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Convective instability and transient growth in flow over a backward-facing step[1] DWIGHT BARKLEY, University of Warwick, HUGH BLACKBURN, Monash University, SPENCER SHERWIN, Imperial College London — We present transient energy growth of 2D and 3D optimal linear perturbations for flow over a backward-facing step. Reynolds numbers based on the step height and peak inflow speed are considered in the range $0 \leq Re \leq 500$, well below the critical value for the onset of absolute instability. This analysis quantifies for the first time the transient linear response of the flow due to local convective instability downstream of the step edge. The maximum linear transient energy growth is of order 80×10^3 at $Re = 500$. The critical Reynolds number below which all perturbations decay in energy norm is $Re = 57.7$. The centroidal location of the energy distribution for maximum transient growth is typically downstream of all the stagnation/reattachment points of the steady base flow. While their growths are larger, the 3D optimal disturbances are broadly similar in shape to the 2D cases, and the corresponding spanwise wavelengths are of order ten step heights. Nonlinearity is shown to have a stabilizing effect on the instability.

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