ELSEVIER

Optics and Lasers in Engineering **27** (1997) 529–530
Published by Elsevier Science Limited
Printed in Northern Ireland
0143–8166/97/$17·00

PII: S0143–8166(96)00061–9

Guest Editorial

SPECIAL ISSUE ON *OPTICAL FLOW MEASUREMENT: RECENT ADVANCES AND APPLICATIONS*

Optical flow measurement techniques have proved themselves to be invaluable in applications as diverse as gas turbine aerodynamic studies to the measurement of blood flow. The information obtained is used to provide simple qualitative assessments of the flow through to high resolution quantitative data for comparison with computational fluid dynamic codes.

The eight contributions in this special issue cover recent developments and applications of optical flow measurement instrumentation. The first two papers report methods that do not require seeding particles in the flow. These are potentially very useful methods for applications where the introduction of seeding particles is difficult or where the particles have difficulty in following the flow, due for example, to large velocity gradients. The first paper by Lading *et al.* is a theoretical treatment of a new type of laser anemometer that is based on collective light scattering using the combination of a reference beam laser Doppler anemometer (LDA) and a laser transit anemometer (LTA). The second technique by Seasholtz *et al.* is based on molecular Rayleigh scattering applied to high speed flow measurement.

The following two papers describe recent applications of point velocity measurements using LTA and LDA techniques. The first of these, by Beversdorff *et al.*, employs solid state lasers in both LDV and LTA configurations to implement portable robust laser anemometers that are used to measure flow velocities around the fuselage of an aircraft in flight. The second of these contributions, from Ross, utilizes the attributes of single mode optical fibre to implement a three-dimensional LDV system based on a reference beam channel and two Doppler difference channels. The instrument was designed to measure axial and radial velocities around a test model in a large water tunnel. A particularly interesting feature is the design of the reference beam configuration for measurement of the on-axis velocity component. These contributions demonstrate the potential of high power solid state sources, sensitive solid state detectors and single mode optical fibre in solving many of the practical constraints encountered using conventional optical components.

In many test facilities there is a requirement to obtain data quickly to reduce acquisition costs and to obtain simultaneous information from an extended area of the flow. These requirements have led to several planar imaging techniques being developed based on the generation of a light sheet in the flow which is imaged onto a recording medium, for example, photographic film or CCD cameras. The most researched and applied of these techniques is particle image velocimetry (PIV). The next group of three papers describes developments in this area. Lee and Bryanston-Cross describe a technique using CCD technology to obtain velocity magnitude and direction from a single video frame. Lawson *et al.* present a method for optimizing a double-pulsed PIV system and find good agreement with theoretical predictions. The final paper in this group by Jones *et al.* describes the implementation of a fibre optic delivery system for PIV and demonstrates how this can be applied to an industrial research combustor. The final contribution by Ford and Tatam describes the development of the more recently reported planar imaging velocity measurement technique of Doppler global velocimetry (DGV) for application to turbomachinery studies. In contrast to PIV, DGV measures the velocity of particles entrained in the flow by transducing the Doppler frequency shift to an intensity change using an iodine absorption cell. The DGV technique appears to hold great promise for higher speed flows (10–100s $m\,s^{-1}$) with relatively simple three-dimensional implementation possible.

The range of subject matter covered by the contributions in this special issue demonstrates the continuing research importance and developing applications for optical flow measurement.

I would like to thank all the authors for their contributions and the referees for their invaluable comments on the manuscripts.

Ralph P. Tatam
Optical Sensors Group
Centre for Photonics and Optical Engineering
School of Mechanical Engineering
Cranfield University
Cranfield, Bedford MK43 0AL
UK