Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Optimal Disturbances in Spatially Developing Turbulent Boundary Layers[1] TIMOTHY DAVIS, FARRUKH ALVI, Florida State University — Perturbations leading to optimal energy growth in zero pressure gradient turbulent boundary layers are computed. A spatial formulation is adopted to account for the slow development of the turbulent mean flow. Optimals are computed using both an eddy viscosity and quasi-laminar assumption with initial focus given towards steady, streamwise elongated streaks. Results using the eddy viscosity qualitatively agree well with previous temporal analyses, identifying both inner and outer scaled peaks in the energy amplification. Significant differences, however, are noted in the large scale outer structures with spanwise wavelengths $\sim 3\delta$. The eddy viscosity is further shown to have a substantial effect on the optimal structures and, in general, better agreement with experimental observation is found using the quasi-laminar approach. In this case, the optimal structures are found to scale with the geometric mean of the logarithmic layer in the mean flow. Propagating modes are also considered, achieving large energy amplifications when the disturbance phase speed approaches the local mean. The most energetic streamwise scales and optimal structures are found to agree well with natural structures observed in turbulent boundary layers.

[1]Partial support by FCAAP, ARO and NSF

Timothy Davis
Florida State University

Date submitted: 01 Aug 2016 Electronic form version 1.4