Abstract Submitted
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Dynamics of galloping detonations: inert hydrodynamics with pulsed energy release[1] MATEI I. RADULESCU, University of Ottawa, JOSEPH E. SHEPHERD, Caltech — Previous models for galloping and cellular detonations of Ulyanitski, Vasil'ev and Higgins assume that the unit shock decay or cell can be modeled by Taylor-Sedov blast waves. We revisit this concept for galloping detonations, which we model as purely inert hydrodynamics with periodically pulsed energy deposition. At periodic time intervals, the chemical energy of the non-reacted gas accumulating between the lead shock and the contact surface separating reacted and non reacted gas is released nearly instantaneously. In between these pulses, the gas evolves as an inert medium. The resulting response of the gas to the periodic forcing is a sudden gain in pressure followed by mechanical relaxation accompanied by strong shock waves driven both forward and backwards. It is shown that the decay of the lead shock in-between pulses follows an exponential decay, whose time constant is controlled by the frequency of the energy deposition. More-over, the average speed of the lead shock is found to agree within 2 percent to the ideal Chapman-Jouguet value, while the large scale dynamics of the wave follows closely the ideal wave form of a CJ wave trailed by a Taylor expansion. When friction and heat losses are accounted for, velocity deficits are predicted, consistent with experiment.

[1]work performed while MIR was on sabbatical at Caltech

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