Paper ID: 18756
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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Poster Session (P)

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EFFECT OF A MULTI-DISK AEROSPIKE ON THE AEROTHERMODYNAMICS OF A REENTRY CONFIGURATION

Abstract

The primary concern of any hypersonic vehicle design is the effective management of thermal loads and drag. This paper investigates the aerothermodynamics of a 60o sphere cone fitted axisymmetrically with a three disk aerospike at the nose. The scaled down model of the reentry vehicle has a base diameter of 100 mm and spherical nose of 25 mm while the diameter of the aerospike stem is 2 mm. The aerospike protruding out of the nose has one aerodisk cap at the end facing the freestream while other two aerodisks are inserted along the length of the aerospike. Aerospikes with either a hemispherical or flat plate aerodisk have an overall length to diameter ratio (l/D) of 1, 1.5, 2, 2.5 and 3. Transient, two dimensional axisymmetric Navier stokes equations are solved numerically using a commercially available code to obtain the total heat transfer rates, reattachment heat fluxes and aerodynamic drag for various spiked configurations at a freestream Mach No. 21.08 and a static pressure, altitude and temperature of 37.362 Pa, 55.842 km and 258.02 K respectively. The effect varying the diameters of aerodisks as well as the separation between them is also investigated and the results are compared with those for base configuration without spike. The gas used in this computation is air treated as weakly ionized chemically reacting mixture of seven species viz. O, N, NO, O2, N2, NO+ and e- with 24 elementary reactions. The results suggest that an optimal aerodisk design can provide favorable reductions in aerodynamics heating as well as drag.