Particle Image Velocimetry
Part - 4

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Advanced algorithm for PIV image process

- **Particle Tracking Velocimetry:**
  - Tracking individual particle
  - Limited to low particle image density case
  - Velocity vector at random points where tracer particles exist.
  - Spatial resolution of PTV results is usually limited by the number of the tracer particles

- **Correlation-based PIV:**
  - Tracking a group of particles
  - Applicable to high particle image density case
  - Spatial resolution of PIV results is usually limited by the size of the interrogation window size
  - Velocity vector can be at regular grid points.
The ideal of correlation error correction technique (multiple-correlation validation technique)

- Since the noise peak in the correlation space may be randomly, causing the multiplied value to be reduced to zero. Thus, the correct peak can be easily identified.
- The location of the correct peak in the correlation space is corresponding to the averaged movement of the overlap region.

\[
R_{(p,q)} = R_{1(p,q)} \ast R_{2(p,q)}
\]
Correlation error correction technique

Hart method (1998)
the spatial resolution in X and Y direction is different

Hu et al. (1999) method
the spatial resolution in X and Y direction is same
The comparison of various PIV methods

a. FFT-CC method  
(interrogation window size 32 by 32 pixel)

b. D-CC method  
(interrogation window size 32 by 32 pixel)

c. D-CC method with correlation error correction treatment  
(interrogation window size 32 by 32 pixel)
The Effect of the Size of the Interrogation Window

Real flow field

Image processing

Vortical structure

Interrogation window

PIV final result
Hierarchical Recursive PIV Algorithm

Velocity vector at coarse grid level  Offset velocity vector  Vector obtained at new calculation loop  Velocity vector at refined grid
Results from Hierarchical PIV algorithm

interrogation window size 64 by 64 pixel

interrogation window size 32 by 32 pixel

interrogation window size 16 by 16 pixel

interrogation window size 8 by 8 pixel