Correcting Hot-Wire Spatial Resolution Effects

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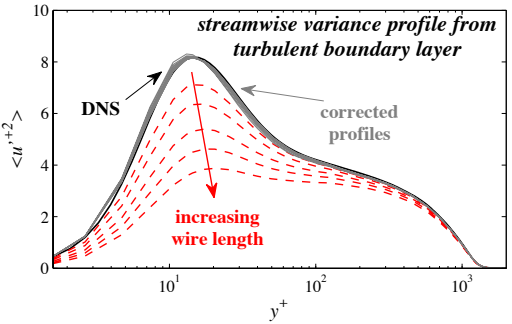
While, to date, there are no measurement techniques capable of reaching the versatility of hot-wire probes and their frequency response, the issue of their spatial resolution is still a matter of debate regarding the effective accuracy achievable with such a measurement tool. Spatial resolution problems are typically encountered, even for mean velocity values, when multi-wire probes are used, however, single-wire probes are typically less sensitive to this effect. Nonetheless, when the analysis deals with high Reynolds number flows and therefore small turbulent structures, then spatial resolution may again be an issue, especially if second and higher-order moments are of interest. Naturally, the trend in the past years has been driven by the idea that spatial resolution could only be improved by decreasing the hot-wire length. On the other hand, new approaches based on the theoretical response of the probe, or more simply on empirical fits of the velocity profiles, have quantified such an effect in particular for the variance of the measured streamwise velocity component and proposed correction schemes. Despite the fact that this latter issue is not yet fully understood for the turbulence intensity, there is even more uncertainty about the measured higher-order moments where even less experimental work has been done in order to quantify such effects as function of the wire length.



Within the present work, a simplified model to correct the filtering effect by assuming that this process is only related to the transverse Taylor micro-scale has been developed. The model was then used to formulate a procedure to evaluate both the turbulence intensity and the transverse Taylor micro-scale in turbulent flows. Recent efforts have now also shed light on the effect on higher-order moments as well as provided a correction scheme. In-house direct numerical simulation data of wall bounded turbulent flows is used to validate the model, while hot-wire measurements have been employed to assess its applicability and performance at high Reynolds numbers.

A. Segalini, R. Örlü, A. Talamelli, A. Segalini, R. Örlü, P. Schlatter & P.H. Alfredsson 2013, *Correcting hot-wire spatial resolution effects in third and fourth-order velocity moments in wall-bounded turbulence.* Exp. Fluids. **54**:1496.