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Measurement uncertainty of mean velocity fields acquired by PIV
SVEN SCHARNOWSKI, CHRISTIAN J. KÄHLER, Bundeswehr University Munich — Particle Image Velocimetry (PIV) has become a standard tool for the investigation of various flow fields. In order to compare the mean velocity distributions or higher order statistics from experiments and numerical predictions, it is essential to know the uncertainty of the estimated values. However, due to the complex evaluation procedure of PIV the error cannot be estimated with standard methods. Many parameters, including particle image size, particle image density, turbulence level, noise level, velocity gradients, number if PIV image pairs ... affect the accuracy. This work systematically analyzes the effect of several parameters on the random and bias errors of the estimated mean velocity by using single-pixel ensemble-correlation as well as window-correlation based PIV. To have full control of all parameters, synthetic PIV images are generated and analyzed, while identifying the most relevant error sources. The different parameters can be determined from the raw data by generating a multidimensional uncertainty hyper-surface that allows for determining the random error of the shift vectors. Furthermore, the knowledge about the dependency on the different parameters enables to identify the bottleneck and thus, to optimize the measurement setup and evaluation procedure to improve the accuracy.

Sven Scharnowski
Bundeswehr University Munich

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