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Autocorrelation based estimate of particle image density in PIV[1]
SCOTT WARNER, BARTON SMITH, Utah State University, PAVLOS VLACHOS, Virginia Polytechnic Institute and State University — In Particle Image Velocimetry (PIV), the number of particle images per interrogation region, or particle image density, impacts the number of valid vectors and, especially in regions of shear, can impact the uncertainty of PIV. Therefore, any estimate of the uncertainty of PIV requires knowledge of particle image density. An auto-correlation-based method for estimating the local, instantaneous, particle image density is presented. The method is applied to synthetic images to provide an initial estimate of how the autocorrelation peak magnitude varies with known values of particle image density, particle image diameter, illumination intensity, interrogation region size, and background noise. From the synthetic image results, an empirical relationship is developed such that the particle image density is a function of the autocorrelation peak height, particle image diameter, illumination intensity, interrogation region size. Results are also obtained using images from two experimental setups with different seeding particles and flow mediums. The experimental results are compared to manual particle counts and are found to be robust. The effect of varying particle image intensities is also discussed and found to effect the particle image density.

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