DIRECT NUMERICAL SIMULATION OF TURBULENT CHANNEL FLOWS USING A STABILIZED FINITE ELEMENT METHOD

by

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ABSTRACT

Direct numerical simulations (DNS) of incompressible turbulent channel flows at $\mathrm{Re}_\tau = 180$ and 395 (i.e. Reynolds number, based on the friction velocity and channel half-width) were performed using a stabilized finite element method (FEM). These simulations have been motivated by the fact that the use of stabilized finite element methods for DNS and LES is fairly recent and thus the question of how accurately these methods capture the wide range of scales in a turbulent flow remains open. To help address this question, we present converged results of turbulent channel flows under statistical equilibrium in terms of mean velocity, mean shear stresses, root mean square velocity fluctuations, auto-correlation coefficients, one-dimensional energy spectra and balances of the transport equation for turbulent kinetic energy. These results are consistent with previously published DNS results based on a pseudo-spectral method, thereby demonstrating the accuracy of the stabilized FEM for turbulence simulations.