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FLUID-THERMAL-STRUCTURAL MODELING AND ANALYSIS OF AN ADAPTIVE AEROSHELL STRUCTURE UNDER HYPERSONIC SPEED ENVELOPE

Abstract

An aeroshell has many critical design parameters within the spacecraft design that must be accounted for in order to provide mission success. The harsh environments associated with exo-atmospheric exposure and hypersonic atmospheric entry expose the vehicle to both very low and very high temperatures. This technical paper provides an innovative design of an adaptive structure which will work as an aeroshell as well as a nose cone, both during the launch re-entry phase. An investigation on a range of input parameters that may potentially make the incorporation of a Fluid-Thermal-Structural Interactions simulation essential, for the case of a 3D adaptive aeroshell structure in a hypersonic cruise flight, undergoing static structural deformation due to aerothermodynamic effects has been discussed. The adaptive aeroshell is designed for Earth-Martian atmospheres as a concept proposal, which has been analysed with both atmospheric parameters. The computational analysis assists with examining of the effect of varying parameters such as the Mach number, altitude, angle of attack and heating time. Results derived from solving the aerodynamic drag and terminal velocity ballistic coefficient has been thus presented.