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Some Insights on Roughness Induced Transition and Control from DNS and Experiments[1] SAIKISHAN SURYANARAYANAN[2], IFEOLUWA IBITAYO[3], DAVID GOLDSTEIN[4], Univ of Texas, Austin, GARRY BROWN, Princeton University — We study the receptivity and subsequent evolution of an initially laminar flat boundary layer on a flat plate to single and multiple discrete roughness elements (DRE) using a combination of immersed boundary DNS and water channel flow visualization experiments. We examine the transition caused by a single DRE and demonstrate the possibility of suppressing it by an appropriately designed second DRE in both DNS and experiments. The different phases of transition are identified and the roles of Reynolds numbers based on roughness height and boundary layer thickness are investigated. The underlying mechanisms in the observed transition and its control are understood by examining detailed vorticity flux balances. Connections are also made to recent developments in transient growth and streak instability. A unified picture is sought from a parametric study of different DRE dimensions and orientations. The potential applicability of the observations and understanding derived from this study to controlling transition caused by design and environmental roughness over aircraft wings is discussed.

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