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The Anatomy of Fourier-Based Correlation Image Velocimetry and Sources of Decorrelating Errors MATTHEW GIARRA, Virginia Tech, PAVLOS VLACHOS, Purdue University — Particle image velocimetry (PIV) algorithms have recently been applied to photographs captured using a variety of techniques including schlieren, synchrotron x-ray, and microscope imaging. While the characteristics of these types of images differ greatly from those of particle images, virtually no analysis has been done to determine how these differences affect the performance of Fourier-based cross correlation (CC) algorithms. Here, we analyze schlieren, x-ray, and traditional PIV images to show that the signal-to-noise ratios (SNR) of their CCs vary across spectral wavenumbers, and that the assignment of a single SNR to the CC is an oversimplification that obfuscates the underlying source of the decorrelating errors. We will show that the failure of traditional algorithms to distinguish correlated from uncorrelated wavenumbers introduces secondary CC peaks that increase measurement uncertainty by decreasing the correlation peak-height ratio, and can cause the measurement to fail by overtaking the true peak. Finally, we introduce a new algorithm that mitigates these issues and increases measurement accuracy by automatically discriminating correlated wavenumbers with no a priori information about the images' contents.

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