Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Convergence and scaling of large-eddy simulations of a turbulent free jet flow HAIFENG WANG, STEPHEN POPE, Cornell University — A large set of large-eddy simulations (LES) is performed for a turbulent free jet flow with Reynolds number 21,000 to investigate systemically the convergence and scaling of the LES results with respect to the turbulence resolution scale (the filter width Δ) and the grid size h. Four convergence problems are considered: (a) convergence of the numerical error with h, for the Smagorinsky model with fixed Δ; (b) convergence of the Smagorinsky model error with Δ, for fixed h ($h \leq \Delta$); (c) convergence of the Smagorinsky model with $\Delta = h$; (d) convergence of the dynamic Smagorinsky model with $\Delta = h$. The convergence results are analyzed for the different LES quantities: the sub- filter eddy viscosity, the sub-filter shear stress, the resolved first, second and third order statistics. The scaling laws of the different LES quantities are analyzed based on the Kolmogorov energy-spectrum, and the LES convergence results agree with the scaling very well.

Haifeng Wang
Cornell University

Date submitted: 02 Aug 2011 Electronic form version 1.4