Dokumenttyp: Zeitschriftenaufsatz

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Titel des Beitrags: Phase-error reduction in large-eddy simulation using a compact scheme

Abstract: A numerical method for the solution of the incompressible Navier-Stokes equations with staggered variable arrangement is presented. Compact differentiation and interpolation with an $O(\Delta x^6)$ truncation error is used for discretization of the skew-symmetric form of the advection term. The scheme conserves kinetic energy in the absence of viscosity and the momentum balance is satisfied within acceptable error bounds. Three test cases demonstrate the properties of the scheme, including disturbance growth in Poiseuille flow, direct simulation (DNS) of turbulent channel flow at $Re \tau = 180$ and large-eddy simulation (LES) at $Re \tau = 395$. The compact scheme yields an accurate prediction of growth rate and phase velocity of the disturbance wave when the wave is resolved within 8 cells. Third- and fourth order moments in DNS of channel flow are in good agreement with results from a spectral code. LES based on the 6th order scheme accurately predicts the mean flow profile whereas explicit finite difference schemes give erroneous results in the wake region. The compact scheme is less sensitive with regard to a Galilean transformation in the streamwise direction than explicit schemes.

Stichworte: Phase-error reduction; large-eddy simulation