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Estimation of Uncertainty Bounds for Individual PIV Measurements JOHN CHARONKO, PAVLOS VLACHOS, Virginia Tech — Numerous studies have established firmly that particle image velocimetry (PIV) is a robust method for non-invasive, quantitative measurements of fluid velocity, and that when carefully conducted, typical measurements can accurately detect displacements in digital images to within a tenth of a pixel or less. However, previously, these estimates have only been able to provide guidance on the expected error for an average measurement under specific image quality and flow conditions. This work demonstrates a new method for estimating the uncertainty bounds to within a given confidence interval for a specific, individual measurement. We show that for a phase-only, generalized cross-correlation the ratio of primary to secondary peak heights correlated strongly with the range of observed error values for each individual displacement measurement, regardless of flow condition or image quality. Using an analytical model of the relationship derived from synthetic data sets, the uncertainty bounds at a 95% confidence interval are then computed for several artificial and experimental flow fields, and the true errors are shown to match the predicted uncertainties. While this method is not able to predict the true error for a given measurement, knowledge of the uncertainty level for a PIV experiment will provide great benefits in engineering design studies and CFD validation efforts.

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