

A octopus tentacle inspired soft robotic gripper

Abstract

Octopus use their suction cups and tentacles synergistically to better conform different surfaces. Inspired by this unique biological feature, we designed and fabricated a pneumatically actuated, soft robotic tentacle-“OctopusGripper”. By 3D printing molds and casting silicone elastomers, a tapered tentacle was fabricated with a height of 200 mm, and two rows of active suckers on the inside surface. With the function between tentacle and suckers, “OctopusGripper” can wrap around and grip a variety of objects with different sizes and shapes. The exhibition of the “OctopusGripper” attracted wide public attention at the Hanover Messe.

Methods

The “OctopusGripper” consists of a soft silicone structure, which pneumatically deforms and thus wraps around the object being gripped. For this purpose, the tentacle (Fig. 1(c)-1) was fabricated by using purely soft silicone elastomeric material (mold star 30, smooth-on Inc., USA) with a uniform circular ring

sector shaped chamber (Fig. 1(c)-3) cut out inside. The tentacle bends while the chamber is filled with compressed air. A textile cover (Fig. 1(c)-2) is embedded

around the air chamber, restricting its expansion and protecting the silicone from bursting. In the middle of the tentacle is a wafer-thin plastic film (Fig. 1(c)-5). It prevents the structure from drooping under gravity. Similar to the octopus, two rows of suction cups (Fig. 1(c)-6) were assembled on the tentacle (Fig. 1(b)). Silicone tubes (Fig. 1(c)-4) allowed the air in and out to realize bending and vacuum.

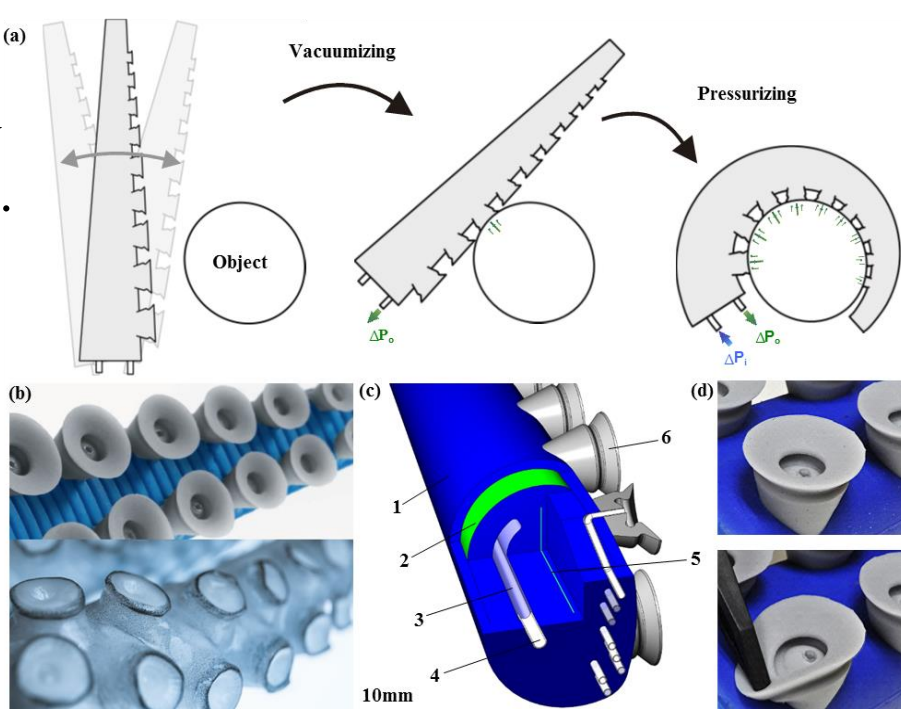


Fig. 1. Design and structure of “OctopusGripper”. (a) Grasping strategy of “OctopusGripper”. (b) “OctopusGripper” and biological octopus. (c) The 3D structure of “OctopusGripper”. (d) Softness of suckers

Results

Profit from the softness of tentacle and suckers (Fig. 1(d)), “OctopusGripper” can easily wrap around and grip a variety of objects with different sizes and shapes by simply controlling the chamber’s air pressure and the suckers’ vacuum. The grasping strategy can generally be divided into three steps: 1) the tentacle approaches the target object; 2) vacuumize the suckers to attach to object; 3) pressurize the tentacle and then wraps around the object,

meanwhile, suckers attach to the object to enhance the gripping force. As is shown in Fig. 2, an iron canister, a book, a cup



Fig. 2. grasping different objects demonstration

and a bottle is grasped stably by “OctopusGripper”.

Conclusion

- The combination of interlocking gripping and secure adhesion makes the “OctopusGripper” suitable for a number of objects with different shapes and geometries with a smooth surface and high sensitivity. Furthermore, its safe structure already meets the strict criteria of a soft robotics component and guarantees a safe working relationship with people.

- “A soft gripper by sucking and wrapping.” China, Patent No.: 201710346369.1.
- “OctopusGripper” demonstration video: <http://softrobotics.buaa.edu.cn/videos/index.htm>;
- Media coverage: MIT Technology Review: <https://www.technologyreview.com/s/604023/this-robotic-tentacle-can-easily-grasp-smooth-objects/>
- Media coverage: Wired UK: <http://www.wired.co.uk/article/octopus-robot-tentacle>