Flame Acceleration and Transition to Detonation in Channels[1]
GABRIEL GOODWIN, RYAN HOUIM, ELAINE ORAN, Univ of Maryland-College Park — Two-dimensional numerical simulations of a confined, homogeneous, chemically reactive gas were used to compute and catalog interactions leading to deflagration-to-detonation transition (DDT). The geometrical configuration was a long rectangular channel with regularly spaced obstacles and adiabatic boundary conditions on all of the surfaces. The channel contained a stoichiometric mixture of ethylene-oxygen at 300 K and one atm that was ignited with a circular flame. The reactive Navier-Stokes equations were solved on an adapting grid by a high-order Godunov algorithm. The channel height was fixed at 0.32 cm and obstacle heights created blockage ratios ranging from 0.8 to 0.05, where the blockage ratio is defined as the obstacle height divided by the channel height. The computations show the development of a turbulent flame, the creation of shocks, shock-flame interactions, and a host of fluid and chemical-fluid instabilities. The result is an accelerating flame and eventual DDT in unburned, but shock-heated, material. Several DDT mechanisms were observed; these will be shown and discussed, with an emphasis on several new observations related to shock interactions.

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Date submitted: 27 Jul 2015   Electronic form version 1.4