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Direct numerical simulation of a turbulent boundary layer with separation and reattachment at $Re_\theta = 1500$ HIROYUKI ABE, Japan Aerospace Exploration Agency — Direct numerical simulation (DNS) has been performed in a flat-plate turbulent boundary layer with large adverse and favorable pressure gradients, thus involving separation and reattachment. This work extends a series of our DNSs at lower Reynolds numbers (Abe et al. 2012; 2015), where suction and blowing are imposed at the upper boundary for providing pressure gradients. Particular attention is given to the Re dependence. The present inlet Reynolds number is equal to $Re_\theta = 1500$, which is by a factor of five larger than that for seminal DNSs (Spalart & Coleman 1997; Na & Moin 1998). Number of grid points used are 13 billion ($N_x \times N_y \times N_z = 4096 \times 1536 \times 2048$ in the streamwise (x), wall-normal (y) and spanwise (z) directions, respectively) to resolve the essential motions. At the inlet, spatial resolution normalized by wall units is set to $\Delta x^+ = 8$, $\Delta y^+ = 0.1 \sim 10$, $\Delta z^+ = 5$. Significant Re effect is observed for skin friction outside the bubble, while it is small for mean quantities inside the bubble. In the separated region, large-scale structures of streamwise velocity fluctuations and pressure rollers become more prominent with increasing Re_θ, which impinge significantly on the wall at reattachment.

Hiroyuki Abe
Japan Aerospace Exploration Agency

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