Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Forced synchronization and asynchronous quenching in a thermo-acoustic system SIRSHENDU MONDAL, SAMADHAN A PAWAR, RAMAN SUJITH, Indian Institute of Technology Madras, India — Forced synchronization, which has been extensively studied in theory and experiments, occurs through two different mechanisms known as phase locking and asynchronous quenching. The latter indicates the suppression of oscillation amplitude. In most practical combustion systems such as gas turbine engines, the main concern is high amplitude pressure oscillations, known as thermo-acoustic instability. Thermo-acoustic instability is undesirable and needs to be suppressed because of its damaging consequences to an engine. In the present study, a systematic experimental investigation of forced synchronization is performed in a prototypical thermo-acoustic system, a Rijke tube, in its limit cycle operation. Further, we show a qualitatively similar behavior using a reduced order model. In the phase locking region, the simultaneous occurrence of synchronization and resonant amplification leads to high amplitude pressure oscillations. However, a reduction in the amplitude of natural oscillations by about 78% of the unforced amplitude is observed when the forcing frequency is far lower than the natural frequency. This shows the possibility of suppression of the oscillation amplitude through asynchronous quenching in thermo-acoustic systems.

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Date submitted: 20 Jul 2017 Electronic form version 1.4