Bubble identification from images with machine learning methods

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Abstract

An automated and reliable processing of bubbly flow images is highly needed to analyse large data sets of comprehensive experimental series. A particular difficulty arises due to overlapping bubble projections in recorded images, which highly complicates the identification of individual bubbles. Recent approaches focus on the use of deep learning algorithms for this task and have already proven the high potential of such techniques. The main difficulties are the capability to handle different image conditions, higher gas volume fractions and a proper reconstruction of the hidden segment of a partly occluded bubble. In the present work, we try to tackle these points by testing three different methods based on Convolutional Neural Networks (CNN's) for the two former and two individual approaches that can be used subsequently to address the latter. Our focus is hereby on spherical, ellipsoidal and wobbling bubbles, which are typically encountered in air-water bubbly flows. To validate our methodology, we created test data sets with synthetic images that further demonstrate the capabilities as well as limitations of our combined approach. The generated data, code and trained models are made accessible to facilitate the use as well as further developments in the research field of bubble recognition in experimental images.

Keywords. Bubbly flows, Deep Learning, Computer Vision, CNN, Instance segmentation