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Pressure, acceleration and velocity structure functions in DNS at high Reynolds number and/or improved small-scale resolution[1] K.P. IYER, P.K. YEUNG, Georgia Tech, R.J. HILL, Univ. of Colorado and NOAA. —
Evidence from both numerical simulation and experiment in the literature suggest the second-order structure function of pressure fluctuations requires higher Reynolds number than the pressure spectrum for inertial range scaling. We use a direct numerical simulation database for isotropic turbulence at resolution up to 4096^3 to directly calculate the pressure structure function and pressure gradient two-point correlation. We examine the relationships between those statistics and those same quantities calculated from fourth-order velocity structure functions. Our results suggest that the longitudinal, mixed and transverse fourth-order velocity structure functions, usually denoted by $D_{LLLL}(r)$, $D_{LLNN}(r)$ and $D_{NNNN}(r)$, obey, to a good approximation, the same scalings for scale size r in the inertial range. While mutual cancellations limit the accuracy with which these can be used to evaluate the pressure structure function the ambiguities clearly become smaller at higher Reynolds number. We also use new datasets of improved small-scale resolution albeit at lower Reynolds number to re-examine the nature of pressure gradient and viscous force correlations at small scale separations, more definitively than possible before.

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