Abstract Submitted
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On the Existence of Hairpin Vortices PETER BERNARD, University of Maryland — Numerical simulation of the transitioning and turbulent boundary layer using a vortex filament scheme (AIAA paper 2009-3547) provides a direct view of the organization of the vortex lines from which the structural aspects of the flow may be understood. It is found that the common assumption that the physical form of coherent vortical structures should be synonymous with regions of rotational motion is unwarranted. In fact, what are normally referred to as hairpin vortices are found not to be vortical objects in their own right, but rather the rotational motion corresponding to vortical features of a very different kind. The latter may be described as raised streamwise-oriented furrows in the vortex layer overlying low speed streaks. Upstream, the uplifted vorticity has a streamwise projection producing counter-rotating motion normally described as being the legs of hairpin vortices. Downstream, the upwelling vorticity detaches from the wall acquiring a mushroom shape, with the illusion of hairpin legs continuing within counter-rotating motion produced by streamwise oriented filaments. Arch vortices are produced by roll-up of the shear layers along the top of the furrows. The existence of hairpin vortices is equivalent to imagining that regions of rotational motion contain vorticity forming a complete structure - in contradiction to the objects observed in the filament simulation.

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