SIMULTANEOUS LDV AND PIV MEASUREMENTS DOWNSTREAM OF A CYLINDER

APPLICATION NOTE POWERSIGHT-004 (A4)

Laser-based Diagnostic Techniques

Laser Doppler Velocimetry (LDV) and Particle Image Velocimetry (PIV) are both laser-based, optical flow techniques in which seed particles are introduced into a flow, and the motion of the particles is tracked in time in order to determine the velocity of the flow. It is assumed that the tracer seed particles have been chosen in such a way that they are faithfully following the continuous-phase flow of the fluid of interest. The major differences between the two techniques, arises from the fact that LDV is a point-measurement using a photo-detector, and PIV is a planar technique that uses a camera. The purpose of this application was to measure a common flow with both techniques simultaneously, and then compare the results.

LDV - PIV Setup

The 500 mW TSI PowerSight™ was used for the LDV measurements, and the 4MP 15 Hz camera was used for the PIV. Both systems were setup on a water channel with cross section 150 x 150 x 650 mm, and outfitted with a cylinder mounted vertically with a diameter of 25 mm and a length of 150 mm. The measurement region was positioned 7 cylinder diameters downstream of the center of the cylinder.

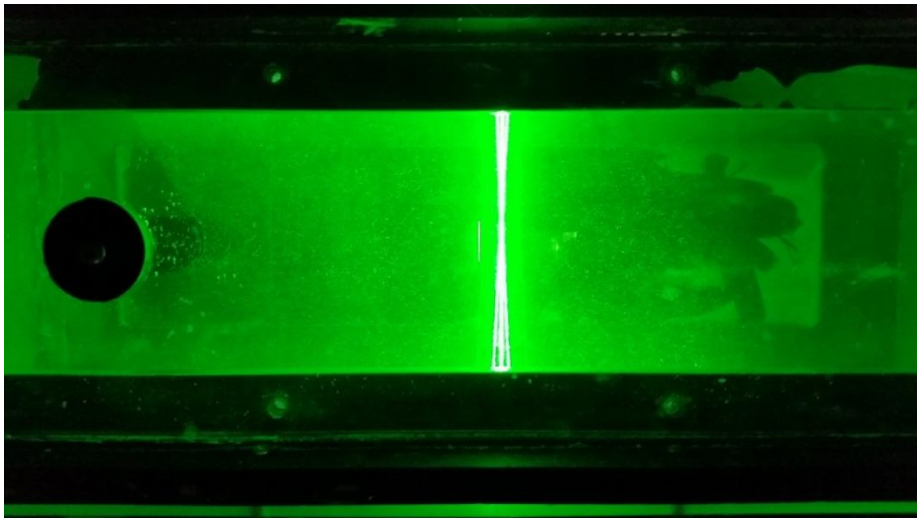

Fig. 1. The experimental setup showing the PIV light sheet and the LDV beam crossing downstream of the cylinder. Flow is from left to right.

The LDV data was acquired and processed using the TSI FlowSizer64™ software, and the PIV data was acquired and processed using the TSI INSIGHT 4G™ software with a deformation processing scheme which began with spot size of 64 x 64 and reduced to 32 x 32 pixels. No vector modification was used, meaning that no vector filters, smoothing, or removal was used, for either the PIV or LDV.

Results

The mean streamwise (u) velocity of the flow was 7.22 cm/s. A time trace showing the agreement between the LDV and the PIV can be seen in Figs. 2 and 3. The green line represents the LDV velocity measurements which were captured at an average of 150 Hz, and the red dots represent the PIV measurements which were recorded at 15 Hz.

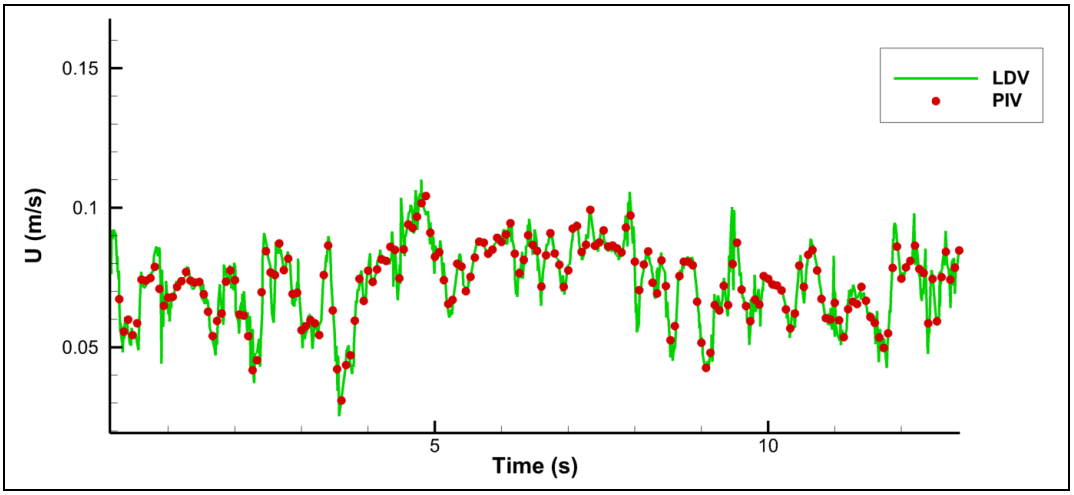

Fig. 2. Time trace showing the comparison between the LDV (green line) and the PIV (red dots).

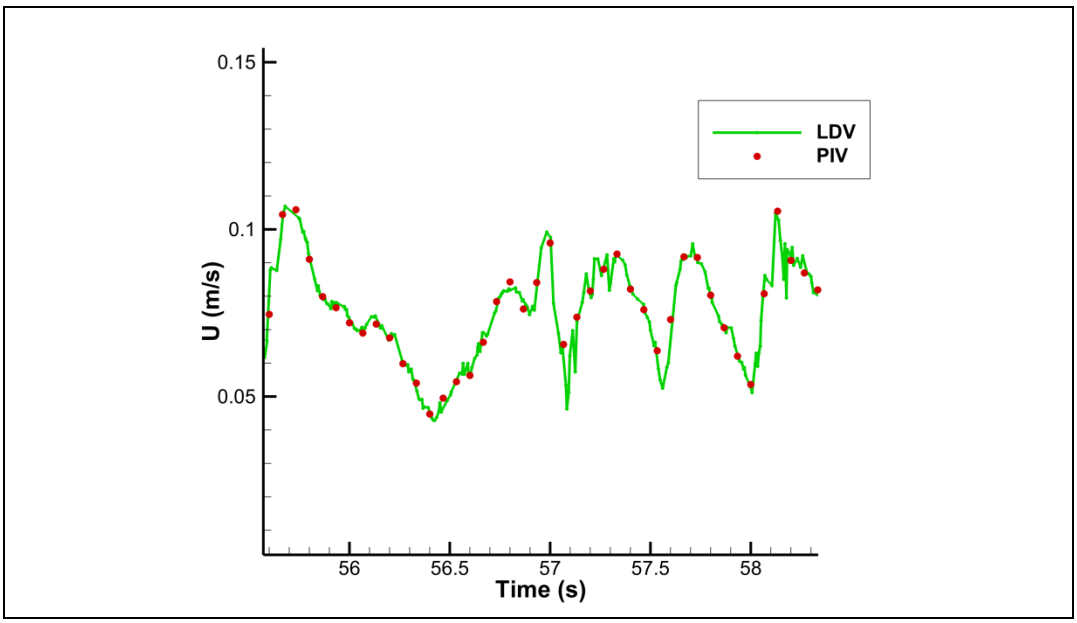

Fig. 3. A close up of the time trace showing the comparison between the LDV (green line) and the PIV (red dots).

The measurement techniques show remarkable agreement, with a coverage factor of greater than 99%.

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