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Secondary Instability of Roughness-Induced Transient Growth[1]
NICHOLAS DENISSEN, EDWARD WHITE, Texas A&M University — Optimal perturbation methods have provided the primary means of studying transient growth in theoretical and computational frameworks. Many interesting aspects of transient growth have been analyzed with these approaches, including the onset of secondary instability leading to transition-to-turbulence. However, while optimal perturbations are those that experience the most transient energy growth, this is not synonymous with the perturbations most likely to cause transition. The present work performs stability analysis of the flow field behind an array of periodic roughness elements. The incompressible flow over spanwise-periodic circular cylinders was previously computed via Direct Numerical Simulation, and the present work shows the resulting sub-optimal transient growth is more susceptible to secondary instabilities than optimal disturbances. The results agree qualitatively with experimental work and the implications of this are discussed for future work on more realistic rough surfaces.

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