Abstract

Grasping a soft object such as a snowball or shaped wet sand is possible with a person's hand in several points of contact with the object. To closely resemble this grasping, short of building a robotic hand with haptic feedback, we used a compliant soft gripper. Specifically, we used an existing "fin-ray" finger that was 3D printed with flexible material (TPU). This material passively adapts to the object's geometry but cannot dynamically stiffen. Therefore, we embedded Shape memory alloy (SMA) wires in the "fin-ray" fingers which can be thermally or electrically actuated with Joule heating. A finger is geometrically attached, for quick change, to a mount that is attached to each "claw."

Testing included grasping of select objects that had a force sensor attached. Using these force resistive measurements, we determined the corresponding forces associated with four gripper types: including the base gripper, integrated with fingers, integrated with fingers enhanced with a spring steel, and integrated with fingers enhanced with SMA. We attempt to visually display the results with a marshmallow which is an object that exhibits a noticeable deformation. We found that maximizing SMA into a miniature gripper as discussed is difficult due to bending kinks, and therefore there is difficulty with packing enough SMA to discern a result. As the purpose of this research is for delicate object handling in extraterrestrial environments, we developed a gripper which likely needs to be scaled up for better results, directly relating to the increase in SMA wire.