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Skin friction measurements of mathematically generated roughness in the transitionally- to fully-rough regimes JULIO BARROS, MICHAEL SCHULTZ, KAREN FLACK, United States Naval Academy — Engineering systems are affected by surface roughness which cause an increase in drag leading to significant performance penalties. One important question is how to predict frictional drag purely based upon surface topography. Although significant progress has been made in recent years, this has proven to be challenging. The present work takes a systematic approach by generating surface roughness in which surfaces parameters, such as rms, skewness, can be controlled. Surfaces were produced using the random Fourier modes method with enforced power-law spectral slopes. The surfaces were manufactured using high resolution 3D-printing. In this study three surfaces with constant amplitude and varying slope, P, were investigated ($P = -0.5, -1.0, -1.5$). Skin-friction measurements were conducted in a high Reynolds number turbulent channel flow facility, covering a wide range of Reynolds numbers, from hydraulic-smooth to fully-rough regimes. Results show that some long wavelength roughness scales do not contribute significantly to the frictional drag, thus highlighting the need for filtering in the calculation of surface statistics. Upon high-pass filtering, it was found that k_{rms} is highly correlated with the measured k_s.

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