Contribution ID: **6** Type: **Spotlight talk**

AI image processing in fluid dynamics applications

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In multiphase fluid dynamics knowledge of the particle size distribution of the dispersed phase is one of the key points of interest. In chemical engineering bubble columns are used as mass transfer apparatuses, where a gas is dispersed in a liquid phase. The size distribution of the bubbles is the determining factor for the total surface contact area between the two different phases and with that a dominant factor on mass transfer.

In experimental investigations this necessitates an accurate and reliable segmentation of gas bubbles that overlap in recorded images to accurately determine their size. Since proper statistics are needed in many cases, an automated procedure is required to evaluate larger datasets. Machine learning applications offer a great opportunity to improve the segmentation and supersede existing techniques (Watershed, ⋯).

These tasks can be solved by many different Convolutional Neural Networks and their variants (U-net, StarDist, etc.). We first demonstrate successful instance segmentation results by applying the Stardist algorithm and comparing it with a two-stage U-net based segmentation approach.

These types of neural networks are trained using supervised learning techniques and require a rather large set of manually annotated image data. Since manual creation of labels is tedious and throughput is limited, there is a lack in the amount of available training data as well. This work presents an approach using deep generative models to create artificial images that resemble experimental data, enabling us to enlarge the dataset for segmentation training. This approach is used to specifically train U-net and a variant of Stardist (MultiStar) to improve the segmentation of overlapping bubbles.

We further outline potential shortcomings of our experiments and discuss future research directions.

Physical Presentation

I would not feel comfortable to present in front of an audience and prefer a video (call) presentation.

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