Improved upper bounds on energy dissipation rates in plane Couette flow with boundary injection and suction\textsuperscript{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 $\epsilon$ 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, $\theta$, 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 $2^\circ$, respectively. The computed upper bounds on $\epsilon$ scale like $Re^0$ as $Re > 20,000$ for each fixed $\theta$, this agrees with Kolmogorov's hypothesis on isotropic turbulence. The outcome provides new upper bounds to $\epsilon$ 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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