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Modeling boundary-layer transition in DNS and LES using Parabolized Stability Equations[1] ADRIAN LOZANO-DURAN, M. J. PHILIPP HACK, PARVIZ MOIN, Center for Turbulence Research, Stanford University — The modeling of the laminar region and the prediction of the point of transition remain key challenges in the numerical simulation of boundary layers. The issue is of particular relevance for wall-modeled large eddy simulations which require 10 to 100 times higher grid resolution in the thin laminar region than in the turbulent regime (Slotnick *et al.*, NASA/CR-2014-218178, 2014). Our study examines the potential of the nonlinear parabolized stability equations (PSE) to provide an accurate, yet computationally efficient treatment of the growth of disturbances in the pre-transitional flow regime. The PSE captures the nonlinear interactions that eventually induce breakdown to turbulence, and can as such identify the onset of transition without relying on empirical correlations. Since the local PSE solution at the point of transition is the solution of the Navier-Stokes equations, it provides a natural inflow condition for large eddy and direct simulations by avoiding unphysical transients. We show that in a classical H-type transition scenario, a combined PSE/DNS approach can reproduce the skin-friction distribution obtained in reference direct numerical simulations. The computational cost in the laminar region is reduced by several orders of magnitude.

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