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The dynamics and control of perturbations along a shear layer[1]

JUNG J. CHOI, ZVI RUSAK, RPI — The dynamics of small and large scale convective perturbations along a shear layer is studied using the linear and nonlinear parabolic stability equations. The predictions are compared with results from direct numerical simulations and available experimental data. The response of the flow to upstream excitations at both low and high frequencies is described. The perturbation equations are also used to derive a physically-based, reduced-order model of the flow dynamics for the open-and closed-loop control of the flow. Computed examples for the cases of a free shear layer and the shear layer behind a backward facing step are presented. The results demonstrate the effect of upstream excitation of certain sets of modes of perturbations with various magnitudes on the mean flow structure and the evolution of the perturbations. For example, it is found that exciting high frequency modes can modify the regular cascade of energy over distance along the shear layer.

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