VOLUMETRIC MEASUREMENTS
GHOST PARTICLES
INSIGHT V3V™-4G SOFTWARE

APPLICATION NOTE V3V-FLEX-005 (US)

Volume Reconstruction and Ghosts Particles in V3V-Flex

The reconstruction of a 3-D volume of particles from 2-D particle images recorded using a V3V-Flex system is the starting point for volumetric velocity investigations.

A minimum number of two cameras is required for reconstructing a volume of particles. However, increasing the number of cameras (i.e. views) will improve the accuracy of the positioning of the particles inside the reconstructed volume of measurements and thus the accuracy of the velocity measurements especially when a state of the art tracking algorithm is used for velocity measurements. For this reason, V3V-Flex which a 3-D-PTV technique offers a flexible arrangement of three or four cameras and can handle up to 8 cameras.

In V3V-Flex the individual particles are identified in the 2-D images via a Levenberg-Marquardt non-linear solver and segmented triangulation is used to match the identified particles between cameras and reconstruct the volume of particles.

Segmented triangulation algorithm uses the mapping function obtained from automated calibration procedure used in V3V-Flex to map iteratively into physical coordinates each individual center of particle from one camera to other cameras and search within a search area for potential matches using the inverse mapping function: all particle images in the search area are mapped into physical space and those who intersect (within a user defined tolerance) are considered as a particle match. The more cameras are used and narrower is the list of potential matches that fall within the tolerance defined. However, whenever a line of Sight intensity of a particle projection overlaps another projection from a second camera where no real particle exists, a ghost particle might then be created.

In the Multiplicative Algebraic Reconstruction Technique (MART) used in Volumetric **PIV**, the projection of the whole intensity spot of the particle (>5 to 6 pixels) identified on the 2-D image is considered which leads to ~40 to 50 ghosts per real particle for a particle density of 0.05 ppp (particle per pixel). However in V3V-Flex technique (Volumetric PTV) the line of sight intensity of the ***centroid*** of each particle is mapped into the other cameras which reduces drastically the number of ghost particles to ~1 to 2 per real particle for a similar particle density (Elsinga, 2008):

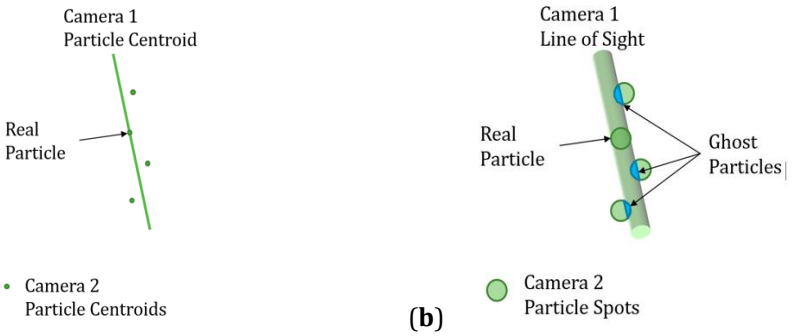

Figure 1: Ghost particle
(a) V3V-Flex
(b) MART algorithm

Reference

Elsinga GE (2008), "Tomographic particle image velocimetry and its application to turbulent boundary layers." PhD thesis, *Delft University of Technology*, Delft, The Netherlands.

UNDERSTANDING, ACCELERATED

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