Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

A Finite-Volume ADI Method for Simulation of Incompressible Flows on Curvilinear Grids SATBIR SINGH, DONGHYUN YOU, Carnegie Mellon University — A second-order accurate finite-volume-based alternating direction implicit (ADI) method is proposed for the solution of incompressible Navier-Stokes equations on structured curvilinear meshes. Numerical accuracy and stability at high Reynolds numbers are achieved with the selection of the discrete operators and solution algorithms which assure discrete kinetic energy conservation in the inviscid limit. Unlike the conventional finite-difference-based ADI schemes, in which the factorization is performed along the transformed generalized-coordinate directions, in the proposed method, the discretized equations are factored along the curvilinear mesh lines without coordinate transformation. The accuracy, stability, and efficiency of the proposed method are assessed in simulations of an unsteady convection-diffusion equation on Cartesian and skewed meshes, and simulations of lid- driven cavity flow, flow over a circular cylinder, and turbulent channel flow. In the proposed method, the computational cost required for the solution of momentum equations is found to be 3 to 5 times smaller than that required when a bi-conjugate gradient stabilized (BCGSTAB) iterative method is employed.

Satbir Singh
Carnegie Mellon University

Date submitted: 06 Aug 2010 Electronic form version 1.4