Wall-Resolved Large-Eddy Simulation of Turbulent Flow Past a NACA0012 Airfoil

WEI GAO, WEI ZHANG, RAVI SAMTANEY, KAUST — Large-eddy simulation (LES) of turbulent flow past a NACA0012 airfoil is performed at angle of attack (AoA) 3° and $Re_c = 2.3 \times 10^4$. The filtered incompressible Navier-Stokes equations are spatially discretized using an energy conservative fourth-order scheme developed by Morinishi et al. (J. of Comput. Phys., 1998), and the subgrid-scale (SGS) tensor is modeled by the stretched-vortex SGS model developed by Pullin and co-workers (Phys. of Fluids, 2000, J. of Fluid Mech., 2009). An extension of the original stretched-vortex SGS model is utilized to resolve the streak-like structures in the near-wall flow regions. The mean velocity and turbulence intensity profiles on airfoil surface and in wake are validated against experimental data reported in Dong-Ha Kim et al. (AIAA, 2009). To further verify our LES capacity, some high-order turbulence quantities are also compared with the DNS results produced by our in-house DNS code. The effect of grid-refinement on the wall-resolved LES approach is also discussed.

1Supported by KAUST OCRF funded CRG project on simulation of turbulent flows over bluff bodies and airfoils.