Numerical Investigations on Mixing and Combustion in Scramjet Engine Combustion Chambers using Strut Injectors

Rapid mixing of supersonic streams is vital in many advanced aerospace systems and the importance of the same is increasingly appreciated because of the renewed interest in hypersonic flight, which necessitates combined cycle propulsion systems at high altitudes. In the air-breathing stage of the hypersonic vehicles, the performance of the conventional ramjet engine falls below unacceptable level due to dissociation and shock losses, which necessitates the introduction of supersonic combustion ramjet engine called Scramjet engine. The most challenging part of scramjet technology is the design and development of the supersonic combustor. The rapid mixing of air and fuel issuing at high speed within a short combustor with acceptable stagnation pressure loss and effective flame stabilization is the fundamental constraint in the design of supersonic combustor. The fuel injection system for supersonic combustion systems has been studied for decades with the objective of proper mixing and complete combustion. To achieve fuel injection in the supersonic core region, strut injections have been used to improve fuel distribution and mixing.

The present research work focusses on the various strut injection schemes in a 2D combustors under non-reacting and reacting flow fields. The numerical code of the study will be validated with the experimental data. The analysis will be done using the commercially available AnsysFluent software. The key parameters include, wall pressures, midline pressures, qualitative and quantitative mixing, combustion efficiency, and the total pressure loss across the combustor. The results of the study would be useful for supersonic combustion applications.

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