Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Cambering effects on Rapidly-Prototyped, Highly-Flexible Membrane Wings[1] DAVID PEPLEY, Grove City College, ANDREW WRIST, PAUL HUBNER, University of Alabama — Much of the inspiration for micro air vehicle (MAV) design comes from animals, likes bats, which use membrane wings for flying and gliding at low Reynolds numbers. Previous research has shown that membrane wings are more aerodynamically efficient than rigid wings. This is a result of both time-average cambering of the membrane and dynamic interaction with the shear layer. In most of the previous research, the membrane was attached to a flat (uncambered) frame. Traditional airfoil theory suggests that the cambering of wings improves aerodynamic efficiency and endurance. This research analyzed the effects of cambering the frames on wing efficiency and endurance. Six different cambered membrane wings with an aspect ratio of two, each with two cells with an aspect ratio of one, were 3-D printed using an Objet30 Pro and tested in a low-speed wind tunnel at 10 m/s (Re = 50,000). A NACA 4504 profile was used as a baseline with the frame thickness, percent camber, and maximum camber location being altered for comparison. The lift, drag, and pitching moment of the cambered and flat wings were recorded using a load cell. Results showed that cambering the frame of membrane wings increases aerodynamic and endurance efficiency at low Re. The effects of altering the camber, increasing the batten thickness, and changing the max camber location on aerodynamic and endurance efficiency were also examined.

[1]Special thanks to the National Science Foundation for research funding

Paul Hubner
University of Alabama

Date submitted: 29 Jul 2014 Electronic form version 1.4