

Shock tube Richtmyer-Meshkov experiments: inverse chevron and half height

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This paper reports results from two Richtmyer-Meshkov instability (RMI) shock tube experiments. The first features an inverse chevron perturbation and the second consists of a half height dense gas region.

The experiments were conducted on the AWE's 200 x 100 mm shock tube with a shock Mach number of 1.26 (70kPa overpressure). Both configurations involved a three zone test cell arrangement of air / dense gas / air all initially at atmospheric pressure. Using sulphur hexafluoride (SF₆) as the dense gas yielded an Atwood number of 0.67. Gas separation was by means of profiled windows and fine wire meshes supporting microfilm membranes. Visualisation of the mixing was by laser sheet illumination of the dense gas seeded with an olive oil aerosol. A pulsed laser allowed a drum camera to record over 50 images of the mixing process augmented by an Intensified CCD (ICCD) camera capturing a single image per experiment.

The inverse chevron was on the downstream membrane with a central obtuse angle of 157° and amplitude 20mm. This is complimentary to the chevron presented at the previous workshop (Smith et al., 2001) and is related to the inclined interface experiments initiated at the 5th meeting of this workshop (Bashurov et al., 1995).

The half height experiment was significantly different from previous experimental configurations which involved perturbations on otherwise plane interfaces. In this case the central, dense gas region of the test cell was filled to halfway (100mm high) with seeded dense gas. The interfaces to either side feature microfilm membranes and were plane, whereas the top interface was membraneless and is nominally plane. This then introduced a Kelvin-Helmholtz instability to the experiment.

Sample laser sheet images from each experimental configuration are compared to corresponding code images from the AWE TURMOIL 3D LES model. A qualitative comparison between experimental and code images is presented. Quantitative analysis in the form of line-outs through both sets of images are included and substantial agreement on large scale features is demonstrated.

A time sequence is included on this proceedings CD/DVD for each experiment to allow improved visualisation of the mixing history.

References

Bashurov, V.V., et al., 1995, Experimental and numerical evolution studies for 2-D perturbations of the interface accelerated by shock waves. Proceedings of the Fifth International Workshop on Compressible Turbulent Mixing.

Smith, A.V., et al. 2001, Shock tube experiments on Richtmyer-Meshkov instability across a chevron profiled interface. Proceedings of the Eighth International Workshop on Compressible Turbulent Mixing.