3-D TIME RESOLVED PARTICLE IMAGE VELOCIMETRY (TRPIV)

The 3-D Time Resolved PIV (TRPIV) facility was established in 2008 at Department of Aerospace Engineering in Unsteady Aerodynamics Laboratory with financial support from the Department of Science and Technology under FIST program. The equipment is capable of measuring three components of velocities in a plane in unsteady flow in the range of low speed (1cm/s) to supersonic speed (800m/s). It enables one to obtain quantitative knowledge about kinematics and dynamics of flow by extracting unsteady changes in vorticity, streamlines and coherent structures. The instrument can measure turbulence intensity and higher order statistics in high Reynolds number flows. This facility is used by a number of research groups from various academic institutions and R&D laboratories dealing in fluid dynamics. The TRPIV system installed in IIT Kanpur is the first of its kind in India.

Unique features: The TRPIV system (Figures 1 and 2) is capable of measuring velocity at 1 kHz frequency in an area of 20 cm^2, when the cameras operate at full resolution. It can measure velocity in smaller areas with cameras operating at lower resolution at 10 kHz frequency range. Thus it is an important tool for measuring turbulence. It can measure supersonic velocity up to 800m/s, as the inter-frame capture time of the cameras is 100ns. The system operates in stereoscopic mode to measure all three components of velocities in a plane. Among all the existing velocity measurement techniques, only TRPIV system is capable of measuring fluctuations over time in an entire plane in the flow field. Two illustrative examples showing the capability of TRPIV are shown in Figures 3 and 4.

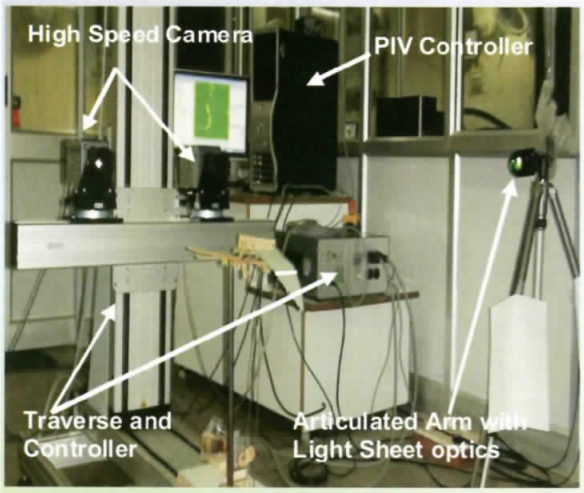

Figure 1: The setup with cameras, laser and model.

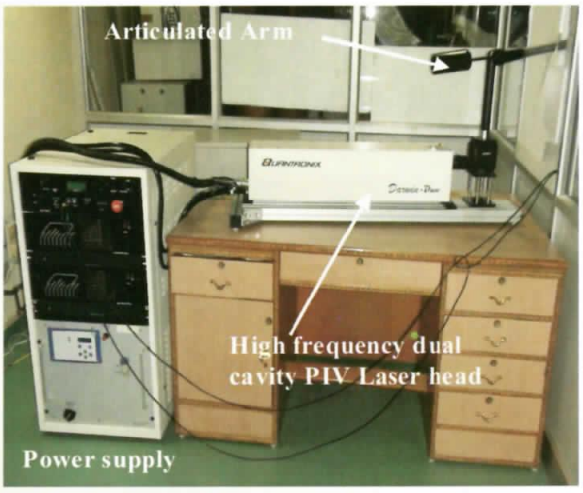

Figure 2: Laser head with power supply.

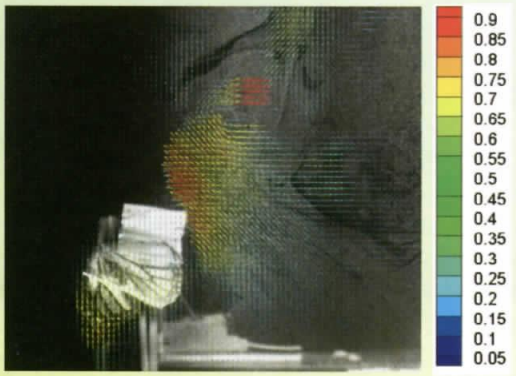

Figure 3: Downstroke motion of a butterfly wing, illustrating typical flow field in the wake of a bird wing.

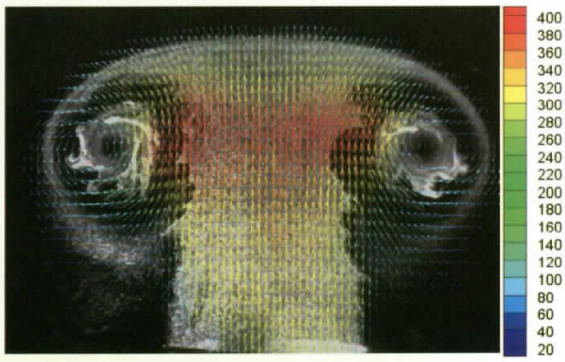

Figure 4: Compressible vortex ring at Mach 1.3, t = 610ms. This has relevance to simulate initial transient behavior of a supersonic jet, that may emerge from a rocket engine.

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