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Evaluation of turbulence models for prediction of separated turbulent boundary layer under unsteady adverse pressure gradients[1]
JUNSHIN PARK, DONGHYUN YOU, POSTECH — Predicitive capabilites of Reynolds-averaged Navier-Stokes (RANS) techniques for separated flow under unsteady adverse pressure gradients have been assessed using SST $k-\omega$ model and Spalart-Allmaras model by comparing their results with direct numerical simulation (DNS) results. Both DNS and RANS have been conducted with a zero pressure gradient, a steady adverse pressure gradient, and an unsteady adverse pressure gradient, respectively. Comparative studies show that both RANS models predict earlier separation and fuller velocity profiles at the reattachment zone than DNS in the unsteady case, while reasonable agreements with DNS are observed for steady counterparts. Causes for differences in the predictive capability of RANS for steady and unsteady cases, are explained by examining the Reynolds stress term and eddy viscosity term in detail. The Reynolds stress and eddy viscosity are under-predicted by both RANS models in the unsteady case. The origin of the under-prediction of the Reynolds stress with both RANS models is revealed by investigating Reynolds stress budget terms obtained from DNS.

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Junshin Park
POSTECH

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