Versatile Soft Grippers Based on Dielectric Elastomer Actuators

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ABSTRACT

We present and demonstrate a versatile soft gripper which we recently developed [1]. The gripper, shown in Fig. 1, is capable of picking and placing various objects such as a raw egg (60.9 g), a piece of paper (0.8 g), and a highly deformable water balloon (35.6 g), even though the device mass is 1.5 g. The mechanism behind is simultaneous generation of actuation and electroadhesion (electrically controlled adhesion), which is enabled by a new design of a soft actuator technology, dielectric elastomer actuators (DEAs).

DEAs are a class of electroactive polymers that exhibit high compliance (∼1 MPa), large actuation stroke (∼90 % linear strain), and fast response (1 kHz bandwidth), and have self-sensing capability. DEAs usually consist of an elastomer membrane sandwiched between two compliant electrodes. Applying a voltage (typically a few kV) induces opposing charges on the electrodes which squeeze the membrane and expand the area as electrostatic actuation.

The new design of DEAs used for the gripper employs interdigitated shape for the electrodes, so that out-of-plane electric fields are formed on the surface when actuated. These electric fields generate the electroadhesion force by inducing surface charges on the close objects which attract to the charges on the electrodes. In the gripper, the electroadhesion force provides the holding force enabling handling of objects that are fragile, heavy, and deformable, while the electrostatic actuation conforms the gripper fingers to various object geometries.

During the workshop, we will explain the gripper in more detail in the poster session, and show a simple pick and place operation of objects in the demo session.

REFERENCES

[1] J. Shintake, S. Rosset, B. Schubert, D. Floreano, and H. Shea, "Versatile soft grippers with intrinsic electroadhesion based on multifunctional polymer actuators," *Advanced Materials*, vol. 28, no. 2, pp. 231-238, 2015.

This work was supported by the Swiss National Centre of Competence in Research (NCCR) Robotics, and the Swiss National Science Foundation grant 200020-153122.

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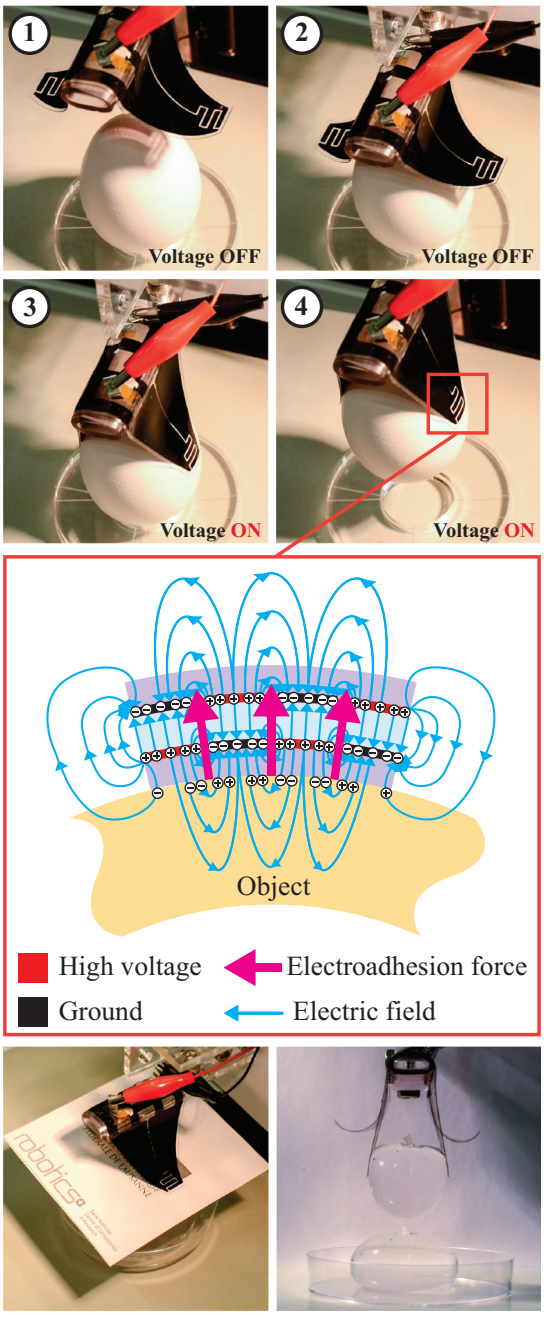

Fig. 1. (top) Sequence of the gripper picking up a raw egg (60.9 g). (middle) Cross-section of the gripper's finger tip. The interdigitated electrodes sandwiching the elastomer generate both the electrostatic actuation and the electroadhesion force. (bottom) Pictures of the gripper holding a piece of paper (0.8 g) and a highly deformable water balloon (35.6 g).