Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Direct numerical simulation of the incompressible temporally developing turbulent boundary layer[1] MELISSA KOZUL, DANIEL CHUNG, JASON MONTY, Univ of Melbourne — We present a Direct Numerical Simulation of the incompressible temporally developing turbulent boundary layer. The approach is inspired by temporal simulations of flows which are generally thought of as developing in space, such as wakes and mixing layers, and has previously been applied to the study of compressible boundary layers. The flow is the turbulent counterpart to the laminar Stokes' first problem where a fluid at rest is set into motion by a wall moving at constant velocity. An initial profile that models the effect of a wall-mounted trip wire is implemented allowing characterisation of initial conditions by a trip Reynolds number. Comparisons of various statistics demonstrate that the temporally developing boundary layer is a good model for the spatially developing boundary layer once initial conditions can be neglected. Analysis of similarity solutions point to their asymptotic collapse. We therefore propose its use as a tool with which to study further manipulations of the turbulent boundary layer. In this study, the development of the turbulent boundary layer under the condition of isotropic free-stream turbulence is investigated. Our temporal tool allows rapid and simplified simulation for a parameter space beyond the reasonable scope of costly spatial simulations.

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Date submitted: 28 Jul 2015 Electronic form version 1.4