Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Analysis of Premixed Flame Response and Rayleigh Criterion through a Novel Flame Transfer Function VIJAYA KRISHNA RANI, SARMA RANI, Univ of Alabama - Huntsville — Linear modal analysis of combustion instabilities requires a flame transfer function which describes the flame heat-release response to acoustic perturbations. In this study, a novel flame transfer function (FTF) is developed that provides an explicit relationship between heat-release and pressure fluctuations for laminar premixed flames. While the FTF is generalized for any mean flame shape, a triangular mean flame stabilized at the cross-sectional interface of a dump combustor is analyzed. For this flame, the effects on the FTF magnitude and phase of the acoustic frequency, location (on the mean flame), modal index, and the mean Mach number are investigated. To illustrate and analyze the Rayleigh's criterion, the spatio-temporal integral of the correlation of pressure and heat-release fluctuations is calculated. It is found that the magnitude of the FTF shows harmonic-like oscillations whose amplitude decreases with frequency, suggesting that the flame shows preferential response to certain frequencies than others. The oscillatory behavior becomes increasingly prominent as one moves away from the flame anchoring point(s). Finally, evaluation of the Rayleigh integral clearly demonstrates the flame-acoustic phase shifts at which combustion instability may arise.

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Date submitted: 22 Jul 2015 Electronic form version 1.4