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A nonlinearity-coupled receptivity process generating a Tollmien–Schlichting wave behind a backward-facing step

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A nonlinear process generating a Tollmien–Schlichting wave in a boundary-layer flow over a backward-facing step is examined by analyzing the numerical solution of the incompressible Navier–Stokes equations. The flow under consideration has two types of instabilities: the Kelvin–Helmholtz instability of the separated shear layer and the viscous instability of the downstream reattached boundary layer. When the instability of the separated shear layer is excited at the two mutually close frequencies ω1 and ω2, the difference, ω2−ω1 component, is generated and developed through the nonlinear interaction between the two primary waves of frequency ω1 and ω2 in the separated region. The low-frequency ω2−ω1 component soon changes in structure near the reattachment location and evolves into the viscosity-conditioned Tollmien–Schlichting wave in the downstream reattached boundary layer.