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Drag control of wall-bounded turbulent flows. XI CHEN, JIE YAO, FAZLE HUSSAIN, Department of Mechanical Engineering, Texas Tech University — Using direct numerical simulations of turbulent channel flow, we present a new method for skin friction reduction, enabling large-scale flow forcing without requiring instantaneous flow information. We show that the lack of drag reduction at high Re ($Re_\tau =$ 550) recently reported by Canton *et al.* [J. Canton *et al.*, PRF (2016)] is remedied by a proper choice of the large-scale control flow, i.e. via near-wall spanwise opposed wall-jet forcing (SOWF), each wall-jet covering multiple streaks. The control method is characterized by three parameters, namely, the wall-jet amplitude A^+, the spanwise wall-jet spacing Λ^+, and the wall-jet height y_c^+ (+ indicates viscous scaling). We show as an example that with a choice of $A^+ \approx .015$, $\Lambda^+ \approx 1200$ and $y_c^+ = 30$ (these three parameters values were found to produce maximum drag reduction for $Re_\tau = 180$), the flow control definitely suppresses the wall shear stress at a series of Reynolds numbers, namely, 19%, 14%, and 12% drag reductions at $Re_\tau = 180$, 395, and 550, respectively. Vortex structures (λ_2) and flow statistics (Reynolds shear stress, rms of vorticities, kinetic energy budget, etc.) are further examined to explain the mechanism of drag reduction and increase.

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