Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Capturing the Dynamics of Unsteady Inviscid and Viscous Hydrogen-Air Detonations CHRISTOPHER ROMICK[1], University of Notre Dame, TARIQ ASLAM[2], Los Alamos National Laboratory, JOSEPH POWERS[3], University of Notre Dame — We consider the calculation of one-dimensional unsteady detonation in a mixture of calorically imperfect ideal gases with detailed kinetics. Both inviscid and viscous detonations of an initially stoichiometric hydrogen-air mixture at ambient conditions of 293.15 K and 0.421 atm are considered using a chemical mechanism composed of 19 reversible reactions, containing 9 species and 3 elements. The use of detailed kinetics introduces multiple reaction length scales, and their interaction gives rise to complex dynamics. In the inviscid limit, both shock-capturing and shock-fitting are used on a uniform grid. The diffusive behavior is predicted using a wavelet-based adaptive mesh refinement technique and includes multi-component species, momentum, and energy diffusion, as well as DuFour and Soret effects. In the inviscid limit when using shock-capturing, finer resolutions are necessary to accurately capture the dynamics in the unstable regime than when using shock-fitting. At the resolutions necessary for accurate shock-capturing, diffusion can play a crucial role in determining the overall behavior. Near the neutral stability point, the addition of physical diffusions dampens the amplitude of oscillations significantly.

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Date submitted: 03 Aug 2012 Electronic form version 1.4