DNS of Couette flows with wall transpiration up to $Re_\tau = 1000$

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We present a new set of direct numerical simulation data of a turbulent plane Couette flow with constant wall-normal transpiration velocity $V_0$, i.e. permeable boundary conditions, such that there is blowing on the lower side and suction on the upper side - see figure 1.

![Figure 1: Schematic view of Couette flow with the moving wall velocity $U_w$ and wall-normal transpiration velocity $V_0$. Fluid is blown through the lower wall and removed from the upper wall at a constant rate.](image)

Hence, there is no net change in flux to preserve periodic boundary conditions in streamwise direction. Simulations were performed at $Re_\tau = 250, 500, 1000$ with varying transpiration rates in the range of $V_0^+ \approx 0.03$ to 0.085. Additionally, a classical Couette flow case at $Re_\tau = 1000$ is presented for comparison. As a first key result we found a considerably extended logarithmic region of the mean velocity profile, with constant indicator function $\kappa = 0.77$ as transpiration increases - see figure 2. Further, turbulent intensities are observed to decrease with increasing transpiration rate. Mean velocities and intensities collapse only in the cases were the transpiration rate is kept constant while they are largely insensitive to friction Reynolds number variations. The long and wide characteristic stationary rolls of classical turbulent Couette flow are still present for all present DNS runs. The rolls are affected by wall transpiration, but they are not destroyed even for the largest transpiration velocity case. Spectral information indicate the prevalence of the rolls and the existence of wide structures near the blowing wall. The statistics of all simulations can be downloaded from the webpage [http://www.fdy.tu-darmstadt.de/dns_database/direct_numerical_simulation.de.jsp](http://www.fdy.tu-darmstadt.de/dns_database/direct_numerical_simulation.de.jsp).

![Figure 2: Cases with constant $Re_\tau = 1000$:](image)