ABSTRACT

SOFT ROBOTIC ACTUATORS WITH CUSTOMIZABLE INNER GEOMETRIES USING ADDITIVE MANUFACTURING

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The world of Soft Robotics is a relatively new research field. Top universities are advancing this topic by incorporating external geometric changes and electrical components to further observe predicted actions [1]. Currently, one of the only industrial implementations of Soft Robotics are grippers [1][2]. These grippers are incorporated into industrial robotic arms to grab, lift, or move fragile items such as live animals, produce, or sharp items, as shown in figure 1 [2]. Using the methods of Mechanical Design and Additive Manufacturing (3-D Printing), we have created actuator designs that are highly customizable and replicable worldwide. The actuator shown in figure 2, shows the internal cavity which is designed inversely through a 3-D printed inner insert, as shown in figures 3 and 4. These alterable inserts are housed as part of a complete 3-D printed mold, that in turn gets casted with silicone, to obtain these actuators, as shown in figure 5. To our contributing findings, we have successfully created actuators that consist of internal geometric changes rather than existing external changes [1][2]. This mold created an 80 mm actuator with 7, 3 mm, ridges in its internal cavity and had a minimum wall thickness of 1.75 mm, as shown figure 5. These standard ridges successfully made the actuator acquire a deflection of 48 degrees from an input of 72 ml of air, as shown in figure 6. This technique has been and is currently implemented into the creation of full robotic crawlers. All research that was conducted aids to the furtherment of Soft Robotics and it allows for a new approach to designing fully soft, non-robust,

robots for a variety of application. Not only does this bring new techniques for designing, but it aids to global replicability allowing for research groups worldwide take part in this uprising technology.

Figure 1: Industrial Robotic Gripper Picking Up Dough

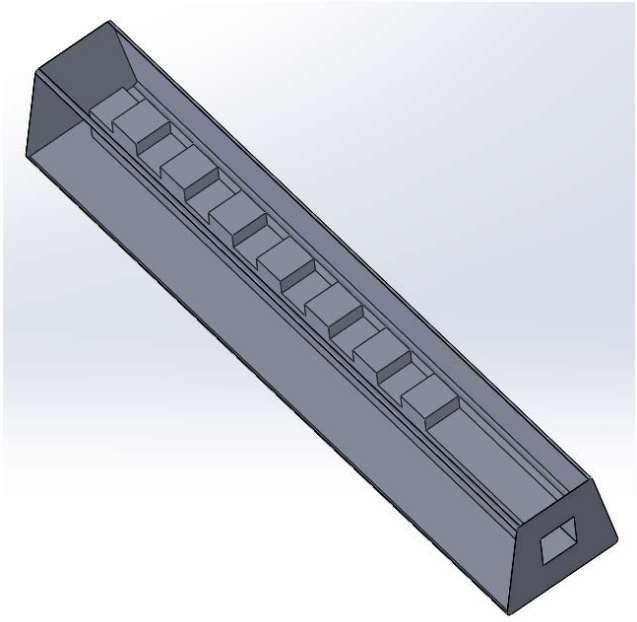

Figure 2: Actuator Design with Transparent Walls to See Inner Design

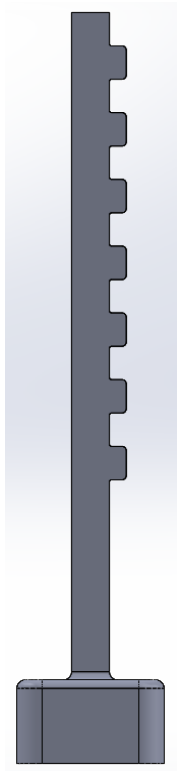

Figure 3: Inner Insert Design Side View

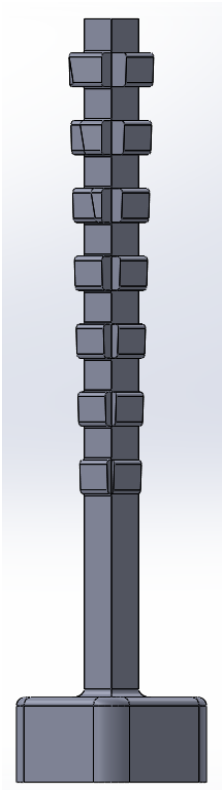

Figure 4: Inner Insert Design

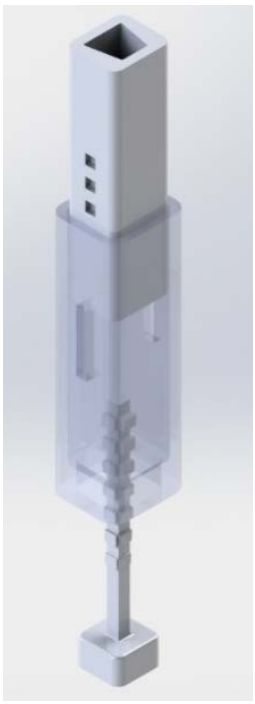

Figure 5: 3-D Printed Mold for Casting Design

Figure 6: Casted Actuator Inflated

REFERENCES

1. "Soft Robotics." Harvard Biodesign Lab, Harvard University, 2017, biodesign.seas.harvard.edu/soft-robotics.
2. "Soft Robotics." *Soft Robotics*, www.softroboticsinc.com/.