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Passive mechanics in jellyfish-like locomotion MEGAN WILSON, JEFF ELDREDGE, UCLA — The aim of this work is to identify possible benefits of passive flexibility in biologically-inspired locomotion. Substantial energy savings are likely achieved in natural locomotion by allowing a mix of actively controlled and passively responsive deformation. The jellyfish is a useful target of study, due to its relatively simple structure and the availability of recent kinematics and flow-field measurements. In this investigation, the jellyfish consists of a two-dimensional articulated system of rigid bodies linked by hinges. The kinematics – expressed via the hinge angles – are adapted from experimentally measured motion. The free swimming system is explored via high-fidelity numerical simulation with a viscous vortex particle method with coupled body dynamics. The computational tool allows the arbitrary designation of individual hinges as "active" or "passive," to introduce a mix of flexibility into the system. In some cases, replacing an active hinge with a passive spring can enhance the mean swimming speed, thus reducing the power requirements of the system. Varying the stiffness and damping coefficients of the spring yield different locomotive results. The numerical solution is used to compute the finite-time Lyapunov exponents (FTLE) throughout the field. The FTLE fields reveal manifolds in the flow that act as transport barriers, uncovering otherwise unseen geometric characteristics of the flow field that add new insight into the locomotion mechanics.

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