Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Transient Growth for the Linearized Navier-Stokes Equations
LINA KIM, JEFF MOEHLIS, University of California — We analytically solve the linearized Navier-Stokes equations for streamwise-invariant sinusoidal shear flow. This is accomplished by considering the infinite dimensional system of ordinary differential equations derived via Galerkin projection onto Fourier modes, a representation which allows one to interpret the dynamics in terms of interactions between streaks and streamwise vortices. We characterize transient energy growth, a mechanism which may trigger nonlinear effects that lead to sustained turbulence, for this system. This includes calculating perturbations which give optimal initial and total energy growth, which is done numerically for large enough truncations to capture the behavior of the full system. We also numerically determine Reynolds number scalings and find optimal wavenumbers for maximum transient energy growth.

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Date submitted: 27 Jul 2006 Electronic form version 1.4