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Forced and mutual synchronization of periodic and aperiodic oscillations in a self-excited thermoacoustic system[1] YU GUAN, The Hong Kong University of Science and Technology, VIKRANT GUPTA, Southern University of Science and Technology, LARRY K.B. LI, The Hong Kong University of Science and Technology — Recent studies have shown that external forcing is effective in controlling both periodic and aperiodic thermoacoustic oscillations. We examine the mutual synchronization of pressure (p') and heat-release-rate (q') fluctuations in a prototypical thermoacoustic system undergoing forced synchronization by periodic acoustic forcing. When unforced, the system can oscillate periodically, quasiperiodically or chaotically. For all three types of oscillations, we find several common features, including (i) the presence of a T^2 quasiperiodic state before lock-in in which asynchronous quenching occurs without mutual synchronization between p' and q', (ii) the emergence of synchronization between p', q' and the forcing signal at lock-in, and (iii) the destruction of synchronization beyond lock-in. As well as providing new insight into the way external forcing affects the mutual synchronization of p' and q', this study shows that, regardless of its initial unforced state, a thermoacoustic system synchronized to external forcing does not necessarily remain synchronized if the forcing becomes too strong. For effective control, this implies that the forcing amplitude should be limited to a value just sufficient to cause the onset of lock-in.

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