Abstract Submitted
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A spatial picture of the synthetic large-scale motion from dynamic roughness[1] DAVID HUYNH, BEVERLEY MCKEON, California Institute of Technology — Jacobi and McKeon (2011) set up a dynamic roughness apparatus to excite a synthetic, travelling wave-like disturbance in a wind tunnel, boundary layer study. In the present work, this dynamic roughness has been adapted for a flat-plate, turbulent boundary layer experiment in a water tunnel. A key advantage of operating in water as opposed to air is the longer flow timescales. This makes accessible higher non-dimensional actuation frequencies and correspondingly shorter synthetic length scales, and is thus more amenable to particle image velocimetry. As a result, this experiment provides a novel spatial picture of the synthetic mode, the coupled small scales, and their streamwise development. It is demonstrated that varying the roughness actuation frequency allows for significant tuning of the streamwise wavelength of the synthetic mode, with a range of 3δ-13δ being achieved. Employing a phase-locked decomposition, spatial snapshots are constructed of the synthetic large scale and used to analyze its streamwise behavior. Direct spatial filtering is used to separate the synthetic large scale and the related small scales, and the results are compared to those obtained by temporal filtering that invokes Taylor's hypothesis.

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