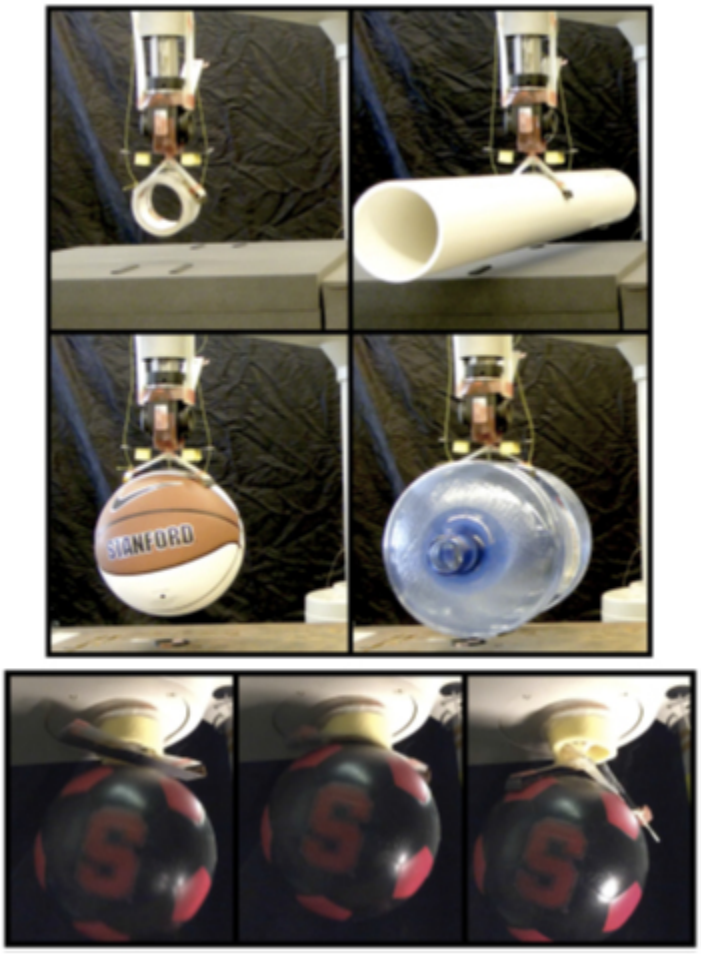
Docket #: S14-443

Gripper device using shear-controlled dry adhesive film

Stanford researchers at the Cutkosky Lab have patented a low cost, passively activated gripper that can grasp large curved, textured or delicate objects using an adhesive film. This film employs dry, gecko-inspired fibrillary adhesives that are able to grasp convex objects almost exclusively by shear force when tension is applied. The adhesion is then easily turned off to release the object when the tension is removed. It is like a reusable, non-tacky tape that only sticks when pulled.

Because the adhesive operates by shear force rather than normal forces or friction, it can grab delicate objects without excessive pressure. This technology could enable a variety of applications that were previously unfeasible, including: transporting objects on steep conveyor belts; robotic gripping for a range of geometries, even geometries that change (like a water balloon); or catching thrown items without active control.



Gripper in action. *Objects picked up and placed by a robotic arm using the shear adhesion gripper include a roll of packing tape, PVC tubing, a basketball and a five gallon water bottle. The lower series of pictures shows the gripper catching a thrown ball, including the moment before contact and the catching mechanism.*

Stage of Research

The inventors have implemented the gripper device on a robotic arm and demonstrated its ability to both grasp a range of objects and catch/throw items without active control. The objects tested included a tossed ball and a partially filled Ziploc bag.

News Article

Grippy not sticky: Stanford engineers debut an incredibly adhesive material that doesn't get stuck *Stanford Report* May 27, 2015.

Applications

- **Robotics** - to passively grasp curved objects with end user applications such as:
  - manufacturing and industrial robotics (e.g., steep conveyor belts, automobile glass handling, package handling, grasping light fixtures and tubing)
  - aerospace (e.g., passively grasping space debris)
  - prosthetics and medical robotics

Advantages

- **Shear adhesion** - grasping is primarily from shear adhesion rather than friction or normal force, which enables gripper to:
  - grasp large curved and textured objects by conforming to non-flat surfaces
  - handle delicate objects while applying very little pressure or squeezing
  - adhere to objects for high angles of conveying
- **Passive grasping** - no power and no pneumatics:
  - simple design and easy control to turn adhesion on and off with no actuation required
  - dynamic applications - can catch objects that make impact with gripper
  - easy release
- **Very low cost** - less than $2
- **Scalable** - mathematical modeling suggests that larger grippers could grab larger objects

Publications

- Patent Application US20160200946A1 "Controllable adhesive on conformable film for non-flat surfaces"
- Hawkes, E. W., Christensen, D. L., Han, A. K., Jiang, H., & Cutkosky, M. R. (2015). Grasping Without Squeezing: Shear Adhesion Gripper With Fibrillar Thin Film. In IEEE International Conference on Robotics and Automation, Seattle, WA, May (pp. 26-30).
- Suresh, S. A., Christensen, D. L., Hawkes, E. W., & Cutkosky, M. (2015). Surface and Shape Deposition Manufacturing for the Fabrication of a Curved Surface Gripper. Journal of Mechanisms and Robotics, 7(2), 021005.

Patents

- Published Application: 20160200946
- Issued: 10,316,220 (USA)

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