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Modeling and Simulation of Swirl Stabilized Turbulent Non-Premixed Flames[1] SALVADOR BADILLO-RIOS, ANN KARAGOZIAN, UCLA

— Flame stabilization is an important design criterion for many combustion chambers, especially at lean conditions and/or high power output, where insufficient stabilization can result in dangerous oscillations and noisy or damaged combustors. At high flow rates, swirling flow can offer a suitable stabilization mechanism, although understanding the dynamics of swirl-stabilized turbulent flames remains a significant challenge. Utilizing the General Equation and Mesh Solver (GEMS) code, which solves the Navier-Stokes equations along with the energy equation and five species equations, 2D axisymmetric and full 3D parametric studies and simulations are performed to guide the design and development of an experimental swirl combustor configuration and to study the effects of swirl on statistically stationary combustion. Results show that as the momentum of air is directed into the inner air inlet rather than the outer inlet of the swirl combustor, the central recirculating region becomes stronger and more unsteady, improving mixing and burning efficiency in that region. A high temperature region is found to occur as a result of burning of the trapped fuel from the central toroidal vortex. The effects of other parameters on flowfield and flame-stabilization dynamics are explored.

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