Abstract Submitted
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The accuracy of cross-stream velocity gradients measured by multi-sensor hot-wire probes MILAN ŠEKULARAC, PETAR VUKOSLAVČEVIĆ, University of Montenegro, JAMES WALLACE, ELIAS BALARAS, NIKOLAOS BERATLIS, University of Maryland — A highly resolved turbulent minimum channel flow DNS with $Re_\tau = 180$ was used to investigate the effects on the accuracy of simultaneous measurements of velocity gradient components resulting from the spatial resolution and sensor arrangement of twelve-sensor hot-wire probes. The sensors were represented as points on the simulation grid, the effective velocity cooling each sensor was determined and sensor equations were then solved in response to the DNS field to obtain velocity and velocity gradient components. It has been found that all cross-stream velocity gradients except $\partial v/\partial y$ and $\partial w/\partial z$ can be measured with reasonable accuracy. Depending on the arrangement of the sensors and the array and probe sizes, either one or the other of these two gradients is subject to high measurement error in the near wall region of this bounded flow. As a consequence, the estimation of $\partial u/\partial x$ from the direct measurement of $\partial v/\partial y$ and $\partial w/\partial z$ by applying the continuity equation for incompressible flow is questionable. It appears that this is the likely explanation for the weak correlation in the near wall region of $\partial u/\partial x$, estimated by applying Taylor's hypothesis, with its value estimated using the continuity equation as has been found in several investigations using twelve-sensor probes.

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