SpectraFluidics - Deployable Arm
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Abstract
The prominent features of the Deployable Arm are its telescopic sections, and a counterweight to provide stability and accuracy. The Deployable Arm is lightweight and easy to operate. Extensive computer simulations, cost analysis, prototyping, and material testing all provided input which was used to improve the Deployable Arm prototype. Analysis of testing results led to the selection of a most cost effective composite material that provided desired performance.

Project Objective
SpectraFluidics developed a sensor that can accurately detect DNT, a byproduct of TNT explosives. They have commissioned our group to design a deployable arm which will mount the sensor. Our objective is to create a proof of concept model that will allow the user to operate the sensor from a safe distance away from the explosive.

Design Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Benchmark</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Maximum weight without sensor attached</td>
<td>15 lbs</td>
<td>10.55 lbs</td>
</tr>
<tr>
<td>2 Compressed length without sensor attached</td>
<td>4.5 ft</td>
<td>4.5 ft</td>
</tr>
<tr>
<td>3 Reach at the maximum extension</td>
<td>15 ft</td>
<td>18.5 ft</td>
</tr>
<tr>
<td>4 Deflection at maximum extension with sensor attached</td>
<td>7 in</td>
<td>12.03 in*</td>
</tr>
<tr>
<td>5 Develop a test the measures position of the end effector of the prototype</td>
<td>N/A</td>
<td>**</td>
</tr>
<tr>
<td>6 Distance from target with sensor attached</td>
<td>Within</td>
<td>3 in</td>
</tr>
<tr>
<td>7 Time to keep sensor within working envelope</td>
<td>60 s</td>
<td>60 s **</td>
</tr>
</tbody>
</table>

*See Recommendations
**See Results: Accuracy

Current Design
Fiberglass Telescoping Pole
- 18.5 ft Fully Extended
- 4.5 ft Fully Compressed
- 6 Sections
- 70% Fiber Density
- 6 Layer Composite
  1. Longitudinal Strands
  2. Circumferential Wrap
  3. Longitudinal Strands
  4. Continuous Strand Mat
  5+6. Highest quality Nexus Veil Composite pole

Counterweight
- 10 lbs
- Balances torque from sensor load
- Can be filled with water & sand

Camera
- Lightweight
- 720p resolution

Straps/Handles
- Used for increased stability
- Straps free load from user hands

Accuracy
The accuracy of the deployable arm was tested using IR sensors. The sensors record the proximity of the tip to the target in 3D. Our team was able to maintain the tip within a 3 inch envelope for 94% of the time during a 1 minute span.

Results

Carbon Fiber
Carbon fiber tubes offer greater stiffness with lower weight compared to fiberglass. Our team chose fiberglass due to cost, but carbon fiber can be used for future production.

Table 1: Design requirements and achievements

Table 2: Improvements of using carbon fiber

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