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**Numerical analyses of evolution of unsteady flow structures in the wake of flapping starling wing model.** KRISHNAMOORTHY KRISHNAN, Coastal Carolina Univ, IFTEKHAR Z. NAQAVI , University of Cambridge, ROI GURKA, Coastal Carolina Univ — Understanding the physics of flapping wings at moderate Reynolds number flows takes on greater importance in the context of avian aerodynamics as well as in the design of miniature-aerial-vehicles. Analyzing the characteristics of wake vortices generated downstream of flapping wings can help to explain the unsteady contribution to the aerodynamics loads. In this study, numerical simulations of flow over a bio-inspired pseudo-2D flapping wing model was conducted to characterize the evolution of unsteady flow structures in the downstream wake of flapping wing. The wing model was based on a European starling's wing and wingbeat kinematics were incorporated to simulate a free-forward flight. The starling's wingbeat kinematics were extracted from experiments conducted in a wind tunnel where freely flying starling was measured using high-speed PIV as well as high-speed imaging yielding a series of kinematic images sampled at 500 Hz. The average chord of the wing section was 6 cm and simulations were carried out at a Reynolds number of 54,000, reduced frequency of 0.17, and Strouhal number of 0.16. Large eddy simulation was performed using a second order, finite difference code ParLES. Characteristics of wake vortex structures during the different phases of the wing strokes were examined. The role of wingbeat kinematics in the configuration of downstream vortex patterns is discussed. Evaluated wake topology and lift-drag characteristics are compared with the starling's wind tunnel results.

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