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LES of Separated Flows Over an Airfoil at Moderate Reynolds Numbers[1] G. CASTIGLIONI, J.A. DOMARADZKI, USC, M. GRILLI, S. HICKEL, TUM, Germany — Separation effects strongly affect flows for unmanned aerial vehicles, micro air vehicles, and rotating machinery, e.g., wind turbines, propellers, and low pressure turbines. The Reynolds number for such flows are usually moderate and they can be accurately simulated using DNS. However, the large computational cost of DNS makes this technique unsuitable for industrial applications while less expensive RANS and LES techniques encounter difficulties in simulating such flows because they consist of a mixture of laminar, separated, transitional, and turbulent regions. In this work we investigate an ability of LES to accurately predict the behavior of such flows on a benchmark case of a laminar separation bubble on a NACA-0012 airfoil at $Re_c = 5 \times 10^4$ at 5 deg of incidence for which accurate DNS results are available (Jones et al., JFM 602, 175 (2008)). Using a conservative immersed boundary method with the Adaptive Local Deconvolution Method (ALDM) we have performed 2D and 3D simulations of this flow with resolution reduced drastically from that in the benchmark DNS. The results to date show good predictions for the pressure coefficient C_p and the location of the separation point, but the friction coefficient C_f is not predicted accurately.

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