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Emergence of detonation in the flowfield induced by Richtmyer-Meshkov instability

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Combustible mixtures of gases can support two steady modes of combustion, namely deflagration and detonation. Under certain conditions a relatively low speed deflagration can accelerate to form a supersonic detonation wave, a process referred to as *deflagration to detonation transition* (DDT). Whilst the behaviour of steady deflagrations and detonations is reasonably well understood, there are many gaps in our understanding of the nature of the transition mechanism.

The aim of this research is to investigate the transition process, i.e. the reasons behind the change of propagation mechanism from the advection/reaction/diffusion mode of a deflagration, to the coupled shock/reaction system of a detonation wave and in particular the role of interfacial instabilities. To this end, the effect of the Richtmyer-Meshkov instability arising from the interaction of a shock wave with a flame has been studied by means of Implicit Large Eddy Simulations. Transition to detonation is shown to take place in the neighbourhood of localised temperature perturbations (hot-spots). Finally, the character of the interim combustion-driven waves arising from these hot-spots is analysed.

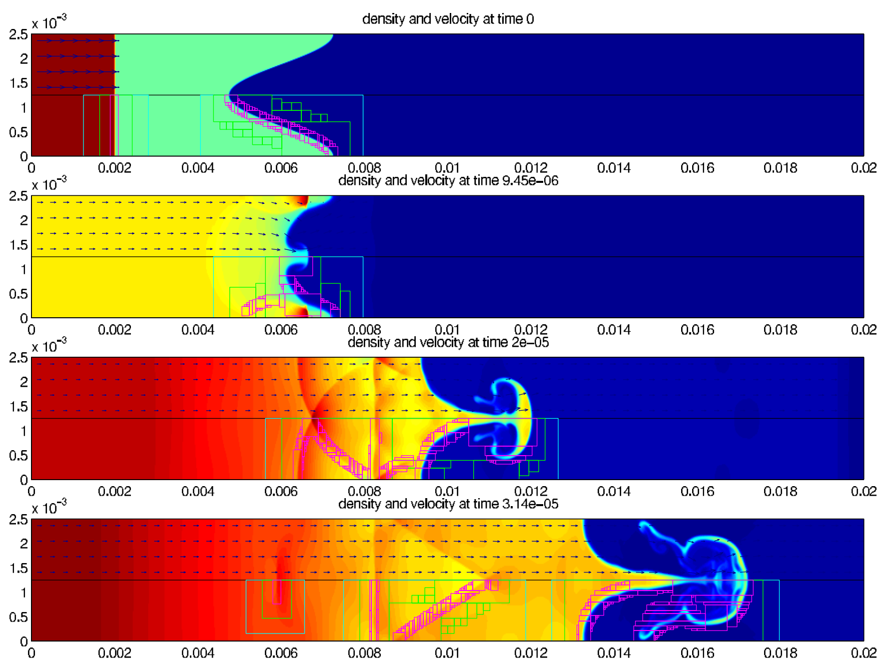

Figure 1: Richtmyer-Meshkov instability induced by the acceleration of a deflagration by a weak shock wave; density and velocity vectors shown. Numerical results using a TVD scheme coupled with adaptive mesh refinement; the boxes denote levels of refinement.