replacing DFD17-2017-000225.

Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

The Finite-Surface Method for incompressible flow: a step beyond staggered grid[1] ARPIRUK HOKPUNNA, Chiang Mai Univiversity, TAKASHI MISAKA, SHIGERU OBAYASHI, IFS, Tohoku University — We present a newly developed higher-order finite surface method for the incompressible Navier-Stokes equations (NSE). This method defines the velocities as a surface-averaged value on the surfaces of the pressure cells. Consequently, the mass conservation on the pressure cells becomes an exact equation. The only things left to approximate is the momentum equation and the pressure at the new time step. At certain conditions, the exact mass conservation enables the the explicit n-th order accurate NSE solver to be used with the pressure treatment that is two or four order less accurate without loosing the apparent convergence rate. This feature was not possible with finite volume of finite difference methods. We use Fourier analysis with a model spectrum to determine the condition and found that the range covers standard boundary layer flows. The formal convergence and the performance of the proposed scheme is compared with a sixth-order finite volume method. Finally, the accuracy and performance of the method is evaluated in turbulent channel flows.

[1]This work is partially funded by a research colloaboration from IFS, Tohoku university and ASEAN+3 funding scheme from CMUIC, Chiang Mai University

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Date submitted: 20 Jul 2017 Electronic form version 1.4