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Structural Aspects of Flow Over Highly Irregular Roughness Revealed from Wall-Normal–Spanwise Plane Stereo PIV Measurements J.M. BARROS, K.T. CHRISTENSEN, University of Illinois at Urbana-Champaign — The structural attributes of turbulent flow over a complex roughness topography were explored with both low-frame-rate and time-resolved stereo particle-image velocimetry in a wall-normal–spanwise ($y - z$) measurement 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. Instantaneous velocity fields in the cross-flow measurement plane revealed structural attributes qualitatively consistent with smooth-wall flow structure, particularly patterns of spanwise-alternating, large-scale regions of low and high streamwise momentum. However, single-point turbulence statistics revealed significant statistical heterogeneity in the form of low- and high-momentum flow pathways marked by enhanced Reynolds stresses and turbulent kinetic energy. The low-momentum flow pathways were also marked by intense vortical activity along their spanwise boundaries, indicating that these pathways could represent preferential "channeling" of large-scale motions due to the roughness below or the generation of "trains" of vortical structures shed from the roughness that advect along a common path downstream.

Kenneth Christensen
University of Illinois at Urbana-Champaign

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