EUROMECH COLLOQUIUM 651
International Colloquium on Films, bubbles, droplets and phase change

August 25th-29th 2025, Metz, France
https://euromech.org/colloquia/colloquia-2025/651

On bubble parameters in the single bubbling regime

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We present an experimental study of rising air bubbles in quiescent water under the single bubbling regime [1]. Bubbles are generated by an upward air injection inside a water-filled glass cylinder. The injection condition is characterized by the gas volumetric flow rate and nozzle diameter. Diffuse backlight-illumination is used to measure the bubble parameters, namely bubble size, bubble aspect ratio, and inter-bubble distance extracted from bubbles of predominant size. Both correlated and uncorrelated image acquisition configurations are considered (see Figure). With respect to the literature, a new method is used here to determine bubble size considering the 3D reconstruction by discs. From correlated acquisitions, three approaches are developed based on bubble volume evolution attached to the nozzle and its sawtooth signal representation. These bubble sizes are successfully validated with respect to a reference size estimated from the bubble formation frequency and volumetric flow rate. Excellent agreement is found with the bubble size extracted from uncorrelated acquisitions and that referenced in the literature [2-3]. The other bubble parameters determined from correlated and uncorrelated image series also show good agreement. At the limit of the single bubbling regime and for an analysis window near the injector, the bubble size is twice the nozzle diameter, the bubble aspect ratio is three-fifths, and the minimum inter-bubble distance is twice the bubble diameter [4]. The volumetric gas flow rate and vertical position of the analysis window affect the bubble size and minimum inter-bubble distance but not the bubble aspect ratio.

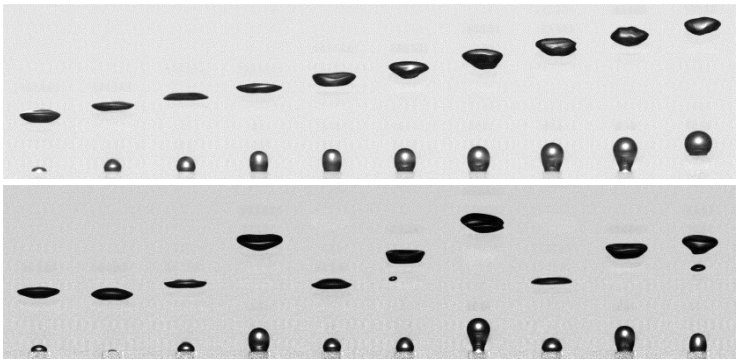

Figure: Image series of bubble formation near the injector for the same operating conditions under correlated (top) and uncorrelated (bottom) image acquisition configurations.

Keywords: Single bubbling, diffuse-backlight illumination, statistical description, image analysis

References

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