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Turbulent boundary layer flow over broad-banded roughness GENO PAWLAK, PAYAM AGHSAEE, University of California San Diego, SAEED MAZROUEI, STEFANO LEONARDI, University of Texas Dallas, KRISHNAKUMAR RAJAGOPALAN, MARCELO KOBAYASHI, University of Hawaii at Manoa — The response of the boundary layer to a regular roughness is often parameterized in terms of the length scales defining the roughness. Difficulty arises in the case of broad-banded and highly irregular roughness distributions such as over coral reefs or urban canopies where the length scale that determines the response of the boundary layer is not clear. Here we use a spectral description for roughness to create idealized two-dimensional irregular roughness profiles, using square waves as a basis function. Laboratory experiments along with Direct Numerical Simulations (DNS) are used to examine the hydrodynamic response to the broad-banded roughness and flow characteristics are related to geometric characteristics of the boundary. The simulations and experiments show that the nature of the flow over two-dimensional irregular walls can be determined as a function of the hydrodynamic origin, which, in turn, can be determined as a function of a mean cavity shape. Results are interpreted in terms of the spectral characteristics of the roughness. The contribution of the various spectral components to the total drag is analyzed for each case. The roughness spectrum influences the flow through the shape of the cavities on the wall and can provide some guidance in predicting the nature of the flow.

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