Soft gripper with variable stiffness hinges and electro-adhesive (EA) pads for grasping

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Introduction

A light-weight and low-cost two-fingered soft gripper capable of multiple modes for grasping a wide range of objects and adapting to unstructured environments.

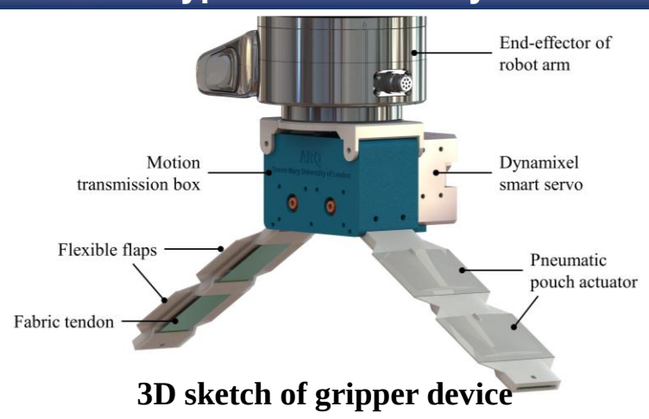
Goal

- Soft grippers with variable stiffness hinges for dexterous grasp
- Electro-adhesive (EA) pads for anchoring on objects to assist grasping using soft gripper

Proposed Methods

- Tendons stretch fingers to morph
- Pouch actuators deform flaps to change the stiffness of hinges
- EA pads help to grasp light, fragile, and slippery items
- Pouch actuators keep soft EA pads in a firm shape to get into tight spaces

Prototype and control system



3D sketch of gripper device

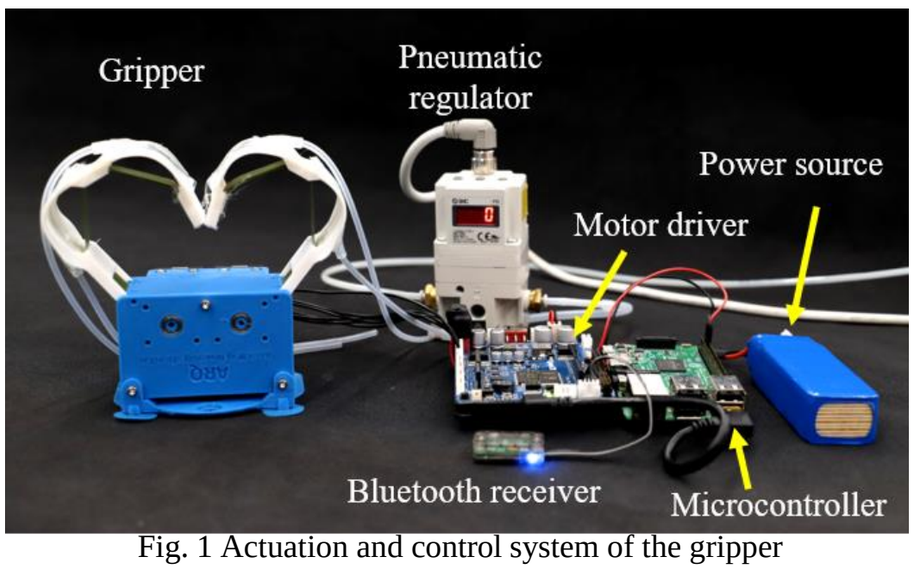


Fig. 1 Actuation and control system of the gripper

Experiments

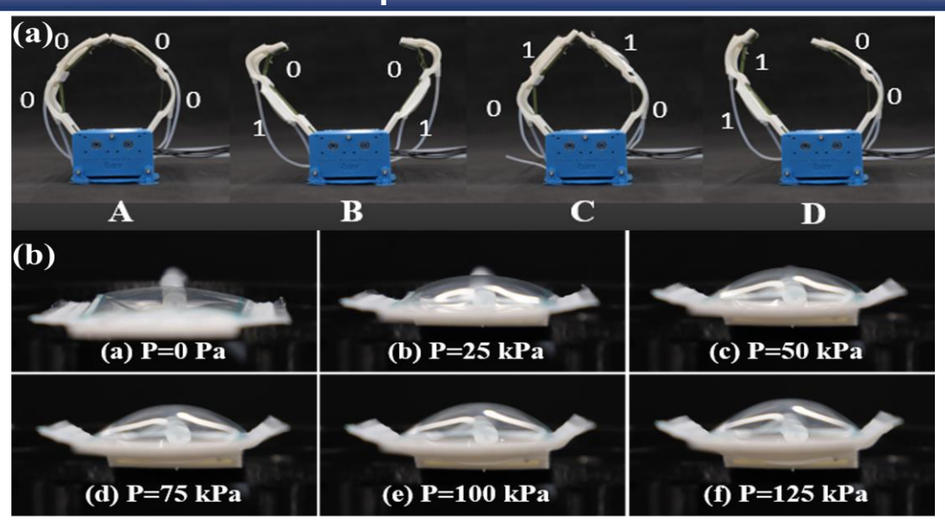
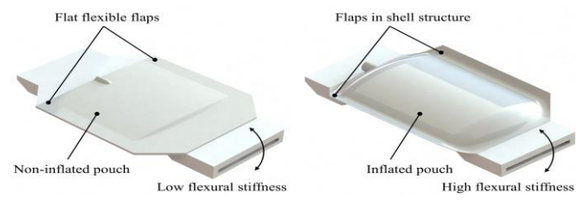


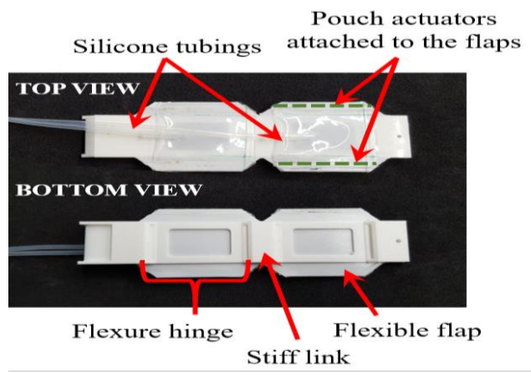
Fig. 2 (a) Actuation of different pouches leads to different gripper configurations upon actuation by tendons (b) Images showing deformation of the shell structure at different pouch

Fig. 3 (a) Grasping different objects (b) Implementing pick and place task (c) Grasping items with EA pads, and the pouch actuator helps to keep the EA pad in a firm shape

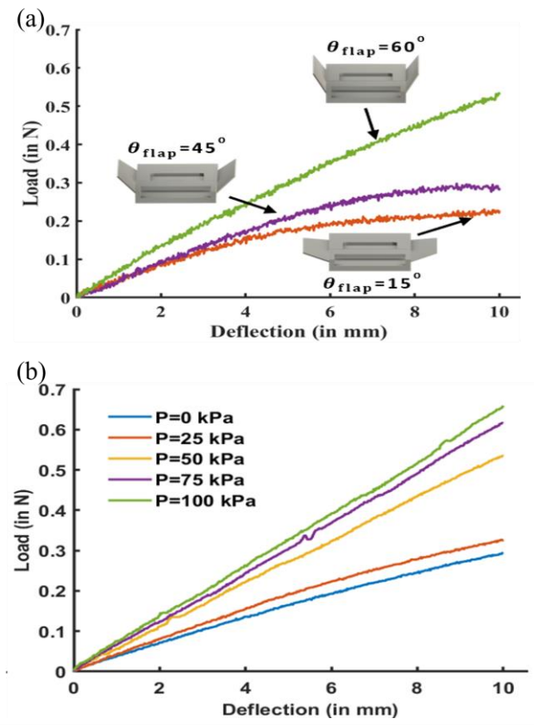
Hinges and analysis

Inspired by origami-folding which transforms 2D flat templates into 3D, our proposed flexure hinge consists of one plate beam and two flaps. The flaps can be folded around the edge of the plate thus resulting in a beam structure with various open sections thereby changing the moment of inertia and the resulting flexural rigidity of the overall structure.





Effect of shape morphing on the flexural stiffness of a flexure hinge, Force vs lateral displacement for (a) prefabricated flexure hinges with flap angles of 15, 45 and 60 degrees, and (b) a flexure hinge embedded with pneumatic pouch actuator at different actuation pressures.



Conclusion

The gripper is easy to control remotely and able to grasp items of different shapes and weights with the help of variable-stiffness and EA pads.

Acknowledgements

*This work is supported by the EPSRC National Centre for Nuclear Robotics (NCNR) and NCNR Flexi Fund

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