The Schulich Hand
Underactuated Robot Hand Capable of In-Hand Manipulation
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Introduction
Bio-inspired robotics are required to bridge the gap between autonomous mechanical design and intricate biological systems.

The purpose of this project is to design an underactuated robot hand capable of in-hand object manipulation.

Underactuation and in-hand object manipulation have generally been independent to one another [1].
- Underactuated systems have less actuators than degrees of freedom (DoF).
- In-hand manipulation is significant motion without losing grip or regrasping of an object.

Combining these two concepts will increase the dexterity and efficiency of underactuated hands and the simplicity and cost-effectiveness of hands with in-hand manipulation.

Applications of this design:
- Autonomous search and rescue after disasters.
- Limb replacement in biomedical prosthetics.
- Exploration of inaccessible or dangerous locations.

Objectives
Design requirements:
- Size of an average human hand
- Have at least 3 phalanges
- Materials suitable for harsh environments
- Support objects up to 10kg
- Weight less than 600g
- Bilateral configuration
- Maximum of 1 motor per finger
- Have a universal wrist mounting system

Objective Motions:
- Longitudinal Translation > 5°
- Long-axis Rotation > 180°
- Short-axis Rotation > 5°

Legend: Objective Grips
- Tip Pinch
- Key Pinch
- Tripod Pinch

Table 1: Object sizes for each grip

<table>
<thead>
<tr>
<th>Grip</th>
<th>Max. Object Size</th>
<th>Min. Object Size</th>
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<tbody>
<tr>
<td>Tip</td>
<td>121.38 mm</td>
<td>0 mm</td>
</tr>
<tr>
<td>Key</td>
<td>39.92 mm</td>
<td>17.61 mm</td>
</tr>
<tr>
<td>Tripod</td>
<td>117.12 mm</td>
<td>38.70 mm</td>
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</tbody>
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Figure 1: Objective Grips (left to right) Tip, Key and Tripod Pinches

References

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