ROUND JET

APPLICATION NOTE V3V-002

The study of jets is important in a number of fluid mechanics engineering applications including propulsion, pollution, and mixing (Fig. 1).

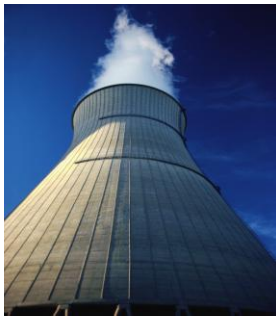

Figure 1: Steam rising from a stack.

In this application, a water jet was introduced downward into a tank of water at a steady flow rate through a rubber tube with a round inner diameter of 13 mm and an outer diameter of 20 mm.

The TSI V3V™ (Volumetric 3-Component Velocimetry) system was used to analyze the resulting flow structure (Fig. 2). The flow was illuminated by a model YAG120-NWL 120 mJ dual-head pulsed Nd:YAG laser operating at 7.25 Hz and 532 nm wavelength. Light cone optics were used at the exit of the laser to shape the beam into an illuminating cone. The laser cone was formed with two -50mm cylindrical lenses mounted at 90° to each other. These cylindrical lenses diverged the beam in the horizontal and vertical directions to illuminate a volume approximately 120 mm × 120 mm × 120 mm. The model V3V-8000 3D camera probe consists of three apertures and a total of 12 million pixels. The camera probe was aligned and calibrated with the CCD a distance of approximately 700 mm from the back plane of the measurement volume.

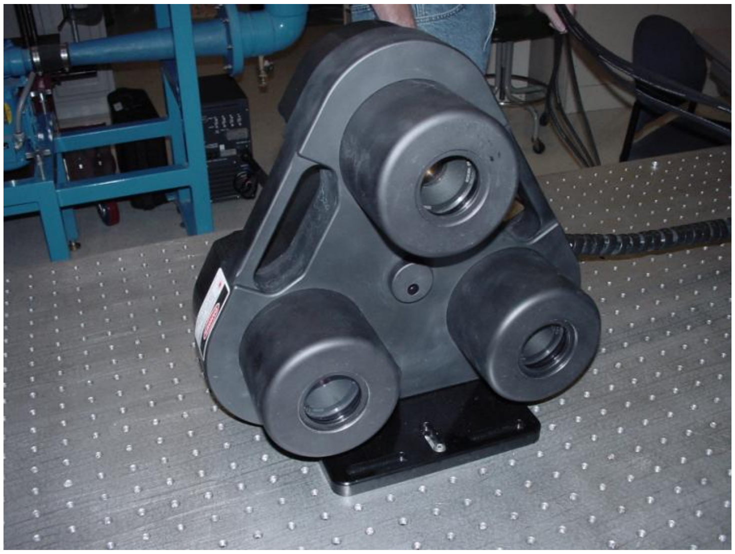

Figure 2: V3V three-aperture camera probe.

The data capture was synchronized with the model 610035 synchronizer. The images were streamed to the model HYPER2 *HyperStreaming*™ computer, and subsequently analyzed.

The flow was seeded with polycrystalline tracer particles. Two image captures were taken with a Δt of 10 ms, and volumetric velocity fields were obtained through unique particle identification, triplet matching, and particle tracking algorithms in TSI's *INSIGHT* V3V™ software.

Figure 3 shows a portion of the overlaid image from the three apertures of the V3V™ camera probe. The x and z locations of the particles are located at the centers of the triangles. The z-location is determined by the size and orientation of the triangle.

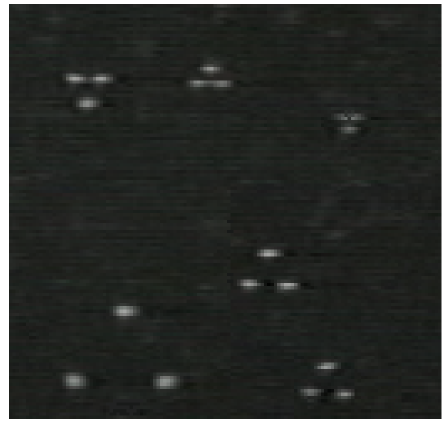

Figure 3: Three aperture image from the V3V camera.

Figure 4 shows a plot of the data results. The jet was aimed in the negative y-direction. The average volumetric velocity field was obtained from 100 captures (time to capture 100 datasets ~14 sec), and processed (time to process 100 datasets ~10 minutes), without the need for traversing or repositioning any component of the system.

The slices represent velocity magnitude and the isosurface represents y-vorticity. The maximum velocity at the core of the jet was 0.67 m/s.

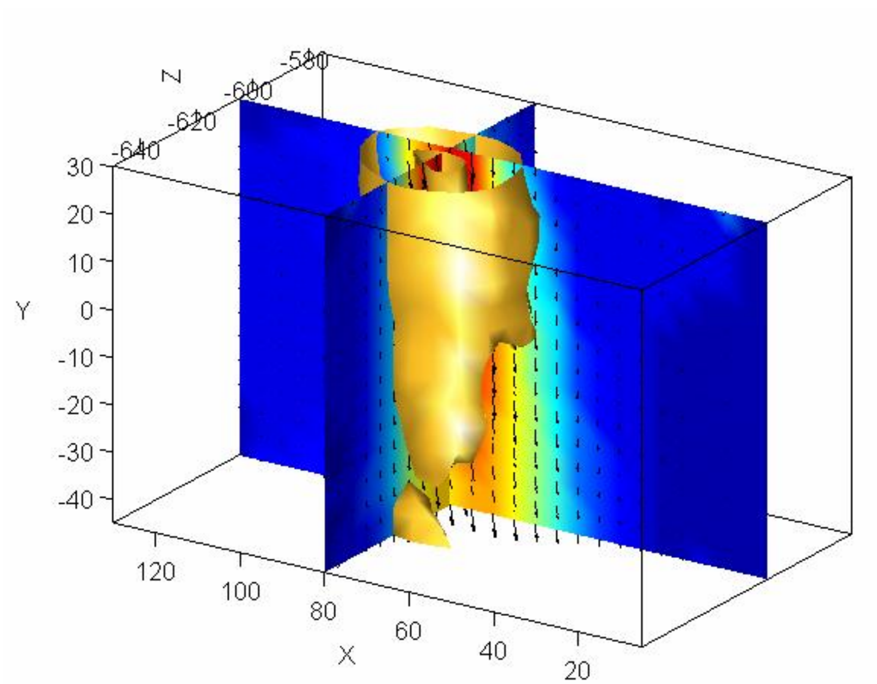

Figure 4: Volumetric 3-component velocity field of a round jet. The isosurface represents y-vorticity, and the slices represent velocity magnitude.

In this study, volumetric 3-component velocimetry was used to analyze the three dimensional flow from a round jet. The V3V™ system was effective in achieving the desired 3D results.

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