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Infinity-norm optimal perturbations in 2D plane Poiseuille flow
DIMITRY P.G. FOURES, COLM-CILLE P. CAULFIELD, DAMTP - University of Cambridge, PETER J. SCHMID, LadHyX - Ecole Polytechnique — Since the emergence of the concept of non-modal stability analysis in the early 90's, many efforts have been made in order to identify the optimal linear mechanisms at stake in the finite-time triggering of highly energetic perturbations in a linearly stable flow. The objective functional typically involved an integrated measure of the total perturbation KE over the domain. In some circumstances however, one may be interested in identifying perturbations which lead to a maximum localized peak value of KE. This problem requires a departure from maximization of the usual quadratic norm (an inherently global measure) of the velocity field. As a demonstration case, we choose to investigate ∞-norm optimal perturbations in a 2D plane Poiseuille flow at $Re = 4000$. We show that for any optimization time horizon, two branches of solutions exist, either associated with perturbations localized in the centre of the domain ("centre mode") or close to the domain boundaries ("wall mode"). We find that for $T \lesssim 0.5T_O$ and $T \gtrsim 2T_O$ (with T_O the global optimal time for total KE), the wall modes are more efficient at producing highly energetic localized perturbations, while centre modes are optimal for intermediate times $0.5T_O \lesssim T \lesssim 2T_O$ only.

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