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Pattern formation on a two-dimensional flame front during thermoacoustic instability

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Thermoacoustic instability is an undesirable phenomenon observed in a system where confined combustion takes place. It is most commonly seen in system such as land based gas turbine and aero-engine combustors. It occurs due to nonlinear interaction between the unsteady combustion process and the acoustic field of the confinement and is manifested as self-excited acoustic and heat release rate oscillations. Such oscillations can be fatal for the structural integrity of the entire system. Nonlinear dynamics of thermoacoustic oscillationsbifurcations, bistability, and chaosoriginates from the flame. Accordingly, flame front dynamics, particularly in the presence of an acoustic field, is an important ongoing study. We conducted experiments on self-excited thermoacoustic instability involving a ducted two dimensional premixed flame stabilized on a perforated burner plate. On changing the fuel flow rates in the system we found that system undergoes subcritical Hopf bifurcation to limit cycle oscillations. On further variation in the parameter changes in the dynamical nature of the oscillations were observed. Interestingly, these changes were accompanied by pattern formation on this thin flame front; the appearance of the pattern resembles Faraday instability. We investigate the pattern formation to identify responsible mechanisms.