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Image processing techniques for the characterization of explosively driven dispersions

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Abstract

Dispersions driven by explosions are challenging to characterize mainly due to the extreme test conditions, the different time and spatial scales of the flow, and the variation of intensity due to the combustion.

An intensity based optical method to characterize the dispersion driven by an explosion is proposed. The velocity and intensity maps of the dispersion are accessed through the post-processing of the images of the dispersion. These images can be obtained either from a global visualization (using a light source, such as in the image given in Figure 1, or the combustion light itself) or from a transversal visualization (using a laser sheet illuminating inside the cloud, such as in the image given in Figure 2).

The developed method is organized into three steps. First, the contour of the cloud is detected via a dynamic grey-scale threshold criterion. The dispersion contours allow the computation of the velocity of the expansion as long as the plume presents a regular edge. Then, Large-Scale Particle Image Velocimetry technique is applied to obtain the velocity map of the dispersion. Additionally, information about the combustion phenomenon can also be accessed via an intensity-based analysis.

The method has been initially verified using a numerical test case. It has been thereafter applied on different experimental measurements presenting challenging features such as variations of light intensity, time scales, and spatial scales.

Figure 1: Talc dispersion illuminated by a powerful light source.

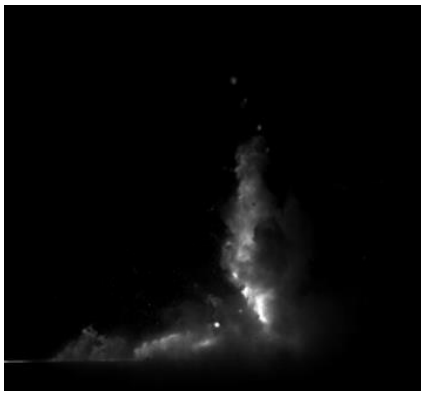

Figure 2: Talc dispersion illuminated by a laser sheet coming from the left.

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