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Effect of random errors in planar PIV data on pressure estimation in vortex dominated flows. JEFFREY MCCLURE, SERHIY YARUSEVYCH, University of Waterloo — The sensitivity of pressure estimation techniques from Particle Image Velocimetry (PIV) measurements to random errors in measured velocity data is investigated using the flow over a circular cylinder as a test case. Direct numerical simulations are performed for $Re_D = 100$, 300 and 1575, spanning laminar, transitional, and turbulent wake regimes, respectively. A range of random errors typical for PIV measurements is applied to synthetic PIV data extracted from numerical results. A parametric study is then performed using a number of common pressure estimation techniques. Optimal temporal and spatial resolutions are derived based on the sensitivity of the estimated pressure fields to the simulated random error in velocity measurements, and the results are compared to an optimization model derived from error propagation theory. It is shown that the reductions in spatial and temporal scales at higher Reynolds numbers leads to notable changes in the optimal pressure evaluation parameters. The effect of smaller scale wake structures is also quantified. The errors in the estimated pressure fields are shown to depend significantly on the pressure estimation technique employed. The results are used to provide recommendations for the use of pressure and force estimation techniques from experimental PIV measurements in vortex dominated laminar and turbulent wake flows.

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