Experiments of the Richtmyer-Meshkov Instability at High Mach Numbers using PIV

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Experiments are presented for the Richtmyer-Meshkov instability of a nearly single mode interface of nitrogen over sulfur hexafluoride. The interface is created by flowing N_2 from above and SF_6 from below in a vertical shock tube. Slots at the interface location allow for a stagnation plane to form. A pair of rectangular pistons oscillate to force a nearly 2D sinusoidal standing wave. Shock waves of strength M = 2.0 and 2.9 accelerate the interface, depositing vorticity along the perturbation, and leading to a growth in amplitude. Due to the high Atwood number ($A = (\rho_2 - \rho_1)/(\rho_2 + \rho_1) = 0.68$) the bubble and spike grow asymmetrically with the vorticity being concentrated near the top of the spike and the bubble becoming nearly flat at later times. The instability development is explored through particle image velocimetry (PIV) by seeding the nitrogen with aluminum oxide particles and acquiring a pair of planar images that are analyzed to obtain the velocity field. The PIV data is processed to provide measurements of the vorticity distribution, circulation, and bubble/spike growth rates. An example is shown in Figure 1, which shows an interface of He/SF_6 after acceleration by a $M = 1.2$ shock wave and the vorticity field found through PIV analysis.

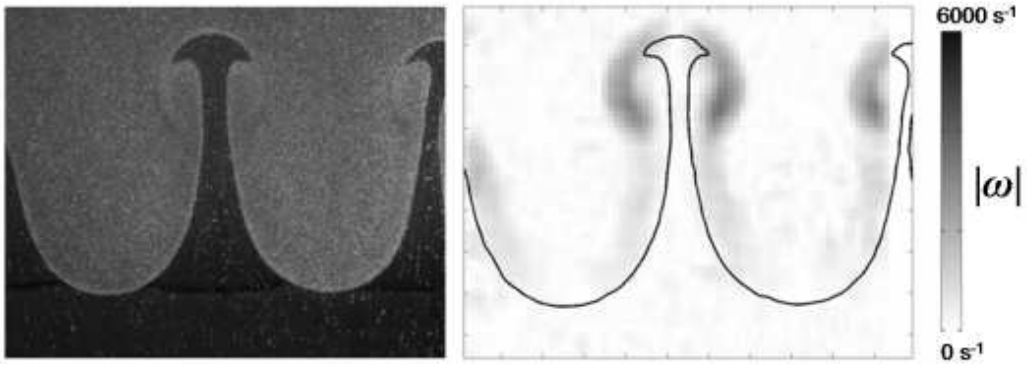

Figure 1: Post-shocked experimental image of a He/SF_6 interface after acceleration by a $M = 1.2$ shock wave. The image on the left shows one of the two raw PIV images while the right shows a vorticity field found through PIV analysis.