Abstract Submitted
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The effect of butterfly scales on flight efficiency and leading edge vortex formation[1] AMY LANG, JACOB WILROY, REDHA WAHIDI, The University of Alabama, NATHAN SLEGERS, MICAHEL HEILMAN, George Fox University, JACOB CRANFORD, University of Alabama Huntsville — It is hypothesized that the scales on a butterfly wing lead to increased flight efficiency. Recent testing of live butterflies tracked their motion over 246 flights for 11 different specimens. Results show a 37.8 percent mean decrease in flight efficiency and a flapping amplitude reduction of 6.7 percent once the scales were removed. This change could be largely a result of how the leading edge vortex (LEV) interacts with the wing. To simplify this complex flow problem, an experiment was designed to focus on the alteration of 2-D vortex development with a variation in surface patterning. Specifically, the secondary vorticity generated by the LEV interacting at the patterned surface was studied, as well as the subsequent effect on the LEV's growth rate and peak circulation. For this experiment butterfly inspired grooves were created using additive manufacturing and were attached to a flat plate with a chordwise orientation, thus increasing plate surface area. The vortex generated by the grooved plate was then compared to a smooth case as the plate translated vertically through a tow tank at Re = 1500, 3000, and 6000. Using DPIV, the vortex formation was documented and a maximum vortex formation time of 4.22 was found based on the flat plate travel distance and chord length. Results indicate that the patterned surface slows down the growth of the vortex which corroborates the flight test results.

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