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Volumetric Three Dimensional Flow Measurements[1] RAJAN MENON, DAN TROOLIN, WING LAI, TSI Inc, Shoreview, MN — Most flows, generally being three-dimensional in nature, need diagnostic techniques that provide instantaneous vector fields and detailed statistical properties in a true 3-dimensional region – a cube. Till now, the diagnostics capabilities have been limited to measuring the instantaneous velocity vectors at a point, in a plane or a thin layer. Starting with a patented approach, a new multi-aperture imaging approach has been incorporated into a system that captures the vector field in a volume. Triple-port imaging approach combined with triplet matching correlation technique is used to extract the velocity of particles, from images, in a cubic measuring region. This approach also enables the system to have, for the first time in particle image velocimetry, an integrated imaging system that does not need any focusing or aperture adjustment. A pulsed volume illumination system combined with the HYPERSTREAMING system for continuous image capture and transfer to the computer is used to get temporal and spatial development of three dimensional flows. System details along with measurements carried out in a wide range of flows presented in the paper clearly show the diagnostics potential of this true 3D system to explore the details of wake flows, vortex dynamics, mixing and other complex flows.

[1]Data on Flapping Airfoil from Caltech is gratefully acknowledged.

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