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On the rms errors and dynamic ranges of triple- and quadruple-pulse particle tracking velocimetry (PTV)[1] LIUYANG DING, RONALD ADRIAN, Arizona State University, SIVARAM GOGINENI, Spectral Energies LLC — Multi-pulse PTV extends conventional dual-pulse PTV by fitting a polynomial to particle locations measured from three or four pulses in a burst, aiming at more accurately resolving a particle short-period trajectory. Particle velocity and acceleration are then evaluated at an optimal time minimizing rms errors. Numerical simulations were performed to completely study the behaviors of position, velocity, and acceleration rms errors of triple- and quadruple-pulse PTV in a 4-D space spanned by four dimensionless variables – normalized time, normalized displacement, normalized particle locating noise, and acceleration factor. We compared three analysis methods – 3-pulse with quadratic fitting, 4-pulse with cubic fitting and 4-pulse with quadratic least-square fitting. In addition, generalized definitions of dynamic spatial range (DSR) and dynamic velocity range (DVR) are proposed for multi-pulse analyses. We calculated DSR ratios and DVR ratios between the multi-pulse and 2-pulse under various flow conditions and noise levels. It is found that the DSR and DVR could be improved by up to 100 times and 10 times, respectively, when the particle trajectory is strongly curved, deceleration is pronounced, and particle locations are accurately determined.

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