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Characteristics of Larger-Scale Motions in Turbulent Flow Overlying Multi-Scale Roughness J.M. BARROS, K.T. CHRISTENSEN, Univ. of Illinois — The energy and Reynolds-stress content of large-scale motions (LSM) and superstructures within turbulent flow overlying a multi-scale roughness topography are explored using high-frame-rate stereo particle image velocimetry measurements in the wall-normal–spanwise plane. The roughness under consideration was replicated from a turbine blade damaged by deposition of foreign materials and contains a broad range of topographical scales arranged in a highly irregular manner. Previous measurements revealed that this roughness induces significant spanwise heterogeneity in the turbulence statistics in the form of low- and high-momentum flow pathways marked by enhanced Reynolds stresses and turbulent kinetic energy. Frequency spectra of streamwise velocity at fixed wall-normal location also display strong dependence on spanwise position. In particular, the roughness promotes enhanced energy content of the LSMs and smaller-scale motions. Depending on spanwise location, pre-multiplied spectra highlight significant modification of the energy content of the superstructures due to roughness compared to smooth-wall flow.

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