High-resolution velocity measurements using dual-view tomo-
graphic digital holographic microscopy\(^1\) JIAN GAO, KARUNA AGARWAL,
JOSEPH KATZ, Johns Hopkins University — A recently developed two-view to-
mographic 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 \(Re_x = 2500\). Matching of the two views at \(\sim 1\mu m\)
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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