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Streamwise non-normality in boundary-layer instabilities UWE EHRENSTEIN , FRANÇOIS GALLAIRE, Lab. J.A. Dieudonné, Université Nice-Sophia Antipolis, France — Temporal linear stability modes depending on two space directions are computed for a two-dimensional unstable boundary-layer flow along the flat plate. The linearized Navier-Stokes system is discretized using Chebyshev-collocation in both the streamwise and wall-normal direction and the resulting eigenvalue problem is solved by means of a Krylov-Arnoldi method. It is shown, that for appropriate inflow and outflow conditions the spatial structure of each individual temporally stable mode is reminiscent of the spatial exponential growth of perturbations along the flat plate, as predicted by local stability analyses. An optimal temporal growth analysis is performed and it is demonstrated that an appropriate superposition of a moderate number of non-normal temporal modes gives rise to a spatially localized wave packet, starting at inflow and exhibiting transient temporal growth when evolving downstream along the plate. This wave packet is shown to be in qualitative agreement with the convectively unstable disturbance observed when solving the full Navier-Stokes equations for an equivalent initial condition. This confirms that a transient cooperation of a finite number of non-normal temporal modes reproduces real-flow convective instabilities, which opens new possibilities of model reduction in open flow problems.

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