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Improvement of particle detection accuracy in digital holographic microscopy by phase retrieval method.[1] HANGJIAN LING, University of Massachusetts Dartmouth — Digital Holographic Microscopy (DHM) is a powerful tool for the measurements of particle motions and fluid flows in three-dimensional (3D) space at microscale. However, the DHM experiences the long-standing virtual image problem, which creates noises in the digital reconstructions and limits the hologram plane to be placed outside of the sample volume. Here, we implement the phase retrieval method in order to solve the virtual image problem. This new method is based on recording two holograms whose planes are displaced along the optical axis, and then reconstructing the complete optical waves estimated by the iterative phase retrieval algorithm. We demonstrate this new method by both numerical simulations and experimental measurements with dense particle suspensions exceeding 2000 particles/mm^3. Results show that this new method totally eliminates virtual images, and recovers the original particle distributions even when the hologram planes are within the particle suspensions. Moreover, this phase retrieval method has a lower false particle detection rate and a higher particle localization accuracy, compared to the traditional method. In this presentation, we will introduce the optical setup and data analysis procedures of the phase retrieval method, as well as its application in turbulent boundary layers for velocity measurements.

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