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Assessment of Scaling Laws in Fully Developed Turbulent Pipe and Channel Flows. E.-S. ZANOUN, BTU, Cottbus, Germany, H. NAGIB, IIT, USA, F. DURST, Erlangen-Nürnberg Univ., L. TERENTIEV, Erlangen-Nürnberg Univ., Germany — We investigated effects of Reynolds number (Re) on mean flow scaling for turbulent pipe and channel flows. Of particular interest are the streamwise mean velocity distribution, the Reynolds shear stress, and the turbulent kinetic energy production. For high Re, the $-u'_1 u'_2$ collapsed when scaled with wall variables, indicating Re-independence close to the wall, i.e. $y^+ < 100$. This contradicts a conclusion by Gad-el-Hak and Bandyopadhyay, that inner scaling fails to collapse the $-u'_1 u'_2$ profiles. However, in the core region of pipe and/or channel the $-u'_1 u'_2$ data do not collapse using inner scaling. For high enough Re, the $-u'_1 u'^{+}_2$(i.e. $-u'_1 u'_2/u^2_\tau$) approaches a maximum value outside the viscous sublayer and the location of its maximum was found to move away from the wall as Re increases. Better agreement was achieved for $-u'_1 u'^{+}_2$ when utilizing Panton's formula with the new von Kármán constant obtained recently by present authors, κ=0.37 & κ=0.38, for channel, and pipe respectively. Re-independence of turbulent kinetic energy production was obtained for $Re_\tau \geq 2\times10^3$ when data are represented in wall units and a peak value of approximately 0.25 was obtained at a fixed distance from the wall, $y^+ \approx 12$. The position of the normalized maximum $[-u'_1 u'^{+}_2(dU^+/dy^+)]$ was found to coincide with wall-normal position at which turbulent and viscous shear stresses are equal.

Hassan Nagib
IIT, Chicago, USA

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