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NUMERICAL INVESTIGATIONS OF FUEL INJECTION TECHNIQUES IN A CAVITY-BASED SCRAMJET

Abstract

In this paper, the location, the angle and the shape of fuel injectors, has been numerically investigated in a cavity-based scramjet in order to provide a extensive analysis of the scramjet performance for different injection techniques. The reference test case investigated is the experimental setup of a cavity-based scramjet tested by prof. Jayaraman. Numerical suimulations have been performed and validated with these experimental data. Simulations have shown that the cavity-based injection impacts the periodic shedding of lateral vortices and drastically boost the mixing rate and the combustion efficiency. Cavities have also shown to decrease the stagnation pressure losses. For the axisymmetric cavity-based scramjet the thermal choking was observed when the fuel ratio increased above 0.5. In order to avoid the thermal chocking, the effect of a divergent combustion chamber was also investigated and a minimum angle of divergence has been found.

Numerical results showed that 30 degree upstream and 45 degree injection into cavity have good result in terms of water and temperature distribution throughout the cavity and into the coreflow. Total pressure losses have been also found the lowest for this configuration.