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Direct numerical simulations of a turbulent separation bubble over a wide Reynolds-number range HIROYUKI ABE, YASUHIRO MIZOBUCHI, YUICHI MATSUO, Japan Aerospace Exploration Agency, PHILIPPE R. SPALART, Boeing Commercial Airplanes — Direct numerical simulations (DNSs) of a turbulent boundary layer separating from a flat plate and reattaching have been performed with inlet data generated by rescaling-recycling at Re_θ=300, 600 and 900. The focus is put on massive separation and the set-up close to those of Spalart & Coleman (1997) and Na & Moin (1998) at lower Reynolds number. This extends the work of Abe et al. (CTR Annual Brief, 2012) but removes the stagnation point, present over the bubble and due to strong blowing and suction V_{top} at the upper boundary. The new simulations have a reduced V_{top}, compensated by a smaller ceiling height. The overall agreement with the earlier DNSs is satisfactory. A small difference appears in the recovery region, in which turbulence is reduced slightly in the present DNSs. At all three Re_θ, separation and reattachment locations are nearly identical. Also, the mean spanwise vorticity is conserved to a large extent along the bubble. We associate this inviscid transport with the high peak in Reynolds shear stress known to appear after reattachment, and to be a challenging phenomenon for turbulence theories and models. In the latter region, a significant Re dependence is found for the skin friction due to the weak development of near-wall turbulence.

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