Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Characteristics of a streak disturbance induced by an isolated roughness element[1] KYLE BADE, AHMED NAGUIB, Michigan State University — A detailed description of a streak disturbance introduced in a Blasius boundary layer by an isolated roughness element will be presented. This work is motivated by the desire to understand the dependence of the evolution/instability of streamwise-oriented streaks (which play a key role in bypass transition) on the method by which they are generated. The proper scaling of the streamwise evolution of the streak disturbance energy is examined. This expands upon established Re_k^2 scaling (White, et al., Physics of Fluids, 2005) of streak disturbances induced by spanwise-periodic roughness element arrays. Examining different roughness heights, k, and employing a method that accounts for the streamwise growth of the streak's wall-normal and spanwise scales, it is found that the streak energy density scales with $\mathrm{Re}_k^{7/3}$, in the case of an isolated roughness element. The data used in the analysis are acquired using hotwire anemometry throughout a three-dimensional domain located downstream of a single cylindrical roughness element. These measurements are complemented by smokewire visualizations, which capture clearly three distinct disturbance states, dependent upon roughness element height; namely, stable streaks, streaks with intermittent turbulent bursts, and turbulent disturbances. Correspondence is established between these states and the streamwise evolution of the streak energy and the cross-stream disturbance profiles.

[1]NSF Grant: CMMI 0932546

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Date submitted: 02 Aug 2012 Electronic form version 1.4