On On directional sensitivity of thermo-anemometer

split-fiber probes

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Abstract

Thermo-anemometry is a well-established experimental technique used in fluid dynamics investigations for more than 60 years. It is predominantly applied to research in the field of turbulence and low speed flow interactions. An undisputable advantage of this technique is above all its very high frequency response to flow unsteadiness and also the fact that a probe insertion causes relatively minor flow disturbances. On the other hand, the heated thermo-anemometer sensors are very fragile and can be easily destroyed by impact of flow impurities. Thus, its use is limited mostly to clean flow environments and laboratory conditions only.

There are many industrial or semi-industrial research tasks demanding reliable measurements of velocity unsteadiness of a high frequency content. Thermo-anemometer fiber probes, and in particular split-fiber probes, can fulfill most of these tasks. Although, the frequency response range of split-fiber probes is limited to about 25 kHz, their ruggedness makes them a suitable research tool for a number of non-laboratory flow investigations.

Direction sensitivity of split-fiber probes in a measurement plane perpendicular to the fiber centerline is quite high. The direction characteristic is linear within the incidence angle range of plus/minus 45 deg. Beyond this angular range, the characteristic becomes non-linear, due to the flow separation effects on the downstream side of the cylindrical sensor. Never-the-less the direction characteristic is still unambiguous up to the range of plus/minus 90 deg. Provided that the probe is properly calibrated and a suitable data reduction procedure is used, split-fiber probes can be reliably used for very broad range of flow incidence angles.

The effects of flow Reynolds number and sensor selected overheat ratio on probe direction characteristics will be manifested. A data reduction scheme utilizing an iterative method as well as a method relying on a merit function will be also presented.

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