**Herbst, A. H.**; **Schlatter, P.**; **Henningson, D. S.**
**Simulations of turbulent flow in a plane asymmetric diffuser.** (English) Zbl 1258.76104
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Summary: Large-eddy simulations (LES) of a planar, asymmetric diffuser flow have been performed. The diverging angle of the inclined wall of the diffuser is chosen as 8.5deg, a case for which recent experimental data are available. Reasonable agreement between the LES and the experiments is obtained. The numerical method is further validated for diffuser flow with the diffuser wall inclined at a diverging angle of 10deg, which has served as a test case for a number of experimental as well as numerical studies in the literature (LES, RANS). For the present results, the subgrid-scale stresses have been closed using the dynamic Smagorinsky model. A resolution study has been performed, highlighting the disparity of the relevant temporal and spatial scales and thus the sensitivity of the simulation results to the specific numerical grids used. The effect of different Reynolds numbers of the inflowing, fully turbulent channel flow has been studied, in particular, $Re_b = 4,500$, $Re_b = 9,000$ and $Re_b = 20,000$ with $Re_b$ being the Reynolds number based on the bulk velocity and channel half width. The results consistently show that by increasing the Reynolds number a clear trend towards a larger separated region is evident; at least for the studied, comparably low Reynolds-number regime. It is further shown that the small separated region occurring at the diffuser throat shows the opposite behaviour as the main separation region, i.e. the flow is separating less with higher $Re_b$. Moreover, the influence of the Reynolds number on the internal layer occurring at the non-inclined wall described in a recent study has also been assessed. It can be concluded that this region close to the upper, straight wall, is more distinct for larger $Re_b$. Additionally, the influence of temporal correlations arising from the commonly used periodic turbulent channel flow as inflow condition (similar to a precursor simulation) for the diffuser is assessed.

**MSC:**

76F65 Direct numerical and large eddy simulation of turbulence
76M20 Finite difference methods applied to problems in fluid mechanics
76M22 Spectral methods applied to problems in fluid mechanics



**Keywords:**

turbulent separation; diffuser flow; large-eddy simulation; dynamic Smagorinsky model

**Software:**

STAR-CD

**Full Text:** DOI

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