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Title

Numerical simulation of the effect of different divergent angle of pylon

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Abstract

Scramjet is the future of high-speed transportation and reusable launch vehicle for satellite placement. However, the combustion of fuel at a supersonic speed is challenging. Since the combustion occurs at the supersonic velocity, the retention time for the proper mixing of air and fuel is less. The present study focuses on the effect of fuel injection with pylon placed downstream of the cavity to enhance the mixing of air and fuel. Cavity-type scramjet combustors are based on the cavities mounted on the walls of the combustion chamber that creates a recirculation region, which increases the residual time for air and fuel mixing. Gruber et al. [1] conducted experimental and numerical studies on a variety of cavity-type flame holding techniques. Different ramp angles and offset ratios were chosen to examine the flowfield. It was observed that as the aft ramp angle was decreased, the flow was observed to be more stable and two-dimensional, however, the residual time decreased and drag increased. Hsu et al. [2] conducted an experimental study with a strut and cavity-based fuel injection. It was observed that keeping strut at the upstream of the cavity led to successful combustion at the wake region of the strut. Verma and Vaidyanathan [3] conducted an experimental study on the pylon with liquid jet spray in a supersonic flow. Acetone was injected in the vertical direction in the wake of the pylon. Three different heights and injection angles were examined. It was observed that the pylon's height had a significant effect on the penetration height and jet breakup. It was also observed that angled injection had better jet spread and penetration height in comparison to vertical injection. It was noted that there is a limited study conducted using cavity-pylon based scramjet combustion. The effect of different divergent angle of the pylon has been taken into consideration in the present study. Hybrid RANS/LES simulation is conducted using an improved delayed detached eddy simulation (IDDES) turbulence model [4]. The cavity-based combustor is taken as a benchmark to validate the code. The mixing efficiency is highly affected by the downstream placement of the pylon. It was noted that the Further analysis is conducted using dynamic mode decomposition (DMD) [5].

References

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