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Improved Low-Order Models of Bio-inspired Pitching and Perching CHENGJIE WANG, JEFF D. ELDREDGE, Mechanical & Aerospace Engineering, University of California, Los Angeles, CA, USA — To study the flying of small creatures, their simplest flapping motions, pitching and perching, are investigated by low-order inviscid point vortex models. These motions induce coherent vortex shedding at the leading edge, which has a profound influence on the generated force. Instead of fully recovering the flow field around wing, the reduced models track only small number of discrete vortices with time-varying strength to account for the unsteady aerodynamics. The idea of impulse matching is introduced to develop the new governing equation, different from the previously-developed Brown-Michael equation. For both pitching and perching motions, the results from the impulse matching model are compared with high fidelity simulations under different pitching rate and axis position, and this comparison shows a good qualitative agreement, which is better than obtained with the Brown-Michael approach. The results are also compared with previous experiments conducted in a water tunnel, and good qualitative agreement is achieved. Further, some detailed analysis of the high fidelity simulation has been performed to get intuition about the leading edge vortex, which can help us in improving the low-order model.

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