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Behavior of Different Turbulent Length Scales in a Boundary Layer with Isotropic Freestream Turbulence[1] SHEILLA TORRES-NIEVES, JOSE LEBRON, BRIAN BRZEK, LUCIANO CASTILLO, Rensselaer Polytechnic Institute, HYUNG-SUK KANG, CHARLES MENEVEAU, The Johns Hopkins University, RAUL B. CAL, Portland State University — The effects of different length scales on interactions between nearly isotropic freestream turbulence (FST) and a favorable pressure gradient, turbulent boundary layer (TBL) over a rough surface are studied. Measurements are obtained using Laser Doppler and Hotwire Anemometry, at $Re_\theta \leq 4{,}300$. An active grid is used to generate FST levels of up to 7%. Profiles of mean turbulent statistics show that the classical view of TBL flows is not able to collapse the data when FST is present. The different effects of FST on the streamwise and wall-normal variances result in that the addition of isotropic FST promotes anisotropy in the boundary layer. Second-order structure functions are examined to identify which turbulence length scales contribute mostly to creating the anisotropy. The analysis demonstrates that the effect of FST resides in a wide range of length scales, and is not limited to the largest scales of the flow as in the zero pressure gradient case. Spectral analysis is performed to more accurately identify the relevant scales.

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