Abstract Submitted
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Experimental Study of Transient Growth Instabilities JONATHAN F. MORRISON, PHILIPPE LAVOIE, Department of Aeronautics, Imperial College, London, SW7 2AZ, UK, AHMED NAGUIB, Department of Mechanical Engineering, Michigan State University, East Lansing, 48824, USA — Transient growth of instabilities in laminar boundary layers has attracted significant attention in recent years. Theoretical work on the subject provides predictions regarding the evolution of disturbances arising from optimal perturbations. While experiments have provided qualitative verifications of the theory, the non-optimal nature of the disturbances introduced in experiments does not always provide a conclusive validation. An extensive parametric study was undertaken to study the transient growth of instabilities introduced by a spanwise periodic array of roughness elements in a wind tunnel. A distinctive aspect of these experiments is that the effects of Reynolds number, and the roughness height and spacing relative to the boundary layer thickness are investigated independently of each other. A particularly novel and important aspect of the present study is that the three components of the perturbation velocity field generated by the by the roughness elements are measured. This allows a complete quantification of the sub-optimal perturbations present in such experiments and the transient growth of the associated disturbances. The perturbation velocities are presented for optimal and a range of suboptimal roughness distributions.

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