Volumetric Three-Component Velocimetry GANG PAN, DANIEL BJORKQUIST, DANIEL TROOLIN, HAI ZHANG, WING LAI, TSI Inc. — We have developed and tested a novel 3D PIV system, Volumetric Three-Component Velocimetry (V3V), for instantaneous volumetric measurement of the three-dimensional velocity fields. The V3V system, which is based on the Digital Defocusing PIV (DDPIV) technique originally developed at CalTech, uses volume illumination and employs a unique 3D camera to capture two-frame double-exposure particle images at 7.5 fps in a 10x10x10 cm^3 volume. The captured images are processed by a fast reconstruction algorithm to obtain particle 3D positions. The positioning accuracy is about 10 um in XY and 40 um in Z based on the experiment results. A particle tracking method based on the expectation-maximization algorithm has been implemented to extract three-component velocity vectors. From each capture we can obtain $5000 \sim 10000$ particle velocity vectors in the measurement volume, and it takes only about 10 seconds to process each capture from the raw image to the final vector field. The capability of the V3V system has been assessed in various water flow measurement including a vortex ring flow and the flow past a wing in a water tunnel.

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