Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

High Order Conservative Finite Difference Scheme for Variable Density Low Mach Number Turbulent Flows OLIVIER DESJARDINS, GUILLAUME BLANQUART, GUILLAUME BALARAC, HEINZ PITSCH, Center for Turbulence Research, Stanford University — The high order conservative finite difference scheme of Morinishi *et al.* (2004) is extended to simulate variable density flows in complex geometries with cylindrical or cartesian non-uniform meshes. The formulation discretely conserves mass, momentum, and kinetic energy in a periodic domain. In the presence of walls, boundary conditions that ensure primary conservation have been derived, while secondary conservation is shown to remain satisfactory. In the case of cylindrical coordinates, it is desirable to increase the order of accuracy of the convective term in the radial direction, where most gradients are often found. A straightforward centerline treatment is employed, leading to good accuracy as well as satisfactory robustness. A similar strategy is introduced to increase the order of accuracy of the viscous terms. This numerical methodology is used to simulate a series of canonical turbulent flows ranging from isotropic turbulence to a variable density round jet. It is shown that fourth order spatial accuracy improves significantly the quality of the results over second order in most of the cases. The additional gain in accuracy provided by higher than fourth order methods does not justify their increased cost.

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Date submitted: 03 Aug 2007 Electronic form version 1.4