Fall 2012 Underactuated Robotic Gripper with Human-like Compliance

Aim: To develop an underactuated (1 motor driven) three fingered robotic gripper with human-like compliance in its fingers.

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Preliminary work (*as of 10/31):*

1. Finger mechanism was decided.
2. Palm shape was decided.
3. Preliminary solidworks model was designed.
4. Lego prototype was built to understand all the configurational options and kinematic constraints.

Action:

<table>
<thead>
<tr>
<th>Week</th>
<th>To Do</th>
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![](image)
1. Solve Synthesis Problem
   - Decide Trajectory for finger
     - Stereotypical Fingertip Trajectories During Grasp
       D. G. Kamper, E. G. Cruz and M. P. Siegel
       doi: 10.1152/jn.00546.2003
     - This paper describes the typical range of motion of a human finger. It specifies fingertip trajectories for gripping motions.
     - These trajectories were considered as goals in synthesis.
   - Decide constraints to make finger 1-DOF
     - Multiple Finger, Passive Adaptive Grasp Prosthetic Hand
       N. Dechev, W.L. Cleghorn, S. Naumann
     - This paper suggests a single degree of freedom solution for gripping.
     - We implemented this mechanism in Solidworks, leading to our first prototype.

2. Solidworks model of base and tendon-actuator plan.

Prototype 3D-Printed. This first prototype model is quite complex to manufacture, and has many link interferences.
Matlab simulation using synthesis data for final tweaking and analysis of motion.

- The 2nd outer link determines how quickly the finger tip joint closes as the finger approaches a grasping position. We shortened this link to reduce the rate.

- The first outer link length determines the rate at which the middle knuckle joint closes in relation to the rest of the finger and shifts the overall range of the fingertip. Lengthening this link allows the finger to open wider, but the finger closes at a much slower rate.
Final Solidworks design of the finger.
This new design eliminated link interferences by adapting a stacked design using only planar links. The new links are easier to manufacture.
Order parts not readily available.
• Parts were 3D-printed. Palm was crafted out of wood.
| 4. (11/19 - 11/25) | • Linear motor was chosen over rotary motor to simplify design.  
| | • Software control  
| | • Debugging |
| 5. (11/26 - 12/2) | • Debugging  
| | • Testing  
| | • Formal Documentation |
| 6. (12/3 - 12/9) | • Demonstration. |