

Paper 18.5

Point and planar LIF for velocity-concentration correlations in a jet in cross flow

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ABSTRACT

Simultaneous measurements of velocities and concentration with Planar Laser Induced Fluorescence (PLIF) combined with Particle Image Velocimetry (PIV) are compared to similar measurements with pointwise Laser Induced Fluorescence (LIF) made with a slightly modified standard Laser Doppler Anemometer (LDA). The flow considered is the mixing of a jet in a fully developed cross flow in a square duct with a width of 10 jet diameters. Both a laminar flow case, $Re=675$, and a turbulent flow case, $Re=33750$, are presented. For both flows, the ratio jet-to-duct mean velocities was $R=3.3$. Result of mean velocities, mean concentration and Reynolds fluxes in the symmetry plane of the jet are presented for PIV and PLIF measurements. The LIF measurements performed with the LDA equipment was in general in good agreement with the PIV/PLIF measurements. The cross sections selected for comparison are challenging, since these involve areas with high velocity- and concentration gradients, which in turn amplifies the effect of a finite measurement volume in the two measurement systems. In addition, the concentration measurement was realized by injecting clean water into the dye seeded main flow. This "inverse" configuration resulted in a deeper insight to the concentration measurement process, itself. The comparison of LDA/LIF and PIV/PIF data also resulted in better understanding of the two measurement systems.

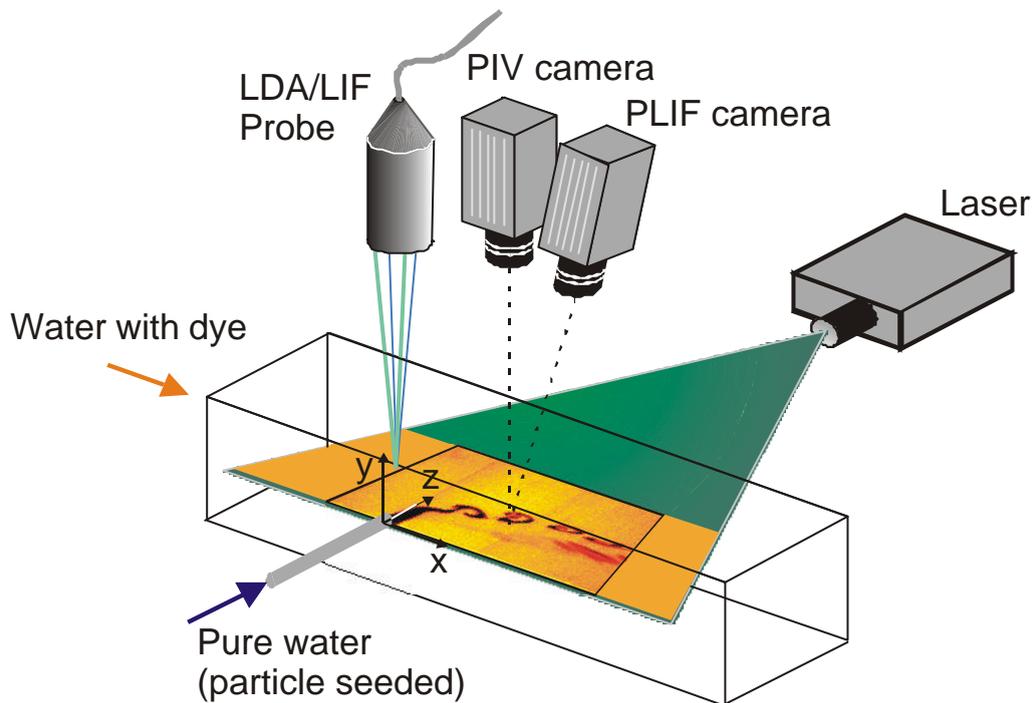


Fig. 1. Schematic diagram of the test section with the PIV and PLIF measuring system.