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DNS and LES of Separated Flows at Moderate Reynolds Numbers[1] F. CADIEUX, J.A. DOMARADZKI, USC, T. SAYADI, S. BOSE, Stanford-CTR, F. DUCHAINE, CERFACS, France — Flows in rotating machinery, for unmanned and micro aerial vehicles, wind turbines, and propellers consist of different flow regimes. First, a laminar boundary layer is followed by a laminar separation bubble with a shear layer on top of it that experiences transition to turbulence. Subsequently, the separated turbulent flow reattaches and evolves downstream from a nonequilibrium turbulent boundary layer to an equilibrium one. Typical RANS and LES turbulence modeling methods experience difficulties when simulating such flows because they were developed for fully developed turbulent flows. This currently leaves DNS as the only reliable but computationally expensive alternative. Our work assesses the capability of LES to reduce the resolution requirements for such flows. Flow over a flat plate with suitable velocity boundary conditions away from the plate to produce a separation bubble is considered. Benchmark DNS data for this configuration was generated with the resolution of 50×10^6 mesh points; also used was a different DNS database with 15×10^6 points reported by Spalart and Strelets in JFM 403 (2000). Employing two codes, one using structured and another unstructured mesh, we concluded that accurate LES are possible using O(1%) of the DNS resolution.

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