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Resolution Effects and Small-Scale Intermittency in Direct Numerical Simulations of Turbulence[1] DIEGO A. DONZIS, P.K. YEUNG, Georgia Tech, K.R. SREENIVASAN, ICTP, U. Maryland — The Reynolds number attainable in direct numerical simulation (DNS) on a domain of given size depends on both the number of grid points and the degree to which the smallest scales are resolved, which for homogeneous turbulence is usually represented by the parameter $k_{max}\eta$, where k_{max} is the highest wavenumber resolved and η is Kolmogorov scale. Recent theoretical developments have pointed to the need for highly resolved simulations, especially for high-order statistics describing small-scale intermittency. We have carried out a systematic comparison of simulations up to 2048^3 in size and $k_{max}\eta$ varied from about 1.5 to 11 with the Taylor-scale Reynolds number fixed at around 140 and 240. The results suggest that moments of dissipation and enstrophy fluctuations are accurate up to order 4 when $k_{max}\eta \geq 3$, even if an analytic range for velocity structure functions at the corresponding order predicted by recent theory is not attained. An analysis of departures from analytic behavior gives guidance for the smallest scales that need to be resolved, as a function of the desired statistics and the Reynolds number. However normalized statistics such as the ratio of different moments, and statistics in the inertial range, are less sensitive.

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