Spectral Improvement of Time Resolved PIV by FTEE in Homogeneous Isotropic Turbulence

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HIGHLIGHTS

• Investigation of the performance of the time-resolved PIV technique FTEE with an optimized 2-Frame PIV algorithm
• Tests conducted on synthetic generated particle fields from DNS and experimental of decaying homogeneous isotropic turbulence (HIT).
• It is shown that FTEE algorithm is able to resolve smaller scale structures by virtue of its ability to reduce the interrogation window (IW) size compared to the 2-frame algorithms

ABSTRACT

This work investigates the performance of the time-resolved PIV technique FTEE with an optimized 2-Frame PIV algorithm on both synthetically generated and experimentally measured homogeneous isotropic turbulence (HIT). In the case of the synthetic tests, the algorithms are compared with a model that appropriately filters the full resolution HIT to replicate a perfect PIV treatment. Several turbulence quantities are computed such as turbulent kinetic energy, energy dissipation and integral length scale for both the experimental and synthetic experiments. Calculation of the energy spectra was carried out to analyse the algorithm’s ability to resolve turbulent scales. It is shown that FTEE algorithm is able to resolve smaller scale structures by virtue of its ability to reduce the interrogation window (IW) size compared to the 2-frame algorithms. This is mainly owing to the ensemble cross correlation of the cross-correlation maps that permits lower particle numbers in the IW and the modilisation of trajectories by a non-linear polynomial.