A Novel Soft Robotic Grasper

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Rigid robotic hands are expensive and difficult to control due to their inherently complex multi-jointed fingers and lack of compliance. To address these problems in an interdisciplinary approach involving biology, physics, mechanical engineering, and materials science, I designed and constructed the novel soft robotic grasper that is highly compliant, simple to control, durable, and extremely cost-effective (The components cost less than $10). In this project, I optimized elastomeric pneumatic network actuators that act as robotic fingers by bending in a quasi-circular motion when inflated. In an iterative process, I designed and prototyped the grasper base to interface three pneumatic actuators in an optimized opposition configuration. The grasper is actuated via the pneumatic control board in a binary system that simultaneously opens and closes the three pneumatic actuators. To characterize the grasper's efficacy, I conducted a dynamic grasping experiment in which the grasper executed 22 grasps of 13 real-world objects with varied geometries (ranging from a credit card to a soccer ball). Unique to this device, the grasper picked up objects such as a smartphone in a weak pinch grasp and passively manipulated them into a more stable grasp in a process that I have termed "Passive In-Hand Manipulation" (PIHM). In a strength test, the grasper supported 6.8 kilograms (roughly 13 pounds). Applications of the novel soft robotic grasper include: soft prosthetic hand, pneumatic surgical grasper for manipulating delicate tissue, industrial robotic manipulator for complex pick-and-place tasks involving irregularly-shaped objects, durable robotic grasper for hazard and military robots, and underwater exploration robots that gather delicate coral specimens.