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TURBULENCE MEASUREMENTS IN LIQUID FLOWS USING A DEDICATED LDV SYSTEM

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ABSTRACT

LDV measurements are providing information about flows in situations or environments where other techniques are not able to perform satisfactorily. The potential of the system is almost unlimited, provided the operation of the system becomes simpler and other aspects such as accessibility to measurement region, operational skill required to obtain accurate measurements, etc., do not become obstacles. The use of fiber optics is making the instrumentation mechanically simpler and immune to environmental noise while providing geometric flexibility. One key element of the measurement system, the signal processor, becomes the most crucial item in making the system operationally simple. Until now, the user skill required to obtain "good measurements" has restricted the use of LDV systems to experienced or highly skilled experimentalists.

This paper describes non-invasive measurements taken using a LDV system in water flows in hydraulic models. The focus here is on the detailed information that has been obtained using a simplified innovative measurement approach. This multichannel LDV system, controlled by a computer, does not need any user intervention in obtaining accurate measurements.

The key components of the system include the use of a fibre optic measuring head that is easily maneuverable, whereas the velocity information is povided by a new generation of signal processor. This processor operates automatically and has a built-in unique validation scheme that provides only good measurements. Further, its ability to search and seek the signal automatically makes it user independent and ideal for using it in any type of flow.

Multichannel measurements using this system were carried out in channel flows and boundary layers. The instantaneous velocity measurements are processed, using an IBM PC computer, to obtain mean, turbulence, and Reynolds stress values. In addition, the variation of these properties are also mapped over the region of interest. The entire operation including system set-up, data collection, processing, traversing of the measuring point, and display of results including mapping of the flow field is also achieved using a computer. The fact that no operator intervention is needed makes this approach attractive to be used by an experimentalist regardless of his expertise in LDV.

Multicomponent measurements made in this open channel flow provide statistical properties that are of interest in the intake region of hydraulic structures and energy transfer studies. Comparisons of measurements with existing data have also been carried out. Detailed measurements will be carried out in the boundary layer region around models also. The maneuverability of the fiber probe allows measurements very close to the surface. This measurement technique has provided higher level statistics in such complex flows. Discussion of the nature of the property variations provide better understanding, which is of relevance in hydraulic flows.

This unique method to measure flow can be used in many potentially new applications such as instrumenting models and building dedicated systems for monitoring and measuring flows and mixing applications. Accuracy and measurement ease become the most important factors since the system operates automatically without user intervention.

NOTE: This paper was unavailable at press time. This abstract was prepared by the Organizing Committee. Unbounded copies of the paper may be obtained from the author(s).