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An optimal arrangement of a three or four hot-wire sensor array to simultaneously measure velocity component statistics in turbulent wall flows JAMES WALLACE, University of Maryland, PETAR VUKOSLAVCEVIC', University of Montenegro — A highly resolved turbulent channel flow DNS with $Re_\tau = 200$ has been used to investigate the ability of probes made up of arrays of three or four hot-wire sensors to simultaneously and accurately measure statistics of all three velocity components in turbulent wall flows. Such arrays have also been combined in probes to measure, in addition, velocity gradient based statistics. Various virtual sensor arrangements have been tested in order to study the effects of position, number of sensors and spatial resolution on the measurements. First, the effective cooling velocity was determined for each sensor of an idealized probe, where the influence of the velocity component tangential to the sensors and flow blockage by the presence of the probe are neglected. Then, simulating the response of the virtual probes to obtain the effective velocities cooling the sensors, velocity component statistics have been calculated neglecting the velocity gradients over the probe sensing area. A strong influence of both mean and fluctuation velocity gradients on measurement accuracy was found. A new three-sensor array configuration designed to minimize the influence of the velocity gradients is proposed, and its accuracy is compared to two-sensor X- and V-array configurations.

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