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DNS study of large-scale structures in a separated turbulent boundary layer HIROYUKI ABE, YASUHIRO MIZOBUCHI, YUICHI MATSUO, Japan Aerospace Exploration Agency — Direct numerical simulations (DNSs) of a separated flat-plate turbulent boundary layer have been carried out. The inlet data are prescribed by DNSs of a zero-pressure-gradient turbulent boundary layer with the rescaling-recycling method; blowing and suction are imposed at the upper boundary for producing a separation bubble. The Reynolds numbers at the inlet are set to be Re_θ=300, 600 and 900, where Re_θ is the Reynolds number based on the freestream velocity and the momentum thickness. Particular attention is given to large- scale structures existing in a separated region. Results indicate that large-scale organized structures of the streamwise velocity fluctuation appear in a detached shear layer when a large separated region is formed. The latter structures consist of positive and negative regions alternating in the spanwise direction with a spacing of about $2 \sim 3\delta_{99}$ (δ_{99} denotes the 99% boundary layer thickness at the inlet), which become more apparent with increasing Reynolds number. They are most likely associated with large-scale spanwise meandering of the separation line. There is also close relationship between the large-scale structures and vortical structures, the latter tending to form vortex clusters where hairpin-like vortices are also observed.

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