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Shock induced ignition and DDT in the presence of mechanically driven fluctuations[1] WENTIAN WANG, JAMES G. MCDONALD, MATEI I. RADULESCU, University of Ottawa — The present study addresses the problem of shock induced ignition and transition to detonation in the presence of mechanical and thermal fluctuations. These departures from a homogeneous medium are of significant importance in practical situations, where such fluctuations may promote hot-spot ignition and favor the flame transition to detonation. The problem is studied in 1D, where a piston-induced shock ignites the gas. The fluctuations in the shock-compressed medium are controlled by allowing the pistons speed to oscillate around a mean, with controllable frequency and amplitude. A Lagrangian numerical formulation is used, which allows to treat exactly the transient boundary condition at the piston head. The hydrodynamic solver is coupled with the reactive dynamics of the gas using Cantera. The code was verified by comparison with steady state ZND solutions and previous shock induced ignition results in homogeneous media. Results obtained for different fuels illustrate the strong relation of the DDT amplification length to mechanical fluctuations in systems with a high effective activation energy and fast rate of energy deposition, consistent with experiments performed on fast flame acceleration in the presence of strong mechanical perturbations.

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