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Stochastic modeling of mode interactions via linear parabolized stability equations WEI RAN, ARMIN ZARE, University of Southern California, M. J. PHILIPP HACK, Center for Turbulence Research, Stanford University, MIHAILO JOVANOVIC, University of Southern California — Low-complexity approximations of the Navier-Stokes equations have been widely used in the analysis of wall-bounded shear flows. In particular, the parabolized stability equations (PSE) and Floquet theory have been employed to capture the evolution of primary and secondary instabilities in spatially-evolving flows. We augment linear PSE with Floquet analysis to formally treat modal interactions and the evolution of secondary instabilities in the transitional boundary layer via a linear progression. To this end, we leverage Floquet theory by incorporating the primary instability into the base flow and accounting for different harmonics in the flow state. A stochastic forcing is introduced into the resulting linear dynamics to model the effect of nonlinear interactions on the evolution of modes. We examine the H-type transition scenario to demonstrate how our approach can be used to model nonlinear effects and capture the growth of the fundamental and subharmonic modes observed in direct numerical simulations and experiments.

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