Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

A grid-independent length scale for large-eddy simulations U. PIOMELLI, Queen's University, Canada, B.J. GEURTS, University of Twente, Netherlands — In most large-eddy simulations a length-scale related to the grid size is used in the subgrid-scale models. Rapid variations of the mesh may cause errors and unphysical results. We propose a new length scale for small-scale turbulence models that is decoupled from the grid, and is determined dynamically from the velocity field itself. It is based on an approximation to a local integral scale used in turbulence models. The resulting eddy-viscosity model has many features of dynamic models (it vanishes near a wall or in laminar flows, and senses the local small scales of the flow) but does not require the use of spatial filtering operations, which are costly and may be difficult to perform on unstructured grids. The model coefficient is determined by a Successive Inverse Polynomial Interpolation procedure (Geurts & Meyers, 2006), in which the coefficient is optimized computationally to minimize a specified cost function. Since this procedure can be performed on coarse grids, it adds little to the computational cost of the method. A set of 4-6 coarse simulations with the new model is required to approximate the optimum with fair accuracy, and the total cost of a simulation is comparable to that of a single simulation with a dynamic model. The new length scale also has the desirable feature that refining the mesh does not result in a DNS, but in a grid-converged LES. Applications to plane channel and mixing layers will be presented.

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Date submitted: 29 Jul 2009

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