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Improved upper bounds on energy dissipation rates in plane Couette flow with boundary injection and suction[1] HARRY LEE, University of Michigan - Ann Arbor, BAOLE WEN, The University of Texas at Austin, CHARLES DOERING, University of Michigan - Ann Arbor — The rate of viscous energy dissipation ϵ in incompressible Newtonian planar Couette flow (a horizontal shear layer) imposed with uniform boundary injection and suction is studied numerically. Specifically, fluid is steadily injected through the top plate with a constant rate at a constant angle of injection, and the same amount of fluid is sucked out vertically through the bottom plate at the same rate. This set-up leads to two control parameters, namely the angle of injection, θ, and the Reynolds number of the horizontal shear flow, Re. We numerically implement the background field variational problem formulated by Constantin and Doering with a one-dimensional unidirectional background field $\phi(z)$, where z aligns with the distance between the plates. Computation is carried out at various levels of Re with $\theta = 0, 0.1^\circ, 1^\circ$ and 2°, respectively. The computed upper bounds on ϵ scale like Re^0 as $Re > 20,000$ for each fixed θ, this agrees with Kolmogorovs hypothesis on isotropic turbulence. The outcome provides new upper bounds to ϵ among any solution to the underlying Navier-Stokes equations, and they are sharper than the analytical bounds presented in Doering et al (2000).

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