Supplementary movie descriptions for:

Title: Self-buckling and self-writhing of semi-flexible microorganisms

Authors: Wilson Lough,[a] Douglas B. Weibel,[b] and Saverio E. Spagnolie[cd]

[a] *Department of Physics, University of Wisconsin-Madison, Madison, WI 53706.*
[b] *Department of Biochemistry, University of Wisconsin-Madison, Madison, WI 53706.*
[c] *Department of Mathematics, University of Wisconsin-Madison, 480 Lincoln Dr., Madison, WI 53706.*
[d] *Department of Chemical and Biological Engineering, University of Wisconsin-Madison, Madison, WI 53706.*

Movie M1. A single Proteus mirabilis cell. Buckling causes a change in local velocity at the leading end of the cell, resulting in a reversal of flagellar orientation.

Movie M2. Flagella drive opposite ends of the P. mirabilis cell body causing it to spin.

Movie M3. Flagellar torque-induced rotation of a P. mirabilis cell with a single self-crossing.

Movie M4. Elongated P. mirabilis cell with multiple self-crossings undergoes self-writhing locomotion.

Movie M5. Phase space trajectories (left) of the first two biharmonic bending (a_0, a_1) and first harmonic twisting (b_0) mode coefficients are shown converging to a limit cycle, for a range of initial conditions. The blue curve represents the phase space trajectory of the twisting and writhing swimmer shown on the right.

Movie M6. When subjected to a sufficiently large moment density, a body with low stiffness undergoes periodic flapping motions. The closed orbit of the first two biharmonic bending (a_0, a_1) and first harmonic twisting (b_0) mode coefficients is shown on the left.

Movie M7. Simulations of multiple bodies with different levels of activity and material parameters demonstrate a range of shape dynamics. Bodies are arranged in a grid according to their active moment densities, twisting moduli, and bending moduli. The configuration of each body represents its' shape and orientation, relative to the position and material frame of the body's own midpoint. The body with the largest average midpoint velocity, at the current time, is highlighted.

Movie M8. Asymmetric perturbations lead to non-periodic dynamics bending stiffnesses (00) $\beta_\perp = 5 \times 10^{-5}$, (01) $\beta_\perp = 7.5 \times 10^{-5}$, (02) $\beta_\perp = 8.5 \times 10^{-5}$, (03) $\beta_\perp = 1 \times 10^{-4}$, and (04) $\beta_\perp = 2.5 \times 10^{-4}$.