Ohlsson, Johan; **Schlatter, Philipp**; **Fischer, Paul F.**; **Henningson, Dan S.**
Direct numerical simulation of separated flow in a three-dimensional diffuser. (English)
Zbl 1189.76318
J. Fluid Mech. 650, 307-318 (2010).

Summary: A direct numerical simulation (DNS) of turbulent flow in a three-dimensional diffuser at $Re = 10000$ (based on bulk velocity and inflow-duct height) was performed with a massively parallel high-order spectral element method running on up to 32768 processors. Accurate inflow condition is ensured through unsteady trip forcing and a long development section. Mean flow results are in good agreement with experimental data by Cherry et al. (Intl J. Heat Fluid Flow, vol. 29, 2008, pp. 803-811), in particular the separated region starting from one corner and gradually spreading to the top expanding diffuser wall. It is found that the corner vortices induced by the secondary flow in the duct persist into the diffuser, where they give rise to a dominant low-speed streak, due to a similar mechanism as the 'lift-up effect' in transitional shear flows, thus governing the separation behaviour. Well-resolved simulations of complex turbulent flows are thus possible even at realistic Reynolds numbers, providing accurate and detailed information about the flow physics. The available Reynolds stress budgets provide valuable references for future development of turbulence models.

MSC:

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

Software:

Nek5000

Full Text: DOI

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