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Three-Dimensional Feature Extraction from Multiphase Flows
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— Light field imaging (LFI) and synthetic aperture (SA) refocusing techniques have been combined in an emerging method to resolve three-dimensional (3D) flow fields over time. Image volumes of a scene are captured using an array of multiple cameras. SA refocusing yields a stack of post-processed images at different focal depths, each with a narrow depth of field. Although this technique has previously been used to reconstruct flow features that are small relative to the field of view, blur artifacts are more clearly visible when this method is applied to relatively larger features. The presence of these artifacts prevents 3D scene reconstruction. To eliminate the artifacts, circles are detected in the raw camera images, and their rims are converted to white pixels, while the rest of each raw image is made black. This simplifies 3D feature detection in the stack of refocused images and allows the scene to be reconstructed in 3D. Simulations and experiments using the aforementioned modified SA method show that it is possible to extract the center coordinates in 3D and radii of spheres found in a scene being recorded with simple back illumination. This technique has been applied to various types of multiphase flows, including bubble flow fields in air and sneezes.

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