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Thermoacoustic Response of Counterflow Diffusion Flames
MATTHEW YAO, GUILLAUME BLANQUART, Caltech — Thermoacoustic instabilities in combustors result from a favorable coupling between the unsteady heat release of the flame and the acoustic pressure field. These instabilities can lead to deleterious effects such as excessive noise and mechanical fatigue. In this work, we study the thermoacoustic response of counter flow diffusion flames. Using a fully compressible formulation and detailed chemistry, we perturb the flame with acoustic oscillations and measure the response in terms of the gain and phase of notable quantities, such as the heat release rate. Compared to typical low Mach formulations, the fully compressible formulation allows for the consideration of the hydrodynamic effects of the spatially varying pressure field in conjunction with the thermodynamic response. A wide range of frequencies are tested, and the behavior of the flame at both ends of the spectrum are characterized. The transmission and reflection of acoustic waves by the flame is also discussed.

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