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Force estimation and turbulence in the wake of a freely flying European Starling HADAR BEN-GIDA, BGU, ADAM KIRCHHEFER, GREGORY KOPP, UWO, ROI GURKA, BGU — Flapping wings are one of the most complex yet widespread propulsion method found in nature. Although aeronautical technology has advanced rapidly over the past 100 years, natural flyers, which have evolved over millions of years, still feature higher efficiency and represent one of nature's finest locomotion methods. One of the key questions is the role of the unsteady motion in the flow due to the wing flapping and its contribution to the forces acting on a bird during downstroke and upstroke. The wake of a freely flying European Starling is investigated as a case study of unsteady wing aerodynamics. Measurements of the near wake have been taken using long duration high-speed PIV in the wake behind a freely flying bird in a specially designed avian wind tunnel. The wake has been characterized by means of velocity and vorticity fields. The measured flow field is decomposed based on the wing position phases. Drag and lift have been estimated using the mean velocity deficit and the circulation at the wake region. In addition, kinematic analysis of the wing motion and the body has been performed using additional high-speed cameras that recorded the bird movement simultaneously with the PIV. Correlations between the wing kinematics and the flow field characteristics are presented as well as the time evolution of the velocity, vorticity and additional turbulence parameters.

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