Correlations between velocity and size of bubbles trapped by gas-sheared liquid film

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HIGHLIGHTS

• The bubbles generated by shearing flow at different flow conditions is investigated using a Brightness based Laser induced Fluorescence technique.
• Image processing was used to identify the bubble rings in the image to provide the size and location of the bubbles.
• A Hungarian linking algorithm was used to track the velocity of the bubbles as they move through the area.
• It is shown that the bubbles, which will be tracking the fluid, move with a coherent velocity in the disturbance wave.
• This coherent velocity is of the order of 3.5 times the mean velocity in the base film.

ABSTRACT

At high enough gas and liquid flow rates, the surface of gas-sheared liquid films are covered by a complex system of waves of different scales. Disruption of ripples on top of disturbance waves by a strong gas shear leads to creation of droplets that entrained into the core of gas stream. In addition, gas may be entrapped by film surface in form of bubbles of various sizes. In this work, the study of gas-sheared liquid film was performed in horizontal rectangular duct using high-speed brightness-based LIF technique. This technique directly measures the thickness of the liquid layer to a resolution of 0.040 mm over a 50mm by 20 mm area simultaneously at speeds of 10 kHz using a high speed camera and pulsed laser set up. Nine experiments were carried out at three liquid Reynolds numbers and three gas Reynolds numbers. In previous work it was demonstrated that the droplet impact entrained gas in the base film and that the number of the bubbles was relate to the flow conditions. In this work the speed of the bubbles is compared to the local film height and the bubble sizes to investigate how these affect the speed of the bubbles. It is shown that the bubble act as traces and so velocity ranges can be determined that change as the film thickness...