

Large eddy simulation and preliminary modeling of the flow downstream a variable geometry swirler for gas turbine combustors

Abstract:

This work presents a novel swirler with variable blade configuration for gas turbine combustors and industrial burners. The flow dynamics downstream the swirler was explored using Large Eddy Simulation (LES). The resolved turbulence kinetic energy in the region where the flow exhibits the main flow phenomena was well above 80% of the total turbulent kinetic energy of the flow. It was evidently shown that the new swirler produces a central recirculation zone and a Rankine vortex structure which are necessary for swirl flame stabilization. Two Reynolds-averaged NavierStokes (RANS) simulation cases utilizing the standard and realizable k- ϵ turbulence models were also conducted for two objectives. The first is to demonstrate the validity of RANS/eddy-viscosity models in predicting the main characteristics of swirling flows with comparison to the LES results. The second objective is to comparatively investigate the flow features downstream the new swirler in both co-rotating and counter-rotating blade configurations. The results show that the counter-rotating configuration produces higher turbulence kinetic energy and more compact recirculation zone compared to the co-rotating configuration.