A hot-wire anemometry guide on *where to or not to* measure.

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Recent interest in turbulent wake studies has seen a renewed utilization of Hot-Wire Anemometry (HWA) in complex, unsteady, turbulence measurements, due to its simple operation compared to laser-optical measurement techniques. Despite its superior temporal and spatial resolution, its weaknesses in such complex flows are well-documented, such as its directional ambiguity for high-flow angles and back-flow in particular. Well-knowing this shortcoming, the range of applicability of this measurement method is practically restricted to flow domains in which backflow is not to be expected either based on previous studies or *ad hoc* measures based on the measured mean velocity profile. The complex interplay of rectified streamwise velocity signals and high-flow angles could seemingly produce distinctive non-zero mean velocity readings as clearly demonstrated in Fig 1a. This figure compares the mean streamwise velocity readings from a single wire (SW) and an X-wire (XW) probe in the near-field wake region of a 3D bluff body. Access to only these HWA measurements would seemingly indicate that the flow field is far from exhibiting backflow. The Prandtl tube measurements on the other hand clearly indicate flow reversal albeit the mirrowing axis for the rectification is far above a zero mean. Only the laser-Doppler velocimetry (LDV) measurements exemplify the full extent of the falsified HWA measurements. The full extent of the severity of biased measurements is given in Figure 1b depicting the percentage of instantaneous outliers for an XW probe as a function of streamwise/wall-normal position behind the bluff body.

The final presentation aims to present measures that are solely based on the measured hot-wire data to discern in which flow region the measurements are falsified due to rectification errors, thereby providing guidelines for experimentalists without needing access to measurements by means of other techniques.

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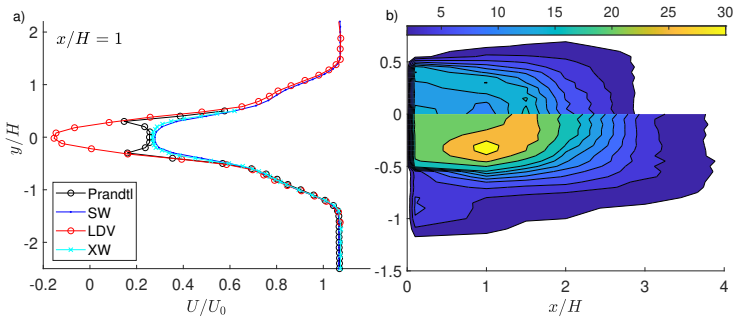

Figure 1: a) Comparison of measured mean streamwise velocity profiles at x/h =1 by means of SW, XW, Prandtl tube and LDV. b) Percentage of outliers for XW calibration maps covering flow angles up to ±45° (top) and ±30° (bottom).