Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Cell-Averaged discretization for incompressible Navier-Stokes with embedded boundaries and locally refined Cartesian meshes: a high-order finite volume approach[1] AMNEET PAL SINGH BHALLA, HANS JOHANSEN, DAN GRAVES, DAN MARTIN, PHILLIP COLELLA, Lawrence Berkeley National Laboratory, APPLIED NUMERICAL ALGORITHMS GROUP TEAM — We present a consistent cell-averaged discretization for incompressible Navier-Stokes equations on complex domains using embedded boundaries. The embedded boundary is allowed to freely cut the locally-refined background Cartesian grid. Implicit-function representation is used for the embedded boundary, which allows us to convert the required geometric moments in the Taylor series expansion (upto arbitrary order) of polynomials into an algebraic problem in lower dimensions. The computed geometric moments are then used to construct stencils for various operators like the Laplacian, divergence, gradient, etc., by solving a least-squares system locally. We also construct the inter-level data-transfer operators like prolongation and restriction for multi grid solvers using the same least-squares system approach. This allows us to retain high-order of accuracy near coarse-fine interface and near embedded boundaries. Canonical problems like Taylor-Green vortex flow and flow past bluff bodies will be presented to demonstrate the proposed method.

[1]U.S. Department of Energy, Office of Science, ASCR (award number DE-AC02-05CH11231).

Amneet Pal Singh Bhalla
Lawrence Berkeley National Laboratory

Date submitted: 14 Jul 2017 Electronic form version 1.4