Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

A mass-conserving mixed Fourier-Galerkin B-Spline-collocation method for Direct Numerical Simulation of the variable-density Navier-Stokes equations BRYAN REUTER, TODD OLIVER, M.K. LEE, ROBERT MOSER, Institute for Computational Engineering and Sciences, UT-Austin — We present an algorithm for a Direct Numerical Simulation of the variable-density Navier-Stokes equations based on the velocity-vorticity approach introduced by Kim, Moin, and Moser (1987). In the current work, a Helmholtz decomposition of the momentum is performed. Evolution equations for the curl and the Laplacian of the divergence-free portion are formulated by manipulation of the momentum equations and the curl-free portion is reconstructed by enforcing continuity. The solution is expanded in Fourier bases in the homogeneous directions and B-Spline bases in the inhomogeneous directions. Discrete equations are obtained through a mixed Fourier-Galerkin and collocation weighted residual method. The scheme is designed such that the numerical solution conserves mass locally and globally by ensuring the discrete divergence projection is exact through the use of higher order splines in the inhomogeneous directions. The formulation is tested on multiple variable-density flow problems.

Bryan Reuter
Institute for Computational Engineering and Sciences, UT-Austin

Date submitted: 01 Aug 2017 Electronic form version 1.4