

Abstract Submitted
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Generalised phase average with applications to sensor-based flow estimation of the wall-mounted square cylinder wake¹ ROBERT MARTINUZZI, University of Calgary, JASON BOURGEOIS, University of Calgary, BERND R. NOACK, Institut PPRIME, France — We experimentally investigate the three-dimensional wake behind a finite wall-mounted square cylinder at $Re = 12,000$ and aspect ratio of 4. Focus is placed on the base flow and oscillatory fluctuation. Time-resolved 3D velocity fields are constructed from high-frame-rate particle image velocimetry (PIV) and simultaneously recorded surface pressure measurements. All three velocity components are resolved in a rectangular near-wake region by two orthogonal dense arrays of parallel PIV planes. A key enabler is a generalized phase-average incorporating slowly varying base flow, a variable oscillation amplitude and higher harmonics. These generalizations reduce the residual 30% below those of a traditional phase average. Moreover, the resolved variations reveal analytical constraints of the mean flow and oscillation levels, like the mean-field paraboloid. The proposed methodology for generalized phase averaging and for construction of 3D velocity fields from 2D PIV data is applicable to a large class of turbulent flows with oscillatory dynamics.

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