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Wall-resolved LES of high Reynolds number airfoil flow near stall condition for wall modeling in LES: LESFOIL revisited[1] KENGO ASADA, Tokyo University of Science, SOSHI KAWAI, Tohoku University — Wall-resolved large-eddy simulation (LES) of an airfoil flow involving a turbulent transition and separations near stall condition at a high Reynolds number 2.1 x 10^6 (based on the freestream velocity and the airfoil chord length) is conducted by using K computer. This study aims to provide the wall-resolved LES database including detailed turbulence statistics for near-wall modeling in LES and also to investigate the flow physics of the high Reynolds number airfoil flow near stall condition. The LES well predicts the laminar separation bubble, turbulent reattachment and turbulent separation. The LES also clarified unsteady flow features associated with shear-layer instabilities: high frequency unsteadiness at St $\simeq$130 at the laminar separation bubble near the leading edge and low frequency unsteadiness at St $\simeq$1.5 at the separated turbulent shear-layer near the trailing edge. Regarding the near-wall modeling in LES, the database indicates that the pressure term in the mean streamwise-momentum equation is not negligible at the laminar and turbulent separated regions. This fact suggests that widely used equilibrium wall model is not sufficient and the inclusion of the pressure term is necessary for wall modeling in LES of such flow.

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