Single Actuator Undulation Soft-bodied Robots Using A Precompressed Variable Thickness Flexible Beam

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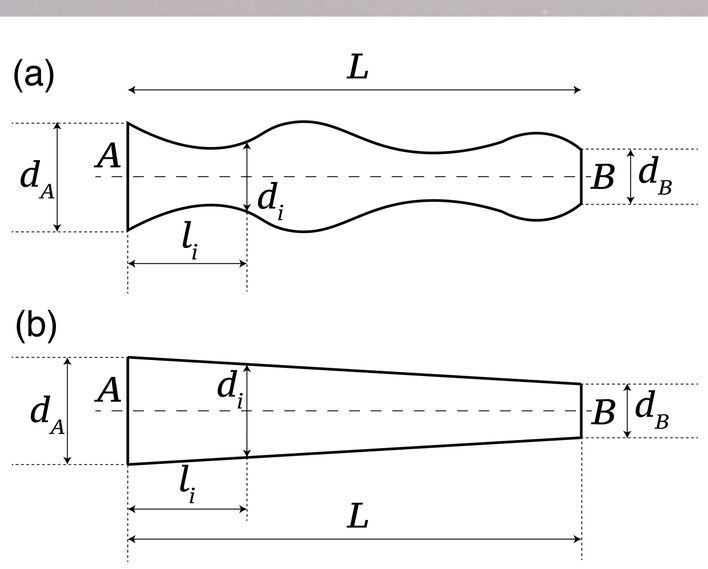
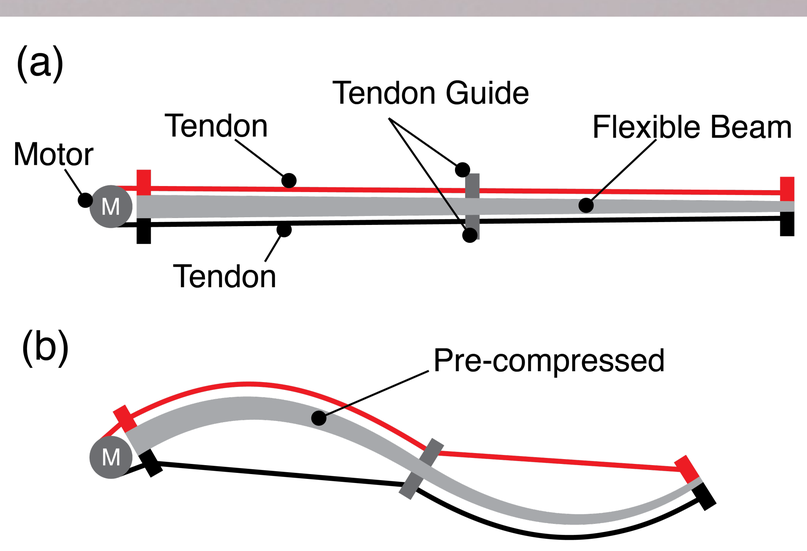
https://tatung.github.io/soft-undulation

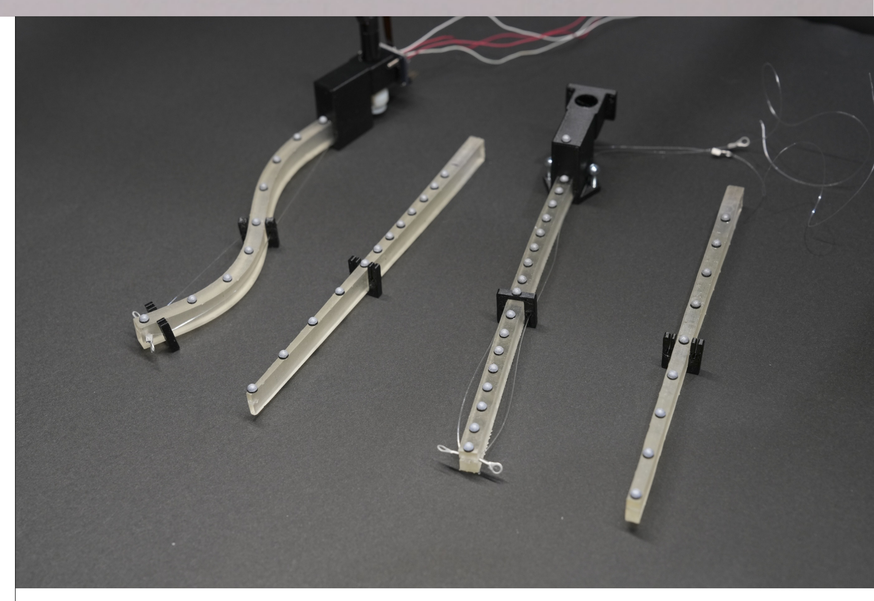
Soft robots, thanks to their flexibility, can adapt to unstructured environments. Undulation, inspired by creatures like snakes and eels, is a common gait but typically needs many actuators, adding weight and limiting performance. This paper proposes a **simple tendon-driven flexible beam with one actuator** (a DC motor) that creates a mechanical traveling wave to **enable undulation**. The beam is **precompressed into an S-shape** by shortening tendons, and the motor winds/unwinds them to deform the beam and produce waves. We experiment with varying pre-tension to explore the relationship between tendon tension and motor movement, simplifying undulation for soft robots.



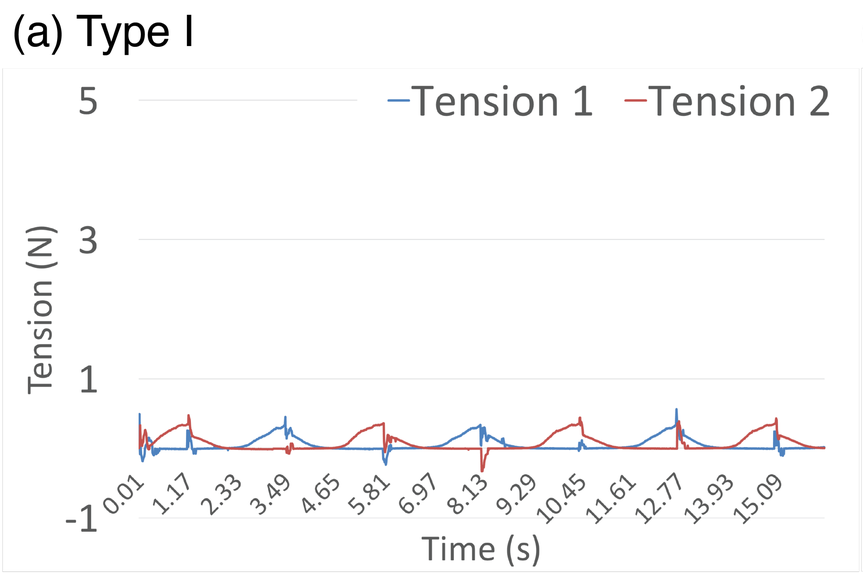
(a) nonlinear variable thickness, (b) linear variable thickness.



(a) Tapered flexible beam with tendons, (b) Pre-compressed flexible beam by shortening both tendons to induce buckling state.



3D-printed variable thickness flexible beam with different value of morphology parameters



The result of measuring tension on each tendon during actuation. (a) TYPE I: Simple bending, (b) TYPE II: Simple bending with buckling, (c) TYPE III: Buckling with traveling mechanical wave