Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Roughness Effects on the Formation of a Leading Edge Vortex[1]
CASSIDY ELLIOTT, AMY LANG, The University of Alabama, REDHA WAHIDI, The University of Texas of the Permian Basin, JACOB WILROY, The University of Alabama — Microscopic scales cover the wings of Monarch butterflies, creating a patterned surface that acts as a natural energy capture mechanism. This patterning is thought to delay the growth of the leading edge vortex (LEV) produced by the flapping motion of a wing. Increased skin friction caused by the scales leads to a weaker LEV being shed into the butterfly's wake, lessening drag and increasing flight efficiency. To test how this roughness effects LEV formation, a plate of random roughness was designed in SolidWorks and printed on the Objet 30 Pro 3D printer. A 2x3x5 cubic foot tow tank was used to test the rough plate at Reynold's numbers of 1500, 3000, and 6000 (velocities of 8, 16, and 32 mm/s) at an angle of attack of 45 degrees. Images were captured of the LEV generated when the plate was towed upwards through the particle-seeded flow. These images were used to determine the XY velocity of the particles using a technique called Digital Particle Image Velocimetry (DPIV). Codes written in MATLAB were used to track and measure the strength of the LEV. Circulation values for the randomly-rough plate were then compared to the same values generated in a previous experiment that used a smooth plate and a grooved plate to determine the effect of the patterning on vortex development.

[1]Funding for this research project was provided by the National Science Foundation under the Research Experience for Undergraduates (REU) program (REU Supplement CBET 1628600 under CBET 1335848).

Cassidy Elliott
The University of Alabama

Date submitted: 25 Jul 2017 Electronic form version 1.4