Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Three Dimensional Plenoptic PIV Measurements of a Turbulent Boundary Layer Overlying a Hemispherical Roughness Element[1] KYLE JOHNSON, BRIAN THUROW, Auburn University, TAEHOON KIM, University of Illinois, Urbana-Champaign, GIANLUCA BLOIS, KENNETH CHRISTENSEN, University of Notre Dame — Three-dimensional, three-component (3D-3C) measurements were made using a plenoptic camera on the flow around a roughness element immersed in a turbulent boundary layer. A refractive index matched approach allowed whole-field optical access from a single camera to a measurement volume that includes transparent solid geometries. In particular, this experiment measures the flow over a single hemispherical roughness element made of acrylic and immersed in a working fluid consisting of Sodium Iodide solution. Our results demonstrate that plenoptic particle image velocimetry (PIV) is a viable technique to obtaining statistically-significant volumetric velocity measurements even in a complex separated flow. The boundary layer to roughness height-ratio of the flow was 4.97 and the Reynolds number (based on roughness height) was 4.5710^3. Our measurements reveal key flow features such as spiraling legs of the shear layer, a recirculation region, and shed arch vortices. Proper orthogonal decomposition (POD) analysis was applied to the instantaneous velocity and vorticity data to extract these features.

[1]Supported by the National Science Foundation grant no. 1235726

Kyle Johnson
Auburn University

Date submitted: 01 Aug 2016 Electronic form version 1.4