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Numerical experiments of variable property turbulent channel flow ASHISH PATEL, JURRIAAN PEETERS, BENDIKS BOERSMA, RENE PECNIK, Process and Energy Department, Delft University of Technology — We perform numerical experiments of turbulent channel flows with varying density and viscosity to investigate the validity of semi-local scaling as proposed by Huang, Coleman and Bradshaw (1995, J. Fluid Mech). Direct numerical simulations of the low Mach number approximation of the Navier-Stokes equations are used, whereby the fluid is internally heated and the temperature at the walls is set to constant. A pseudo-spectral discretization in the periodic directions and a 6th order compact finite difference in wall normal direction is used. The friction Reynolds number based on half channel height and wall friction velocity is $Re_\tau = 395$. Different relations for density and viscosity as a function of temperature are studied. A variable property case has been identified with turbulent statistics that are quasi-similar to constant property turbulence. This case corresponds to the condition when the semi-local scaling is equal to the classical scaling. For cases wherein the semi-local scaling differs from classical scaling in the channel core, we show that the near-wall turbulence deviates towards a state of increased/decreased anisotropy as compared to constant property turbulence. The above results show not only the validity but also the usefulness of the semi-local scaling.

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