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Evolution of K- and H-type structures in a spatially evolving channel flow[1] ALEC KUCALA, SEDAT BIRINGEN, SCOTT WAGGY, Department of Aerospace Engineering Sciences; University of Colorado; Boulder, CO 80309 — A fully parallel, direct numerical simulation (DNS) is performed on the full time-dependent, three-dimensional Navier-Stokes equations in a spatially developing plane-channel flow at $Re = 10,000$, in which two-dimensional eigenfunctions based on the solution of the Orr-Sommerfeld equation are introduced at the inlet with uniform random noise $A_r < 10^{-3}$ added along the spanwise and wall-normal directions. The flow is allowed to "choose" a path to secondary instability, K-type (after Klebanoff) or H-type (after Herbert), depending on the amplitude of the 2D disturbance. Detailed analysis of the spatial evolution of the primary, fundamental and subharmonic modes are presented to examine the path of secondary transition. Flow visualizations using Lagrangian coherent structures (LCS) are shown, giving physical insight into the coherent structures involved in the breakdown of laminar flow in a plane-channel.

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Alec Kucala
Department of Aerospace Engineering Sciences;
University of Colorado; Boulder, CO 80309

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