Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Generalized Velocity Boundary Conditions for Kleiser and Schumann's Influence-Matrix Method XIAOFENG LIU, Dept. of Civil and Environmental Engineering, University of Texas at San Antonio — Kleiser and Schumann (1980) introduced a novel influence-matrix method to treat the incompressibility and no-slip boundary conditions when solving the Navier-Stokes equations. They also outlined the related "tau" error correction technique which is essential for the high accuracy direct numerical simulation (DNS) of turbulent flows. Werne (1995 proposed a revised "tau" correction algorithm on the "A"-problem level. Both method are correct, though some technical differences exist. Note also that both methods are specific for the no-slip boundary conditions where the odd and even modes of Chebyshev expansion in the wall normal direction decouples. In this talk, the Kleiser and Schumann method will be generalized to treat the Robin type velocity boundary conditions and the related "tau" error corrections. This new method will broaden the applicability of the Kleiser and Schumann method to situations where velocity boundary conditions are not limited to no-slip. Three examples (channel flow with a free surface, density current in an open channel, drag reduction in a hydrophobic channel) will be shown with extensive validations using various statistics of turbulent flow. All examples show excellent agreement with data in the literature and the velocity field is divergence free up to machine precision.

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Date submitted: 24 Aug 2010 Electronic form version 1.4