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Accurate measurement of streamwise vortices in low speed aerodynamic flows RYE M. WALDMAN, JUN KUDO, KENNETH S. BREUER, Brown University — Low Reynolds number experiments with flapping animals (such as bats and small birds) are of current interest in understanding biological flight mechanics, and due to their application to Micro Air Vehicles (MAVs) which operate in a similar parameter space. Previous PIV wake measurements have described the structures left by bats and birds, and provided insight to the time history of their aerodynamic force generation; however, these studies have faced difficulty drawing quantitative conclusions due to significant experimental challenges associated with the highly three-dimensional and unsteady nature of the flows, and the low wake velocities associated with lifting bodies that only weigh a few grams. This requires the high-speed resolution of small flow features in a large field of view using limited laser energy and finite camera resolution. Cross-stream measurements are further complicated by the high out-of-plane flow which requires thick laser sheets and short interframe times. To quantify and address these challenges we present data from a model study on the wake behind a fixed wing at conditions comparable to those found in biological flight. We present a detailed analysis of the PIV wake measurements, discuss the criteria necessary for accurate measurements, and present a new dual-plane PIV configuration to resolve these issues.

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