Soft Robotic Arm for Construction Drones (SRACD)

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Introduction

- The field of Soft robotics is constantly breaking into new areas, especially those that require human interaction in close proximity and niche applications. The construction field meets these requirements in many situations.
- The Soft Robotic Arm for Construction Drones (SRACD) is a multilink soft robotic arm meant to be used for a construction drone.
- The arm presents the benefits of a lightweight arm that many drones can be adapted to use as well as a universal gripper for components and some tools. This would allow for the replacement of scaffolding for some small building repair jobs.

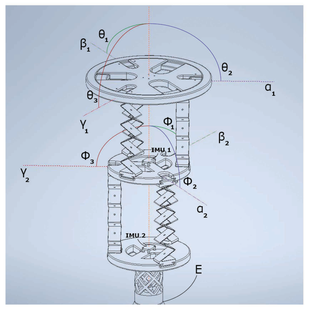

Figure 1: SRACD arm in CAD software in representation of angles in movement as well as labeling

Objectives

- The development of a soft robotic arm that is lightweight for usage on a drone.
- The implementation of FOAMs on a soft robotic arm with the implementation of linear or nonlinear controls for the system.

Methods

- Inertial Measurement Units (IMUs) are used to obtain the relative orientation of each of the links. This is done by measuring the gravitational acceleration in three axes, and using this to determine the orientation of each link relative to gravity, then comparing each link's orientation to the surrounding links.
- Ultrasonic range finders will be used to help obtain the relative distance of each link. The ultrasonic range finder yields the distance between itself and another nearby object, in this case, the next link. Combined with the IMUs, this will allow the relative position of each link to be obtained.

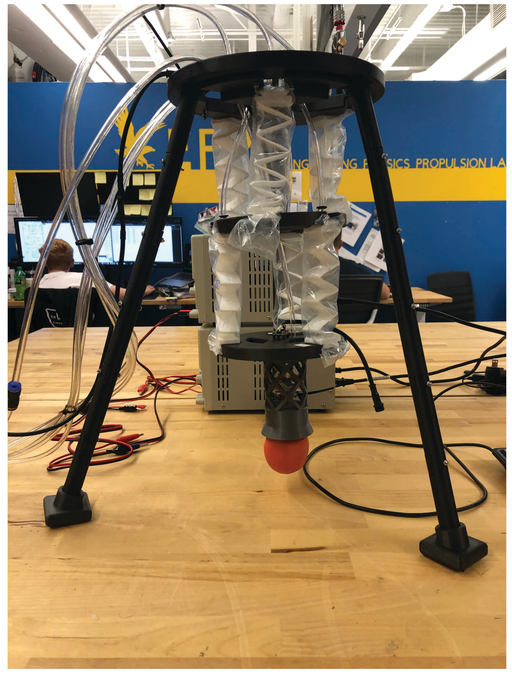

Figure 2: Soft Robotic Arm for Construction Drones (SRACD) test stand

Progress

- We have constructed the two links of the soft robotic arm using FOAMs in the system, each in a delta configuration with an offset of 120 degrees for each link. A universal ball gripper was also implemented for the system. This configuration has shown it can manipulate small parts to 90 degrees relative to the top of its base.
- The SRACD system was run using the IMUs to detect and constrain the motion, in conjunction with control systems tested. Two control systems were tested, the first being a basic negative feedback loop. A PID was also tested and was able to successfully control the system.

Conclusion & Future Work

- The SRACD system is capable of the manipulation of small parts with relative accuracy to the desired location. The arms design, excluding its external hardware, weighs approximately 2.16 pounds encompassing its two links and mounting hardware, making it extremely viable for mounting on a medium-sized drone.
- The universal gripper is capable of grabbing any of the small parts tested but needs guidance in force application before vacuum is applied to it. The implementation of an ultrasonic range finder will allow for the targeting and calculation of the desired force to grab an object before vacuum is applied to grasp the item.