Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

A Fully Conservative and Entropy Preserving Cut-Cell Method for Incompressible Viscous Flows on Staggered Cartesian Grids VINCENT LE CHENADEC, YONG YI BAY, University of Illinois at Urbana-Champaign —

The treatment of complex geometries in Computational Fluid Dynamics applications is a challenging endeavor, which immersed boundary and cut-cell techniques can significantly simplify by alleviating the meshing process required by body-fitted meshes. These methods also introduce new challenges, in that the formulation of accurate and well-posed discrete operators is not trivial. A cut-cell method for the solution of the incompressible Navier-Stokes equation is proposed for staggered Cartesian grids. In both scalar and vector cases, the emphasis is set on the structure of the discrete operators, designed to mimic the properties of the continuous ones while retaining a nearest-neighbor stencil. For convective transport, different forms are proposed (divergence, advective and skew-symmetric), and shown to be equivalent when the discrete continuity equation is satisfied. This ensures mass, momentum and kinetic energy conservation. For diffusive transport, conservative and symmetric operators are proposed for both Dirichlet and Neumann boundary conditions. Symmetry ensures the existence of a sink term (viscous dissipation) in the discrete kinetic energy budget, which is beneficial for stability. The accuracy of method is finally assessed in standard test cases.

Vincent Le Chenadec
University of Illinois at Urbana-Champaign

Date submitted: 01 Aug 2015 Electronic form version 1.4