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Optimal mixing of a passive scalar by supercritical 3D plane Poiseuille flow[1] LUKAS VERMACH, Cambridge Centre for Analysis, University of Cambridge, C.P. CAULFIELD, BPI & DAMTP, University of Cambridge — We consider a passive zero-mean scalar field organised into two layers of different concentration, in a 3D plane channel subjected to a constant along-stream pressure gradient. We employ a fully nonlinear adjoint-looping approach to identify the optimal initial perturbation of the velocity field with given initial energy which yields maximal mixing by a target time horizon, in the sense of minimisation of the spatially-integrated variance of the concentration field. Foures *et.al.* (JFM, 2014) considered 2D plane Poiseuille flow at a sufficiently low (subcritical) $Re \sim 500$ to not be subject to flow instabilities, and demonstrated that the initial perturbation which maximizes the time-averaged energy gain of the flow leads to weak mixing, and is qualitatively different from the optimal initial "mixing" perturbation which exploits classical Taylor dispersion. We generalise this study to the optimisation of mixing three-dimensional flows at a range of significantly higher (supercritical) Reynolds numbers, showing how the potential triggering of "strong" flow instabilities modifies the structure of the optimal initial mixing perturbation qualitatively.

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