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THE NUMERICAL SIMULATION OF A STAGED TRANSVERSE INJECTION BEHIND A REARWARD FACING STEP INTO A MACH 2 STREAM IN A CONFINED ENVIRONMENT AND ITS APPLICATION IN THE DEVELOPMENT OF SCRAMJET TECHNOLOGY

Abstract

The primary aim in this paper is to carry out the numerical simulation of a staged transverse injection behind a rearward facing step into a Mach 2 stream in a confined environment. This problem has been investigated experimentally by McDaniel et al. And the same conditions have been recreated for the numerical simulation. An extensive and in-depth comparison of the numerical predictions with the experimental results has been presented through plots of various flow parameters at different locations in the test section. The numerical results show an excellent agreement with the experimental results. Deviations from the experimental results are also observed in some scenarios due to the inability of the numerical schemes to capture the effects of shocks and expansion fans. Efforts to study the nature and cause of these deviations have also been made. An optimal gridding strategy is evolved and implemented using the commercially available software Gambit.This particular cold flow mixing problem has been completely analysed and has been solved numerically using k-omega (SST) and realizable k-epsilon viscous models. The grid independence test has also been performed confirming convergence of the numerical result. The flow parameters have been analysed and plotted for both with and without injection cases. The mixing has been performed using both with and without species utility of the CFD software Fluent. Scramjet technology is in its research and development stage. And this technology guarantees a revolution in the aerospace industry and would open to us a new mode of hypersonic transport. The main focus of this paper is to try to understand the mixing of the fuel and air in the combustion chamber. Good mixing is the most important prerequisite for good combustion. The central focus has been laid on trying to understand the staged transverse injection technique of mixing.