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Open-loop control of quasiperiodic thermoacoustic oscillations[1]
YU GUAN, The Hong Kong University of Science and Technology, VIKRANT GUPTA, South University of Science and Technology of China, KARTHIK KASHINATH, Lawrence Berkeley National Laboratory, LARRY K.B. LI, The Hong Kong University of Science and Technology — The open-loop application of periodic acoustic forcing has been shown to be a potentially effective strategy for controlling periodic thermoacoustic oscillations, but its effectiveness on aperiodic thermoacoustic oscillations is less clear. In this experimental study, we apply periodic acoustic forcing to a ducted premixed flame oscillating quasiperiodically at two incommensurate natural frequencies, f_1 and f_2. We find that (i) above a critical forcing amplitude, the system locks into the forcing by oscillating only at the forcing frequency f_f, producing a closed periodic orbit in phase space with no evidence of the original T^2 torus attractor; (ii) the critical forcing amplitude required for lock-in decreases as f_f approaches either f_1 or f_2, resulting in characteristic $\vee$-shaped lock-in boundaries around the two natural modes; and (iii) for a wide range of forcing frequencies, the system's oscillation amplitude can be reduced to less than 20% of that of the unforced system. These findings show that the open-loop application of periodic acoustic forcing can be an effective strategy for controlling aperiodic thermoacoustic oscillations.

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Yu Guan
The Hong Kong University of Science and Technology

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