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The role of wing kinematics of freely flying birds downstream the wake of flapping wings KRISHNAMOORTHY KRISHNAN, Student, ROI GURKA, Asso. Professor — Avian aerodynamics has been a topic of research for centuries. Avian flight features such as flapping, morphing and maneuvering make bird aerodynamics a complex system to study, analyze and understand. Aerodynamic performance of the flapping wings can be quantified by measuring the vortex structures present in the downstream wake. Still, the direct correlation between the flapping wing kinematics and the evolution of wake features need to be established. In this present study, near wake of three bird species (western sandpiper, European starling and American robin) have been measured experimentally. Long duration, time-resolved, particle image velocimetry technique has been used to capture the wake properties. Simultaneously, the bird kinematics have been captured using high speed camera. Wake structures are reconstructed from the collected PIV images for long chord distances downstream. Wake vorticities and circulation are expressed in the wake composites. Comparison of the wake features of the three birds shows similarities and some key differences are also found. Wing tip motions of the birds are extracted for four continuous wing beat cycle to analyze the wing kinematics. Kinematic parameters of all the three birds are compared to each other and similar trends exhibited by all the birds have been observed. A correlation between the wake evolutions with the wing motion is presented. It was found that the wings' motion generates unique flow patterns at the near wake, especially at the transition phases. At these locations, a drastic change in the circulation was observed.

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