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On the optimal number and sensor arrangement of multi-sensor hot-wire probes to measure the velocity vector and the velocity gradient tensor in turbulent boundary layers P. VUKOSLAVCEVIC, Univ. of Montenegro, J. WALLACE, N. BARATLIS, E. BALARAS, Univ. of Maryland — Although a 3-sensor array should be sufficient to simultaneously measure the three velocity components, and three such arrays can be combined to measure the six velocity gradients in the cross-stream plane, a fourth sensor has been used for probes developed over the last two decades in order to increase measurement accuracy and the uniqueness range of multi-sensor hot-wire probes. A highly resolved turbulent channel flow DNS with $Re_\tau = 200$ was used to investigate the optimal sensor number and arrangement. The sensors were represented as points on the simulation grid, the effective velocity cooling each sensor was determined assuming an ideal sensor response, and the sensor equations were then solved in response to the DNS field to obtain velocity vector and velocity gradient tensor components. It will be shown that the fourth sensor of each of the three arrays is unnecessary for turbulent boundary layer flow measurements if the arrays' three sensors are arranged judiciously. Requiring only nine sensors instead of twelve is a great advantage with respect to probe construction, size and sensor interference. Results from the types of 12-sensor probes previously used will be compared to those from an optimally designed 9-sensor probe.

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