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High-resolution velocity measurements using dual-view tomographic digital holographic microscopy[1] JIAN GAO, KARUNA AGARWAL, JOSEPH KATZ, Johns Hopkins University — A recently developed two-view tomographic digital holographic microscopy (DHM) system is used for measuring the flow around a pair of cubes with height of 90 wall units immersed in the inner layer of a turbulent channel flow at Re_τ =2500. Matching of the two views at ∼1-μm precision is achieved by implementing a self-calibration procedure that determines the three-dimensional, three-component (3D3C) distortion function, which corrects the geometric mapping. The procedure has been tested using distorted synthetic particle fields, and then implemented on experimental data. The two views are used to overcome the reduced accuracy of DHM in the axial direction of the reference beam due to elongation of the reconstructed traces. Multiplying the two precisely-matched 3D intensity fields is used for truncating the elongated traces. The velocity distributions are obtained by 3D particle tracking guided by 3D cross-correlation of the truncated intensity fields along with other size/shape/smoothness constraints. As demonstrated by how divergence-free the data is, the resulting 3D3C velocity field is substantially more accurate than results obtained from single-view DHM. Results show that the cube is surrounded by a vorticity "canopy" that extends from upstream of its front surface to the separated region in its near wake. Nearly axial necklace vortices remain confined to the near wall region between the cubes, but expand rapidly behind them.

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