Estimating Aeroheating of a 3D Body Using a 2D Flow Solver

Lyndon B. Johnson Space Center, Houston, Texas

A method for rapidly estimating the aeroheating, shear stress, and other properties of hypersonic flow about a three-dimensional (3D) blunt body has been devised. First, the geometry of the body is specified in Cartesian co-ordinates. The surface of the body is then described by its derivatives, coor-dinates, and principal curvatures. Next, previously relatively simple equa-tions are used to find, for each desired combination of angle of attack and meridional angle, a scaling factor and the shape of an equivalent axisymmet-ric body. These factors and equivalent shapes are entered as inputs into a pre-viously developed computer program that solves the two-dimensional (2D) equations of flow in a non-equilibrium viscous shock layer (VSL) about an ax-isymmetric body. The coordinates in the output of the VSL code are trans-formed back to the Cartesian coordi-nates of the 3D body, so that computed flow quantities can be registered with locations in the 3D flow field of inter-est. In tests in which the 3D bodies were elliptic paraboloids, the estimates obtained by use of this method were found to agree well with solutions of 3D, finite-rate-chemistry, thin-VSL equations for a catalytic body.