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Direct measurement of vorticity using tracer particles with internal markers[1] CHINMAYEE PANIGRAHI, SANTOSH KUMAR SANKAR, JIARONG HONG, University of Minnesota — We demonstrate an optical imaging technique to obtain a direct measurement of 3D vorticity in a flow field, based on the measurement of instantaneous rotational rate of microscale tracer particles. The tracer particles of ~ 50 μm with internal markers (~ 2 μm) are fabricated using a flow-focusing microfluidic device. Digital inline holography (DIH), which consists of a collimated coherent light beam and a digital camera that capture the diffraction signals (holograms) from the objects within the beam path, is employed to image several tracer particle within a field of view of centimeter scale. The holograms are then processed using an inverse reconstruction approach to obtain the 3D positions of each internal marker within a tracer particle. The translation and rotation of the particles are then derived from the time-resolved 3D positions of internal markers. The proposed approach is calibrated using a solid-body-rotational flow system and would be applied to probe the small-scale dynamics in different types of turbulent flow.

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