

Description Of Additional Supplementary File

Supplementary Movies:

Movie 1. Demonstration of the softness and compliance of the PTFE-based soft-foldable actuator. This video showcases the softness and compliance of the PTFE-based soft-foldable actuator by actuating after squeezing and applying hammer impacts.

Movie 2. Fabrication of SHY robotic modules. This video shows the entire fabrication process for SHY robots and the three robotic modules while in motion upon pressurization.

Movie 3. Comparison of the hydrophilic properties of pristine and H₂ gas plasma treated PTFE film. This video demonstrates the properties of pristine and plasma-etched PTFE film using a permanent marker. Permanent markings on a pristine PTFE film are easily removed by wiping. Permanent markings on a film with hydrophilic properties stay permanently.

Movie 4. Demonstration of SHY robotic modules with ionic resistive sensing. These videos demonstrate the ionic resistive sensing responses during the actuation of the translational, bending, and roto-translational SHY robotic modules.

Movie 5. Demonstration of real-time shape sensing functionality of SHY continuum robot. These videos show both the estimated and actual tip position of the robot to validate the shape-sensing functionality. Three different actuation sequences are demonstrated. In sequence 1, the robotic modules are actuated in order: i) roto-translation, ii) bending, and iii) translation. In sequence 2, the robotic modules are actuated in order: i) bending, ii) translation, and iii) roto-translation. In sequence 3, the robotic modules are actuated in order: i) translation, ii) bending, and iii) roto-translation.

Movie 6. Demonstration of SHY continuum robot performing pick-and-place tasks of objects of various shapes and sizes. The robot manipulates soft and hard objects including small food items (a rice grain, a coffee bean, a pomegranate seed, a gummy bear, a tangerine vesicle, a blueberry, a salmon roe, and a raspberry), assembly and fabrication components (an M6 nut), daily objects (a LEGO block and a letter block from the Scramble Game), and a 50 g weight.

Movie 7. Demonstration of SHY continuum robot performing needle steering and tissue puncturing. The robot steers the integrated 30 gauge needle and guides the needle toward the brown ring targets on a tissue simulator. Upon reaching each target, the robot punctures the tissue and injects red dye using the needle.

Movie 8. Demonstration of SHY continuum robot performing optical fiber steering. The robot guides the integrated optical fiber to direct light toward the brown ring targets. It focuses the light on the targets by adjusting the robot's position towards them.