Paper ID: 64922
student

49th STUDENT CONFERENCE (E2)
Student Conference - Part 2 (2)

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DESIGN AND NUMERICAL STUDY OF TIMING SCREW FASHIONED SCRAMJET COMBUSTOR

Abstract

The scramjet's performance is closely related to the mixing rate of the combustion zone. In the present article, numerical investigations were used for inspecting the effect of timing-screw fashioned scramjet combustor on mixing of injected hydrogen with supersonic cross-flow. The main purpose of this paper is to demonstrate the role of various timing screw design features on the reacting flow structure and its streamline pattern. 3D models have been chosen for simulating the flow and Navier-stocks equations have been solved with the equations of energy and species mass transfer to determine the hydrogen jet mix rate. Furthermore, Shear Stress Transport (SST) based K-ω turbulence model is employed to accurately elucidate both the near-wall and far-wall regions of the flow domain. The frequency of lands and pockets is one of the important features of the design which augments the mixing rate of the injected hydrogen but combustion efficiency and total pressure recovery are declined to some extent. After extensive parametric investigations, the final design has a mixing rate and combustion efficiency are 35.47% and 24.60%, respectively, more than an existing cavity-based scramjet combustor. Also, the effect of hydrogen jet total pressure on the flow is exclusively studied for the final design.