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Optimal Energy Dissipation Bounds for 2D and 3D Stress-Driven Shear Flows GIOVANNI FANTUZZI, ANDREW WYNN, Imperial College London — The background method (Doering & Constantin, 1995) allows the derivation of rigorous bounds on bulk turbulent quantities in a variety of wall-bounded flows as a function of the governing parameters. A classical example is to bound the energy dissipation ϵ in surface-driven shear flows as a function of the driving force, expressed by the Grashoff number Gr. Of particular interest is to compute the best bounds achievable within this framework. However, the variational problem determining the optimal bounds is difficult to solve when the flow is driven by a boundary flux. Tang et al. (2004) first resolved this difficulty by modelling a surface stress with a localised body force. Instead, we propose a novel numerical approach based on Semidefinite Programming that is able to handle fixed-flux boundary conditions directly, and thereby revisit the bounds on ϵ for surface-stress-driven shear flows. In the 2D case, we find that $\epsilon > 8Gr^{3/2}$, improving the scaling law $\epsilon > 4Gr^{3/2}$ proven by Hagstrom & Doering (2014). In 3D, we confirm the results of Tang et al., suggesting that a surface stress can be modelled accurately by a body force. Finally, a careful analysis ensures that, in principle, our bounds hold analytically for a fixed Gr.

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