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Forced Response of Globally Unstable Reacting Wakes BENJAMIN EMERSON, TIM LIEUWEN, Georgia Inst of Tech — In many practical combustors, a flame is stabilized in the confined wake of a bluff body. In such devices, the flame's dynamics and its unsteady heat release are strongly governed by the fluid dynamics of the bluff body shear layers and wake. This unsteady heat release can couple with an acoustic mode of the combustor to cause a troublesome self-excited oscillation known as combustion instability. This coupling often occurs through the fluid dynamics, where the flame is dynamically wrinkled by acoustically excited vortical structures in the wake. This study experimentally investigates the acoustically excited hydrodynamic response of reacting bluff body wakes using time resolved PIV and chemiluminescence. The focus of the study is to understand how the flow responds to a varicose excitation on top of its globally unstable sinuous mode. In the experiment, the varicose mode is externally excited through harmonic, longitudinal acoustic forcing. The results show a varicose response. However, when forcing near the global mode frequency, the symmetrically arranged structures composing the varicose response quickly stagger to form a rapidly growing sinuous response. This resonant amplification of the sinuous mode is explained using linear spatial stability analysis and a bispectral analysis of the sinuous-varicose interaction.

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