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Direct numerical simulation of turbulent boundary layer with constant thickness[1] YICHEN YAO, CHUNXIAO XU, WEIXI HUANG, Tsinghua Univ — Direct numerical simulation is performed to turbulent boundary layer (TBL) with constant thickness at $Re_\theta = 1420$. Periodic boundary condition is applied in the streamwise direction, and a mean body force equivalent to the convection term in the mean momentum equation is imposed in this direction. The body force is calculated using the published TBL data of Schlatter and Orlu (2010) at $Re_\theta = 1420$. The presently simulated TBL is compared with the conventional TBL and turbulent channel flow at the prescribed Reynolds number. The turbulent statistics agrees well with that of Schlatter and Orlu (2010). The pre-multiplied energy spectra in current simulation also present high similarity with the conventional TBL, while differ obviously with those in turbulent channel. The successful replication of turbulent boundary in the current simulation provides an alternative method for boundary layer simulation with much less computational cost. Meanwhile, in aspect of both turbulent statistics and flow structures, the current results indicate that the differences between turbulent channel and boundary layer flow mainly caused by the discrepancy in driving force distribution rather than the periodic boundary restriction.

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