The prevalence of gas turbines operating in primarily lean premixed modes is predicated on the need for lower emissions and increased efficiency. An enhancement in the mixing process through the introduction of swirl in the combustion reactants is also necessary for flame stabilization. The resulting lean swirling flames can be characterized by a susceptibility to feedback between velocity, pressure and heat release perturbations with a potential for unstable self-amplifying dynamics.

The presentation will focus on recent results from the investigation of swirl-stabilized non-premixed atmospheric flames subjected to acoustic perturbations. This study is motivated by the increasing potential for a wider application of non-premixed flame configurations particularly for future biofuel based gas turbines. Experimental data based on CH\* chemiluminescence intensities, CCD imaging and phase locked data acquisition will be examined. Results will be interpreted for requirements between velocity, heat release and pressure perturbations in highly responsive flame configurations. Analogies to existing literature on premixed flames in the context of acoustic impedance, Rayleigh criterion and phase-conditioned analysis will be presented. Finally, Particle Image Velocity (PIV) measurements are used to discuss the fluid mechanics induced by acoustic forcing in non-premixed flames with varying swirl intensities.

Major: Mechanical Engineering

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Approved for distribution by Dr. Saptarshi Basu, Committee Chair, on April 15, 2010.

The public is welcome to attend.