By C. F. King

Following their UK Symposium at the University of Durham in December, 1983 and a three day International Conference at the University of Manchester in December, 1985, this conference was organised by the LDA Users Group to follow the same successful format of having five internationally recognised invited lecturers, a wide range of refereed papers and a commercial exhibition of the latest instrument by all the leading manufacturers of laser equipment.

The invited lecturers each addressed a specific area of the LDA field. Bachalo’s review of the evolution of particle size and velocity measurement technology and Boutier’s of three dimensional laser velocimetry systems gave excellent overviews of two advancing fields while Wigley’s lecture on laser anemometry techniques in internal combustion engines and that of Dybbs and Edwards on refractive index matching for difficult situations both gave detailed recommendations for the application for LDA techniques in very demanding situations.

It was observed at the first of this series of international conferences that there was a lack of feedback into the computational modelling of turbulent flows of data obtained using LDA. Here, two years later, Gosman presented an invited lecture on the application of LDA measurements to computational fluid dynamics. In his lecture he stressed the complementarity of LDA and computational fluid mechanics (CFM), LDA providing the boundary condition information and data for validation and development of computer models while CFM may be used to plan and guide LDA experiments, minimising data requirements and assisting in interpretation of results. He suggested that the full benefit of the interaction is best achieved in collaborative programmes using both LDA and CFM, with combustion and multiphase flow problems seen as the most demanding and fruitful areas for future collaborative research.

It is refreshing to observe that the field of laser anemometry is one where the applications drive the technical advances. The demand for techniques capable of making measurements in situations with very difficult access has given rise to index matching. Dybbs and Edwards have developed considerable expertise in this field which they have applied to flows in rod bundles, porous media and within the boundary layer roughness elements. In his presentation of the lecture Dybbs stressed the practicalities of the technique and the ability to obtain significant fluid dynamic information in these important flow fields which are unapproachable with other methods. The problems of making measurements in rod bundles and the results obtained using index matching were also demonstrated by the authors of contributed papers.

Wigley described the making of measurements in internal combustion engines as the application of a very powerful innovative technique in an essentially conservative industrial environment. He emphasised the need for a measurement technique capable of providing good quality data quickly and reliably to a conservative and cost conscious industry. The need for data from an otherwise hostile and non-invadable environment points to LDA as the correct tool but the genius of its application rests firmly on meticulous and painstaking attention to detail in the design and use of the system adopted. The internal combustion engine field is one which is being tackled by a number of research groups using LDA and contributed papers examined the variation of swirl velocity and of turbulence in the compression stroke as a function of crank angle and of induction throttling.

Three dimensional flow fields have posed challenges for experimentalists for many years and the development of LDA systems capable of making simultaneous measurements of all three components of velocity is a significant step forward. Boutier’s review of the great variety of systems able to provide simultaneous measurement of the three components demonstrated the wide range of approaches taken, including three colour systems using three lasing lines of a single argon ion laser as the light source. He pointed out that although acquisition of vast quantities of high quality data is now possible, its presentation in a meaningful and readily grasped form is perhaps as much of a challenge as the development of the acquisition systems themselves.

The interaction of the laser system with the particles carried by a flow has given rise to a whole range of applications and advances. Particle sizing and the simultaneous measurement of velocity has been tackled by a wide range of techniques which Bachalo described as running the gamut from narrow-angle diffraction to wide-angle refractive measurements of light scatter. In his invited lecture he surveyed the techniques and presented sample results from the latest instrumentation. This is a field which is still rapidly advancing with more work needed in developing instrumentation that can perform reliably in very dense, high velocity and irregular-shaped particle environments. The uses to which such techniques are currently being put was also demonstrated by the contributed papers, including the sprays from pneumatic atomizers, pressure nozzles and nebulizers, while other authors described advances in technique, particularly the phase-doppler method. Wet steam droplets and bubbly flows have been investigated using LDA techniques and measurements in combustion and evaporating spray flows were also reported.

Fibre optics continued to be of interest both for miniaturisation and for improved access. Particle image velocimetry, an arriving art, has been applied to flow beneath waves while the flow fields investigated with established LDA techniques range from classical situations such as bluff bodies, cylinder wakes and sudden expansions to environmental flows, around buildings and over and around forest stands of coniferous trees.

The overall impression was of considerable progress in both techniques and fields of application, some exciting new developments in simultaneous particle sizing and velocity measurement with multiple point techniques such as PIV about to develop rapidly with the advent of cheap computing power.

The conference was sponsored by the University of Strathclyde and cosponsored by the royal Aeronautical Society and the Institution of Mechanical Engineers. The five invited lecturers and the forty three refereed papers are published in a conference volume available from BHRA, Publications Department, Cranfield, Bedford, UK. The LDA Users Group intend to hold a third international conference in 1989. A preliminary announcement and a call for papers will be issued in 1988.