Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

In vivo **measurement of aerodynamic weight support in freely flying birds** DAVID LENTINK[1], ANDREAS HASELSTEINER, RIVERS INGERSOLL, Department of Mechanical Engineering, Stanford University — Birds dynamically change the shape of their wing during the stroke to support their body weight aerodynamically. The wing is partially folded during the upstroke, which suggests that the upstroke of birds might not actively contribute to aerodynamic force production. This hypothesis is supported by the significant mass difference between the large pectoralis muscle that powers the down-stroke and the much smaller supracoracoideus that drives the upstroke. Previous works used indirect or incomplete techniques to measure the total force generated by bird wings ranging from muscle force, airflow, wing surface pressure, to detailed kinematics measurements coupled with bird mass-distribution models to derive net force through second derivatives. We have validated a new method that measures aerodynamic force *in vivo* time-resolved directly in freely flying birds which can resolve this question. The validation of the method, using independent force measurements on a quadcopter with pulsating thrust, show the aerodynamic force and impulse are measured within 2% accuracy and time-resolved. We demonstrate results for quad-copters and birds of similar weight and size. The method is scalable and can be applied to both engineered and natural flyers across taxa.

[1]The first author invented the method, the second and third authors validated the method and present results for quadcopters and birds.

Andreas Haselsteiner
Department of Mechanical Engineering, Stanford University

Date submitted: 01 Aug 2014 Electronic form version 1.4