Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

On numerical and physical boundary conditions for high Reynolds number large-eddy simulation of wall-bounded turbulent flows[1]

C. PANTANO, D.I. PULLIN, P.E. DIMOTAKIS, California Institute of Technology

— We present results of an integrated subgrid modeling and numerical formulation for coarse-resolution, large-eddy simulations of attached, wall-bounded turbulent flows. The modeling approach is based on a combination of the stretched-vortex subgrid model (in the bulk of the flow) with a localized wall-function treatment that relates the instantaneous wall-parallel velocity to the shear stress at the wall. The formulation minimizes numerical errors introduced by the boundary condition treatment while preserving the physical elements required to reproduce the low-order statistics of these flows. The impermeability boundary condition is built into the method such that only the outer-flow solution is simulated and the inner region is modeled. The only allowed physical parameters of the model are those arising from the "law of the wall," explicitly used as part of the closure. Damping functions, a common feature of closures at this level of description, are not used. Simulation results of turbulent channel flow are presented up to Reynolds number based on wall-friction velocity of 10^6. These are in substantial agreement with experimental data. Further statistical results of the flow and inner region modeling will also be presented.

[1]Supported by the Caltech ASC Center and AFOSR core and MURI programs in mixing, combustion, and hypersonic propulsion.

Dale Pullin
California Institute of Technology

Date submitted: 04 Aug 2006