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Instability of a Local Downflow in a Turbulent Boundary Layer
THOMAS LUNDGREN, University of Minnesota — In the laminar Hiemenz stagnation point flow a downflow produces a straining flow along the boundary. This flow is unstable (Hammerlin,1955) with neutral eigensolution consisting of alternating sign vortex cells of uniform strength along the flow direction. Low-speed and high-speed streaks at the cell boundaries increase in amplitude in the flow direction. In the turbulent problem a local downflow is envisioned to be caused by large scale structures in the outer part of the boundary layer. The Reynolds-averaged equations were employed with an eddy viscosity which depens only on the distance from the wall. The resulting equations are unstable to longitudinal vortices with a structure similar to the Hiemenz neutral egensolutin, with a continuous spectrum of the spanwise wavenumber. It is found that the wavenumber must be smaller than a critical value which depends on the local strainrate. In general when the downflow is weaker the critical wavenuber is smaller (streak spacing larger).

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