Numerical Investigation of Turbulent Channel Flows using a Semi-spectral Code

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ABSTRACT

In the present work, wall-resolved Large Eddy Simulations (LES) of incompressible turbulent flows are performed for a convergent-divergent channel with adverse pressure gradients. Comparative results are shown for different Reynolds numbers and an analysis in terms of wall friction coefficient and budget of turbulent kinetic energy is presented from LES calculations. A discussion of the physical mechanism of streak instability, recently discovered by Laval *et al.*, is extended to a higher Reynolds number flow for two different channel configurations. The budgets of turbulent kinetic energy and individual Reynolds stresses are investigated at the separation and at re-attachment points along the channel. The numerical code employed in this work resolves the incompressible form of the Navier-Stokes equations discretized in a structured grid context. These equations are solved using a semi-spectral methodology. The WALE subgrid scale model is employed in the current wall-resolved large eddy simulations. The results obtained for the present Reynolds numbers show that the streak instability discovered by Laval *et al.* persists even without the presence of curvature at the adverse pressure gradient region. The analysis of the turbulent kinetic energy budgets finds well-defined patterns, for the behavior of turbulent properties along the wall-normal direction, at separation and at re-attachment points.