Nonlinear convective/absolute instabilities in parallel two-dimensional wakes

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Phys. Fluids **10**(11: Nov. 1998), 2724-2736.

Abstract:

The linear versus nonlinear convective/absolute instability of a family of plane wake profiles at low Reynolds number is investigated by numerically comparing the linearized and the fully nonlinear impulse responses. Through an analysis of the linear flow response obtained by DNS, the linear temporal and spatio-temporal instability properties are retrieved, in excellent agreement with the properties obtained by Monkewitz from the study of the associated viscous dispersion relation. Nonlinear terms are then shown to limit the amplitude to a saturation level within the response wavepacket, while leaving the trailing and leading edges unaffected. For this family of open shear flows, the velocities of the fronts, formed between the trailing or leading edge and the central saturated region, are thus selected according to the linear Dee & Langer criterion, whereas the front solutions are fully nonlinear. This property may be of importance in justifying the use of *linear* instability properties to predict the onset and the frequency of the von Kármán vortex street.