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Non-Reacting Numerical Simulation of Axisymmetric Trapped Vortex Combustor

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Abstract : This paper will focus on the suitability of a trapped vortex combustor as a candidate for gas turbine combustor objectives to minimize pressure drop across the combustor and investigate aerodynamic performance. Non-reacting simulation of axisymmetric cavity trapped vortex combustors were simulated to investigate the pressure drop for various cavity aspect ratios of 0.3, 0.6, and 1 and for air mass flow rates of 14 m/s, 28 m/s, and 42 m/s. A numerical study of an axisymmetric trapped vortex combustor was carried out by using two-dimensional and three-dimensional computational domains. A comparison study was conducted between Reynolds Averaged Navier Stokes (RANS) k-ε Realizable with enhanced wall treatment and RANS k-ω Shear Stress Transport (SST) models to find the most suitable turbulence model. It was found that the k-ω SST model gives relatively close results to experimental outcomes. The numerical results were validated and showed good agreement with the experimental data. Pressure drop rises with increasing air mass flow rate, and the lowest pressure drop was observed at 0.6 cavity aspect ratio for all air mass flow rates tested, which agrees with the experimental outcome. A mixing enhancement study showed that 30-degree angle air injectors provide improved fuel-air mixing.

Keywords : aerodynamic, computational fluid dynamics, propulsion, trapped vortex combustor
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