Abstract Submitted
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The accuracy of Reynolds shear stress and velocity-vorticity component correlations measured by a 12-sensor hot wire probe JAMES WALLACE, University of Maryland, PETAR VUKOSLAVČEVIĆ, University of Montenegro, ELIAS BALARAS, NIKOLAOS BERATLIS, University of Maryland — A highly resolved (with sub-Kolmogorov length cells) turbulent channel flow DNS with $Re_\tau = 180$ was used to investigate the effects of spatial resolution and sensor arrangements of multi-sensor hot-wire probes on measurements of Reynolds shear stress and velocity-vorticity component correlations. Such correlations appear in the unclosed Reynolds shear stress gradient term in the mean momentum balance when expressed as $\partial\overline{uv}/\partial y = \overline{w\omega_y} - \overline{v\omega_z}$. The sensors are represented as points on the simulation grid, the effective velocity cooling each sensor is determined and the sensor cooling equations are then solved in response to the DNS field to obtain velocity and vorticity vector components. It is observed that the Reynolds shear stress and some of the velocity-vorticity correlations strongly depend, not only on the probe spatial resolution, but also on the arrangement of the sensors. There is no optimal sensor number and arrangement that gives the highest accuracy for all correlations. Various sensor numbers and arrangements are proposed depending on the correlations to be measured, and resolution effects for each of these arrangements are analyzed.

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