Abstract Submitted
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Forced synchronization of thermoacoustic oscillations in a ducted flame[1] YU GUAN, VIKRANT GUPTA, The Hong Kong University of Science and Technology, KARTHIK KASHINATH, Lawrence Berkeley National Lab, LARRY K.B. LI, The Hong Kong University of Science and Technology — Forced synchronization is a process in which a self-excited system subjected to external forcing starts to oscillate at the forcing frequency f_f in place of its own natural frequency f_n. There are two motivations for studying this in thermoacoustics: (i) to determine how external forcing could be used to control thermoacoustic oscillations, which are harmful to many combustors; and (ii) to better understand the nonlinear interactions between self-excited hydrodynamic and thermoacoustic oscillations. In this experimental study, we examine the response of a ducted premixed flame to harmonic acoustic forcing, for two natural states of the system: (1) a state with periodic oscillations at f_1 and a marginally stable mode at f_2; and (2) a state with quasiperiodic oscillations at two incommensurate frequencies f_1 and f_2. When forcing the periodic state, we find that the forcing amplitude required for lock-in increases linearly with $|f_f - f_1|$ and that the marginally stable mode becomes excited when $f_f \approx f_2$. When forcing the quasiperiodic state, we find that the system locks into the forcing when $f_f \approx f_1$ or f_2 or $1/2(f_1 + f_2)$. These findings should lead to improved control of periodic and aperiodic thermoacoustic oscillations in combustors.

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