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Transient perturbation growth in time-dependent mixing layers C.P. CAULFIELD, BP Institute & DAMTP, University of Cambridge, CRISTOBAL ARRATIA, JEAN-MARC CHOMAZ, LadHyX, Ecole Polytechnique — We investigate numerically the transient linear growth of three-dimensional perturbations in homogeneous time-evolving hyperbolic tangent mixing layers. We identify perturbations, which are optimal in terms of their kinetic energy gain, over a range of finite, predetermined time intervals. We consider a time-dependent two-dimensional base flow associated with the growth and nonlinear saturation of two wavelengths of the classical "Kelvin-Helmholtz instability" (KHI), allowing for the eventual merger of two elliptical KHI billows into a larger single elliptical vortex. If the time-evolving flow actually involves substantial evolution of the primary KHI during the optimization time interval, two broad classes of inherently 3D linear optimal perturbations arise, associated at low wavenumbers with the well-known core-centred elliptical translative instability, and at higher wavenumbers with the braid-centred hyperbolic instability. The growth of the elliptical secondary perturbations is strongly suppressed during primary KHI merger, due to the significant disruption of the primary billow cores, while hyperbolic perturbations, localized in the braid region between the two merging KHI billows, can still undergo significant transient energy growth.

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