Development of a Compliant Gripper Driven by 3 DOF Soft Robot

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Industrial robots are moving toward automation, which makes it increasingly necessary to replace the functions traditionally performed by humans with robotics. Pick and place operation is a prime example of such automation. Robots that pick up and place objects mimic the human action of picking an object up and placing it in a targeted location. It has led to the development of robotic end-effectors that have a human-like feel. Grippers can be articulated in various ways depending on their application area and well-defined desired tasks. As compliant and soft links deflect more under the same load than their rigid body counterparts, they serve as excellent candidates for use in the design and development of grippers for handling delicate objects. This study presents the design, development, and experimental testing of a single piece designed compliant gripper manipulated by a 3 DOF soft robot. The manipulator consists of two soft links. While the bottom arm is 2 DOF and is tendon driven by two servo motors, the upper arm is a single degree of freedom and is tendon driven by a servo motor. The two-finger-designed compliant gripper is also actuated by a servo motor. The base holds the motors and the soft manipulator. The MATLAB Simscape model of the robot is created to perform deformation and motion analysis of the gripper and soft manipulator. OpenCV is used to see real time environment and object analysis. Through this, data will be captured to allow some sense of environmental understanding. Since the soft manipulator and the compliant gripper were designed monolithically, the robot was 3D printed as a single piece using thermoplastic polyurethane (TPU). The gripper is tested for its grasping and lifting performance while recording the applied forces by the gripper using a Flex sensor.