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Hypersonic Air-breathing and Combined Cycle Propulsion, and Hypersonic Vehicle (7)

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NAVIER-STOKES COMPUTATION OF HEAT TRANSFER AND AERO-HEATING MODELING FOR HYPERSONIC WAVERIDER VEHICLES

Abstract

Flight at hypersonic Mach numbers have been area of interest since the World War II, when jet engines were used for the first time. In the quest to reach highest velocities, many hypersonic vehicles have been designed and tested. Although a great progress has been made in this area, however, some of the vital aspects are yet to be solved, one of them being the lift to drag barrier. Wave and skin friction drag will increase drastically for any vehicle flying at such high Mach numbers, making it difficult to obtain a high lift to drag ratio. A promising candidate for solution of this problem is the waverider configuration. Essentially, a waverider is that supersonic or hypersonic vehicle that has an attached shock wave at its leading edge when flying at design Mach number. Because of this, the vehicle appears to be riding on top of the shock, hence the name – waverider. In this study, a simple technique for designing the waverider in two different flow fields has been numerically investigated using the Fluent. A right circular and an elliptical cone is used to generate two different supersonic axisymmetric flows over the bodies at Mach 6. A fourth order polynomial is used to describe the trailing edge curvature of the waveriders at their respective base plane. It is observed that, the waveriders thus obtained has an attached shock wave on the leading edge unlike in conventional hypersonic vehicles, where shock wave is generally detached from the leading edge. This creates a high pressure downstream of the shock, beneath the vehicle, which prevents the leakage from bottom to top surface. Consequently, the flow field at bottom surface is contained and high pressure is conserved.