Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

The mechanism of drag reduction in turbulent pipe flow with spanwise wall oscillation ANDREW DUGGLEBY, KENNETH BALL, MARK PAUL, Virginia Polytechnic Institute and State University, MECHANICAL ENGINEERING DEPARTMENT COLLABORATION — The results of a comparative analysis between turbulent pipe flow and drag reduced turbulent pipe flow by spanwise wall oscillation based upon a Karhunen-Loève expansion are presented. The turbulent flow is generated by a direct numerical simulation at a Reynolds number $Re_\tau = 150$. The spanwise wall oscillation is imposed as a velocity boundary condition with an amplitude of $A^+ = 20$ and a period of $T^+ = 50$. The flow is driven by a constant pressure gradient, resulting in a 27% mean velocity increase with wall oscillation. The peaks of the Reynolds stress and root-mean-squared velocities shift away from the wall and the Karhunen-Loève dimension of the chaotic turbulence attractor is reduced from 2453 to 102. The coherent vorticity structures are pushed away from the wall into higher speed flow, causing an increase of their advection speed of 34% as determined by a normal speed locus. The mechanism of drag reduction by spanwise wall oscillation is discussed.

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Date submitted: 04 Aug 2006 Electronic form version 1.4