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ASSESSMENT OF SHOCK/BOUNDARY-LAYER INTERACTIONS IN HYPERSONIC INTAKE

Abstract

Interactions of shock waves with boundary layer inside supersonic/hypersonic intake is an important topic of research due to their ubiquity in high-speed flow. The repercussion of Shock/Boundary-Layer Interactions (SBLIs) is a huge loss of total pressure, generation of large separation bubble, enormous temperature rise, high fluctuation of pressure and temperature. Particularly, in the hypersonic flow domain, the interactions are severe, reducing engine performance and sometimes leading to engine failure. Therefore, the SBLI phenomenon in the hypersonic intake needs to be thoroughly studied to estimate the consequences of SBLI correctly. Keeping this into mind, the present study computationally evaluates the SBLI phenomenon inside hypersonic intakes using commercial finite volume solver Ansys Fluent. As a qualitative observation, the shock structure inside the hypersonic intake is presented. The static pressure and temperature contour over the computational domain are shown. Moreover, the surface pressure over the ramp and the cowl surface is examined at Mach 5.7 and Mach 7 intake. On the other hand, the static temperatures over the ramp surface of Mach 5.7 and Mach 7 intake are compared. It is interesting to note that, though the cowl corner experiences the maximum wall pressure; however, the separation bubble is not observed at that location. Instead, the separation bubble is formed over the ramp surface, where the wall peak pressure reaches its second maxima. The wall pressure is higher at a higher Mach number which is essentially due to higher shock strength at higher hypersonic speed. The profile of static temperature reveals that the wall temperature is maximum near the cowl corner shock impingement point. It is interesting to note that the wall temperature is higher over the ramp surface. Besides, the wall temperature is higher at a higher Mach number.