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A novel approach for quantifying the zero-plane displacement of rough-wall boundary layers MANUEL FERREIRA, EDUARDO RODRIGUEZ-LOPEZ, BHARATH GANAPATHISUBRAMANI, University of Southampton, AERODYNAMICS AND FLIGHT MECHANICS TEAM — Indirect methods of wall shear stress (WSS) estimation are frequently used to characterise rough wall boundary-layer flows. The zero-plane displacement, hypothesised to be the vertical location where it acts, is often treated as a fitting parameter. However, it would be preferrable to measure both these quantities directly, especially for surfaces with large roughness elements where established scaling and similarity laws may not hold. In this talk we present a novel floating element balance that is able to measure not only the WSS but also the wall normal location at which it acts. While allowing compensation for mild static pressure gradients by means of a first-order analytical model. Its architecture is based on a parallel-shift linkage and it's fitted with custom built force transducers and a data acquisition system especially designed to achieve high Signal-to-Noise Ratios (SNR). The smooth-wall boundary-layer flow is used as benchmark to assess the accuracy of this balance. The values of skin friction coefficient show an agreement with hot-wire anemometry to within 2% at a local Reynolds number $Re_\theta = 4 \times 10^3$ up to 10^4. A rough surface of regularly distributed large elements is used to investigate the ability to infer the zero-plane displacement.

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