Influence of heat loss on the stability of oscillatory modes in combustion wave propagation

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The propagation of planar combustion waves in non-adiabatic model with two-step chain-branching reaction mechanism is investigated. The travelling combustion wave becomes unstable with respect to pulsating instabilities as the critical parameter values for the Hopf bifurcation are crossed in the parameter space. The Hopf bifurcation is demonstrated to be of a supercritical nature and it gives rise to periodic pulsating combustion waves as the neutral stability boundary is crossed. Further increase of the bifurcation parameter leads to the period-doubling bifurcation cascade and a chaotic regime of combustion wave propagation. In the absence of heat losses in the chaotic region, regular windows of period 5, 6, and 7 are observed. The period 3 window is not reached due to flame extinction. The heat losses are shown to modify the location of critical parameter values for the Hopf and period doubling bifurcations in the parameter space. However, the most important impact of the heat losses is that the region of chaotic dynamics is significantly shortened and extinction of combustion wave is promoted.

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