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High fidelity digital inline holographic PTV for 3D flow measurements: from microfluidics to wall-bounded turbulence JIARONG HONG, MOSTAFA TOLOUI, KEVIN MALLERY, University of Minnesota — Three-dimensional PIV and PTV provides the most comprehensive flow information for unraveling the physical phenomena in a wide range of fluid problems, from microfluidics to wall-bounded turbulent flows. Compared with other commercialized 3D PIV techniques, such as tomographic PIV and defocusing PIV, the digital inline holographic PTV (namely DIH-PTV) provides 3D flow measurement solution with high spatial resolution, low cost optical setup, and easy alignment and calibration. Despite these advantages, DIH-PTV suffers from major limitations including poor longitudinal resolution, human intervention (i.e. requirement for manually determined tuning parameters during tracer field reconstruction and extraction), limited tracer concentration, small sampling volume and expensive computations, limiting its broad use for 3D flow measurements. Here we will report our latest work on improving DIH-PTV method through an integration of deconvolution algorithm, iterative removal method and GPU computation to overcome some of abovementioned limitations. We will also present the application of our DIH-PTV for measurements in the following sample cases: (i) flows in bio-filmed microchannel with 50-60 μm vector spacing within sampling volumes of 1 mm (streamwise) x 1 mm (wall-normal) x 1 mm (spanwise); (ii) turbulent flows over smooth and rough surfaces (1.1 mm vector spacing within 15 mm x 50 mm x 15 mm); (iii) 3D distribution and kinematics of inertial particles in turbulent air duct flow.

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