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Vorticity Based Turbulence Model Applied to an Impulsively Moved Flat Plate NICHOLAS KACHMAN, U.S. Navy NAVAIR — A novel technique to model turbulence by vorticity in solid body rotation is presented. The model is based on simultaneously solving the vorticity equation and the Navier-Stokes equation for a 2-D unsteady boundary layer. Only that vorticity that is in solid body rotation is used to develop perturbation velocities that are then applied to the unsteady boundary layer equations. New vorticity is introduced each time step, when the vorticity equation produces a value different from that calculated by the boundary layer equations. Comparing the numerical results to experimental flow visualization demonstrates similar characteristic traits to a turbulent boundary layer, such as no turbulence until Re $\sim$ 4.5x10^4, intermittency, velocity "tubes" that ejected fluid into and out of the boundary layer, and turbulent decay after leaving the plate. Issues remain with the method. First, the velocity perturbations and boundary layer growth are less than expected. It is believed that this is due to the 2-D nature of the solution and that the move to 3-D and the incorporation of vortex stretching will provide values closer to experimental results. Second, the velocity perturbations cause the mesh Reynolds number to be exceeded, which needs to be addressed in future work.

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