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The role of spanwise-flexible propulsors in swimming and flying JAIME WONG, DAVID RIVAL, Queen's University — Natural swimmers and flyers span several orders of magnitude in both Reynolds number and fluid-propulsor mass ratio. Intuitively, one would expect different aeroelastic strategies to be employed across these regimes. However, similar magnitudes of spanwise bending, as measured by flexion angle, have been observed across this entire range for cruise conditions[1]. In this study, it is hypothesized that propulsor flexion has converged to generate similar spanwise vorticity transport in order to control the dynamic-stall vortex ubiquitous in natural swimming and flight. In particular, it is believed that vorticity convection and vortex stretching delay vortex detachment by balancing vorticity generated at the leading-edge and by reducing the overall vortex size, respectively, as recently shown for flapping profiles[2]. Moving forward, passive spanwise flexibility of propulsors is now abstracted as a spanwise-variation in effective incidence. This abstraction is realized as a pitching-flapping motion. By comparing passively flexible cases to rigid cases, the role of flexibility on controlling vorticity transport, and thus delaying vortex detachment is elucidated.
1 Lucas, K. N. et al., Nat. Commun. 5, 3293 (2014)
2 Wong, J. G., Rival, D. E., J. Fluid Mech. 766, 611-625 (2015)

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