Readers' Forum

Brief discussions of previous investigations in the aerospace sciences and technical comments on papers published in the AIAA Journal *are presented in this special department. Entries must be restricted to a maximum of 1000 words, or the equivalent of one* Journal *page including formulas and figures. A discussion will be published as quickly as possible after receipt of the manuscript. Neither the AIAA nor its editors are responsible for the opinions expressed by the correspondents. Authors will be invited to reply promptly.*

Comment on "Application of a Three-Sensor Hot-Wire Probe for Incompressible Flow"

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THE authors of Ref. 1 have presented a new method for the calibration and use of a three-sensor hot-wire or hot-film probe which offers, according to them, several advantages over existing methods, such as rapid and efficient processing of a large amount of data. They also claim that their method can accurately process data taken in flows with high turbulence intensities. Because the reader might get the wrong impression, I would like to add the following:

1) The linearization of the anemometry signals is the main contributor to the time required for hot-wire data processing (HWDP). In the present case, commercially available analog linearizers have been used. The financial cost to the experimentalist of the measurement system will be strongly influenced by the inclusion of these devices for each of the three sensors. Apart from that, such a linearizer may be quite inaccurate at high turbulence intensities and, at best, the signal-to-noise ratio will be only slightly degraded. In modern HWDP "linearization" is made digitally with the use of "look-up" tables allowing a fast conversion of the anemometer signals into velocity components.[2] This technique seems to be faster than using any algebraic relationship between the anemometer voltages and the velocity vector.

2) Qualification tests which can give confidence in the method have not been made. Instead, a comparison with LDV data has been made. This comparison may be inadequate and misleading, for the following reasons:

a) Only maximum values have been compared, not the whole profile.

b) Comparison between quite different experiments may be dangerous. We have recently seen the same experiments[3] made at different places give entirely different results. Scaling laws for turbulent wakes are not widely acceptable and choosing points with the same velocity ratio (0.80) for comparison, is rather inappropriate. The momentum thickness at the trailing edge could possibly be a length scale that could be used to find corresponding points in the two experiments.

3) The turbulence intensity of the flow that has been measured is rather low. Taking typical maximum values (-10 deg $\leq\alpha\leq 15$ deg and -5 deg $\leq\delta\leq 18$ deg) from their Fig. 8 for the pitch and yaw angles of the velocity vectors, it can be concluded that the turbulence intensities under which the method has been tested are rather low.

The best way to test any new measurement technique is to apply the technique in a well-established flow such as a channel flow[4] or pipe or boundary-layer flow.[5,6] By tilting and rotating the probe up to 30 deg the technique, or scheme, can be tested to severe yaw or pitch angles of the instaneous velocity vector, i.e., to an artificially high turbulence intensity.

References

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THE authors would like to thank Dr. Andreopoulos for his review of our paper on the use of a three-sensor hot-wire or hot-film probe in incompressible flow. In response to his discussion, we would like to add the following comments.

This method was developed to acquire and process large amounts of velocity data taken between stages in a large scale axial flow research turbine. As was reported in Ref. 1, in order to adequately define the spatial and temporal variation of both the mean and turbulence velocity fields in this complex, unsteady, three-dimensional flow, it was necessary to obtain approximately 120 million measurements of the instantaneous velocity vector. The hot-wire data reduction techniques that were available during the planning of this

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