Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Characteristics of Large-Scale Motions in a Turbulent Boundary Layer Overlying Complex Roughness J.M. BARROS, U.S. Naval Academy, K.T. CHRISTENSEN, Univ. of Notre Dame — The characteristics of large-scale motions in a turbulent boundary layer overlying complex roughness are explored with high-frame-rate stereo PIV measurements in the wall-normal–spanwise plane. It was previously reported that the single-point turbulence statistics of this flow display strong spanwise heterogeneity, particularly spanwise-alternating low- and high-momentum flow pathways in the mean flow bounded by large-scale streamwise-oriented roll cells and marked by enhanced Reynolds stresses and turbulent kinetic energy. These patterns were interpreted as the imprints of roughness-induced turbulent secondary flows owing to the streamwise elongation and spanwise heterogeneity of the topography. Frequency spectra of all three velocity components at fixed wall-normal location also display strong dependence on spanwise position, principally that of the streamwise velocity. In particular, the roughness promotes enhanced turbulent kinetic energy content of the large-scale motions and smaller-scale motions, coupled with strong spanwise dependence in the energy content of the very-large-scale motions when compared to smooth-wall flow. Modifications of Reynolds shear stress content as a function of scale are also explored from the three-component velocity measurements.

Kenneth Christensen
Univ of Notre Dame

Date submitted: 31 Jul 2014 Electronic form version 1.4