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Dynamic Perturbation of a Turbulent Boundary Layer and Experimental Identification of Critical-Layer-Type Behavior[1] IAN JACOBI, BEVERLEY J. MCKEON, California Institute of Technology — A zero-pressure gradient turbulent boundary layer is perturbed by a spatially impulsive patch of two-dimensional roughness elements, which are actuated dynamically to alternate between smooth and rough surface conditions, and the downstream response is measured by hot-wire anemometry and particle image velocimetry. The dynamic perturbation is observed to contribute a periodic signature to the downstream flow-field, which manifests itself in critical-layer type behavior. The downstream flow field is reconstructed in a phase-locked sense in order to compare the observed behavior with asymptotic representations of the expected behavior at matched flow conditions. Perturbation using a periodic disturbance is shown to reveal underlying features of the turbulent boundary layer which are intimately connected to the critical layer framework for turbulent pipe flow proposed by McKeon & Sharma (*see the DFD-2010 presentation on 'Structure from the critical layer framework in turbulent flow' by Sharma & McKeon*), while simultaneously providing practical insight on the manipulation of the structure of boundary layers.

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