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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 involve a three zone test cell arrangement of air / dense gas / air all initially at atmospheric pressure. Using sulphur hexafluoride (SF_6) as the dense gas yields 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 allows 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 is on the downstream membrane with a central obtuse angle of 157º and amplitude 20mm. This is complimentary to the chevron presented at the previous workshop (Holder 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 is significantly different from our usual experimental configurations involving perturbations on otherwise plane interfaces. In this case the central, dense gas region of the test cell is filled to halfway (100mm high) with seeded dense gas. The interfaces to either side feature microfilm membranes and are plane, whereas the top interface is membraneless and is nominally plane. This then introduces a Kelvin-Helmholtz instability to the experiment.

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

A time sequence will be shown for each experiment to allow improved visualisation of the mixing history. These will also be available to view on the linear shock tube pages within the AWE website.

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..00