUCTURES SYMPOSIUM (C2)  
Space Structures 1 - Development and Verification (Space Vehicles and Components) (1)

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PREDICTION OF TRANSIENT SKIN TEMPERATURE OF HIGH SPEED VEHICLES THROUGH  
CFD

**Abstract**

Severe aerodynamic heating is experienced by vehicles flying at supersonic and hypersonic speeds. This aerodynamic heating can result in very high skin temperatures of the flight vehicle that can even cause mission failure. Hence a detailed knowledge of the aerodynamic heating load is essential for designing an appropriate thermal protection system. Although there is considerable knowledge in high speed aerothermodynamics but still uncertainties in the prediction of the transient skin temperatures exist. This paper describes the procedure which determines the transient skin temperatures of high speeds vehicles using CFD. Solid-Fluid Coupling and transient boundary condition capabilities of the CFD code are used to predict temperature transients. The available X-15 flight data for three different flight trajectories (flight A, B and C) are used for validation of the method. Laminar and turbulent computations are carried out to calculate temperature transients at wing mid-span chord location of X-15 and compared with the available in-flight data. The results obtained for skin temperatures at different locations are found both qualitatively and quantitatively in good agreement with in-flight data. This validates the methodology utilized in modeling the transient aero-thermal analysis of high speed vehicles. This method could be very useful in predicting the aerodynamic heating loads of other high speed vehicles.