Simultaneous Concentration and Velocity Field Measurements in a Shock-accelerated Mixing Layer

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A novel technique to obtain simultaneous velocity and concentration measurements is applied to the Richtmyer-Meshkov instability. After acceleration by a Mach 2.2 shock wave, the interface between the two gases develops into a turbulent mixing layer. A time-separated pair of acetone planar laser-induced fluorescence images are processed to yield concentration (Fig. 1a,b) and, through application of the Advection-Corrected Correlation Image Velocimetry (ACCIV) technique, velocity fields (Fig. 1c,d). This is the first application of this technique to shock-accelerated flows. We show that, when applied to numerical simulations, this technique reproduces the velocity field to a similar quality as particle image velocimetry. When applied to the turbulent mixing layer of the experiments, information about the Reynolds number and anisotropy of the flow is obtained.

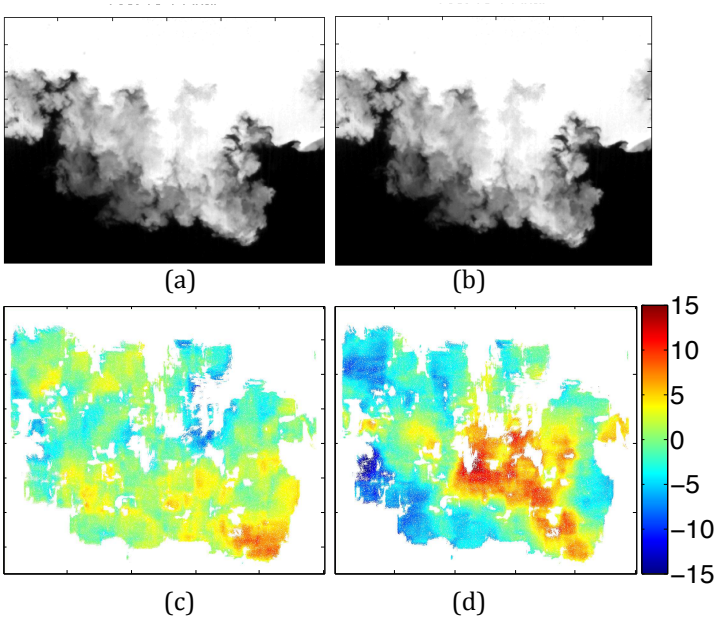

Figure 1: (a,b) Experimental image pair, with inter-frame time Δt=30 μs, corrected to show relative acetone concentration. It is this images pair that is used as input to the ACCIV algorithm. (c,d) ACCIV velocity field results, in m/s, for the (c) transverse (d) streamwise directions.