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Effects of Swirl on Strongly-Pulsed Turbulent Diffusion Flames
Y.-H. LIAO, J.C. HERMANSON, University of Washington — The dynamics of large-scale structures in strongly-pulsed, swirling, turbulent jet diffusion flames were examined experimentally. The combustor used a combination of axial and tangentially-injected air to produce a range of swirl numbers. Gaseous ethylene fuel was injected through a 2 mm diameter nozzle on the combustor centerline with a jet-on Reynolds number of 5000. The flames were fully-modulated, with the fuel flow completely shut off between pulses. High-speed imaging of the flame luminosity was employed to examine the flame dimensions and the celerity of the large-scale flame structures. The flames were found to be approximately 15-20% shorter when swirl was imposed, depending on the injection time. The more compact flames in swirl appear to be due to the presence of recirculation inside the flames. For longer injection times, the celerity of the flame structures generally decreases as the swirl intensity increases. This is evidently due to the reversed velocity in the recirculation zone. For shorter injection times, the flame celerity has an increasing trend with increased swirl intensity due to flames being closer to the fuel nozzle at burnout.

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