LL4MA LAB

THE UNIVERSITY OF UTAH

Robotic Grasp Control Using Tactile Feedback

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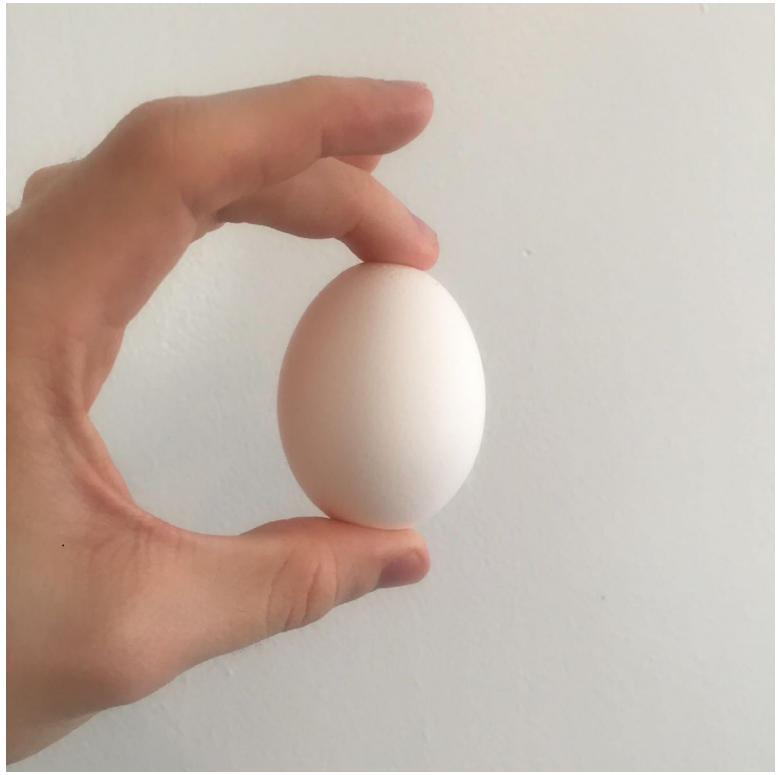
Robotic Grasps



Images: LL4MA, [1]

Approach

- Use tactile information to sense when sufficient force is applied
  - Actions adapt to changes in environment
  - Feedback Control

- Transform grasping, movement, and placement into discrete phases
  - Change robot behavior based on phase

Outline

1. Why use control?
2. Deconstructing a grasp
3. Controlling a robot hand

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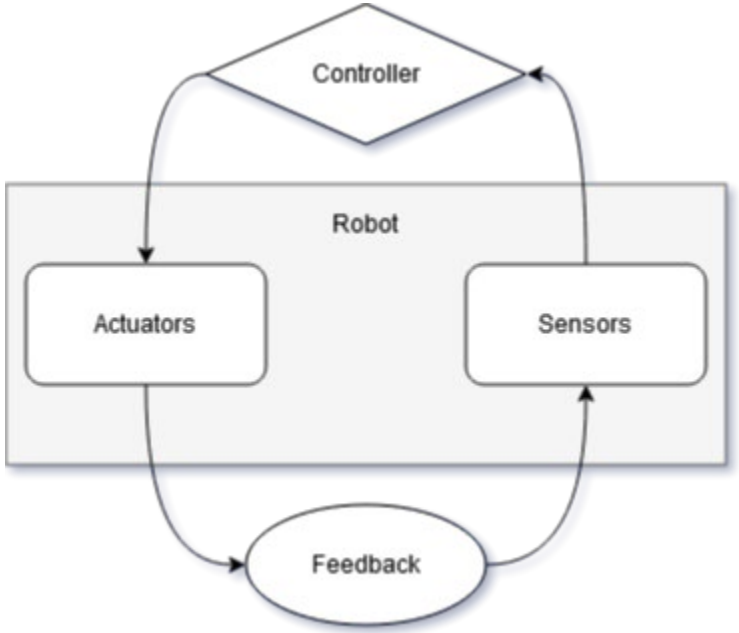
Making Robots Move

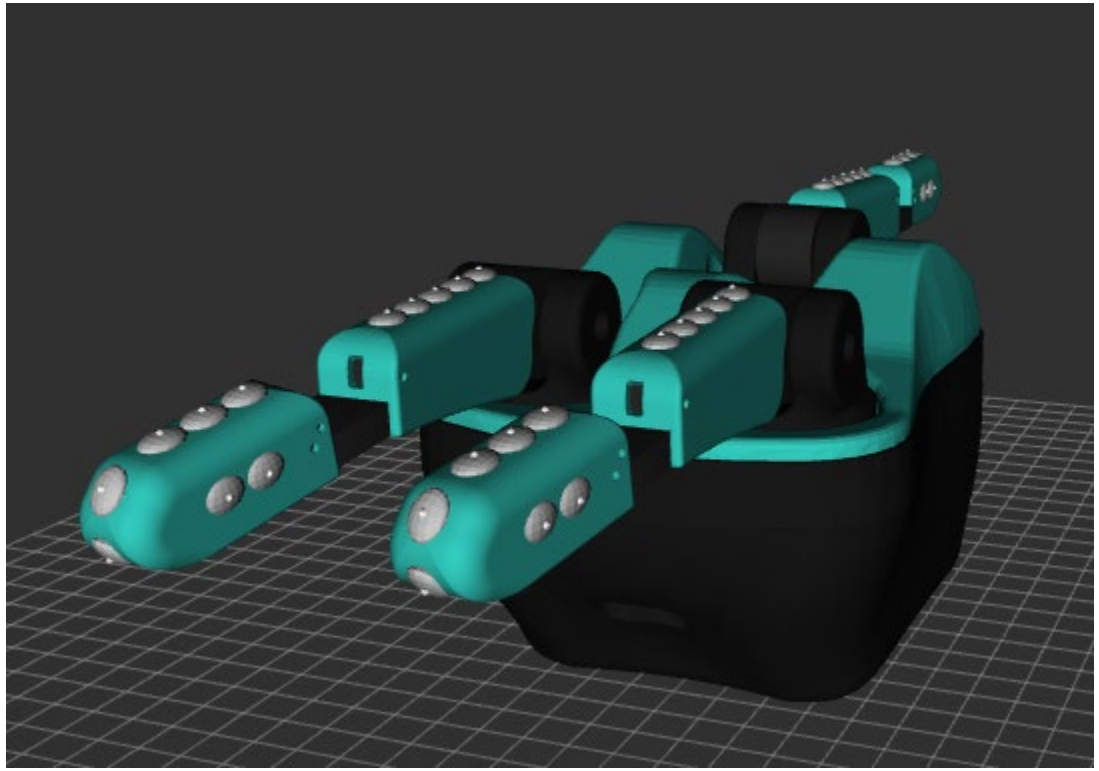
Planning:

Control:



Images: [2], LL4MA

The Robot



Images: [3], LL4MA

Outline

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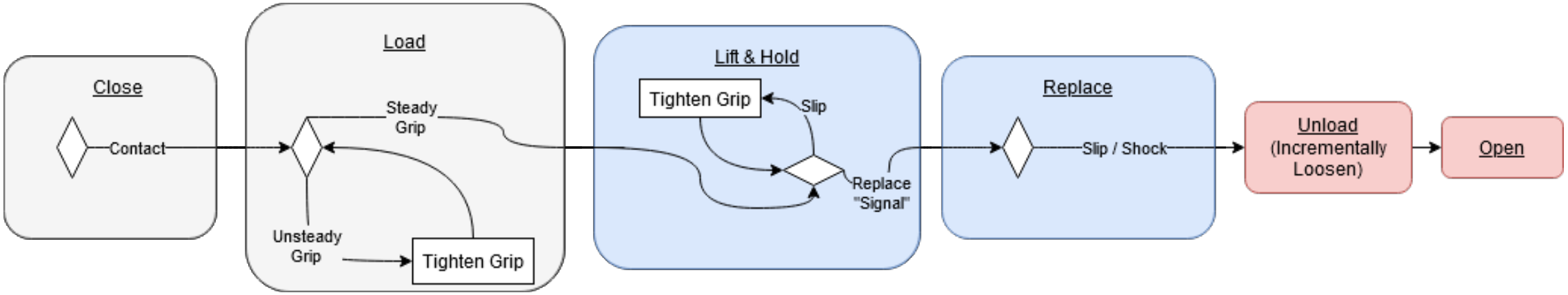
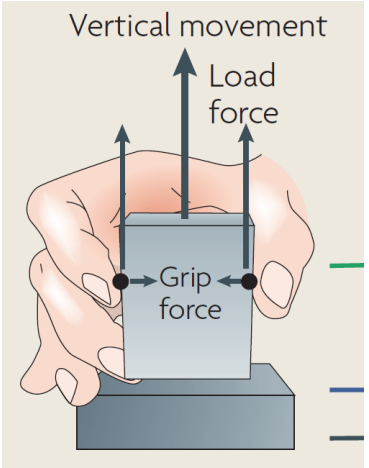
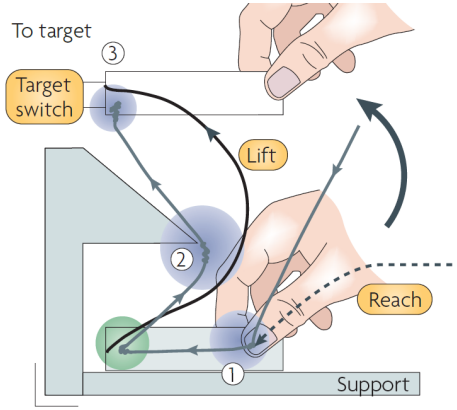
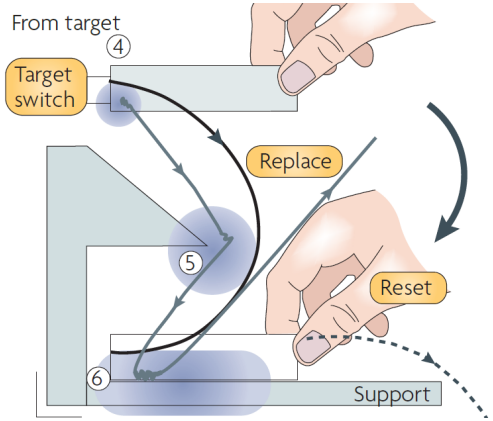
Grasping and Placement









Images: [5], [6]

Outline

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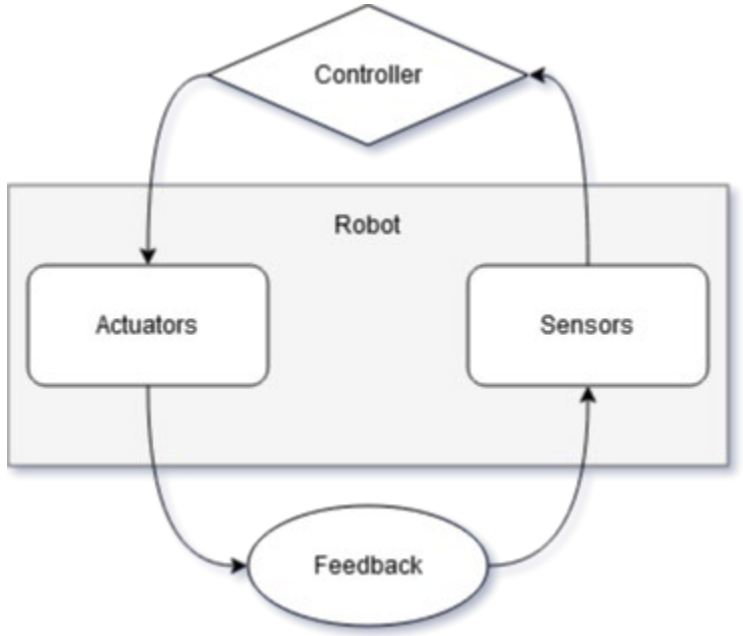
Implementation

Given: $\alpha \in \mathbb{R}$,
$\gamma, \epsilon \in \mathbb{R}_{\geq 0}$,
$F_d \in \mathbb{R}^s_{\geq 0}$

$$u = P(F - F_d)$$
$$= \gamma(F_d - F) \cdot \delta[|F - F_d - \alpha| > \epsilon]$$

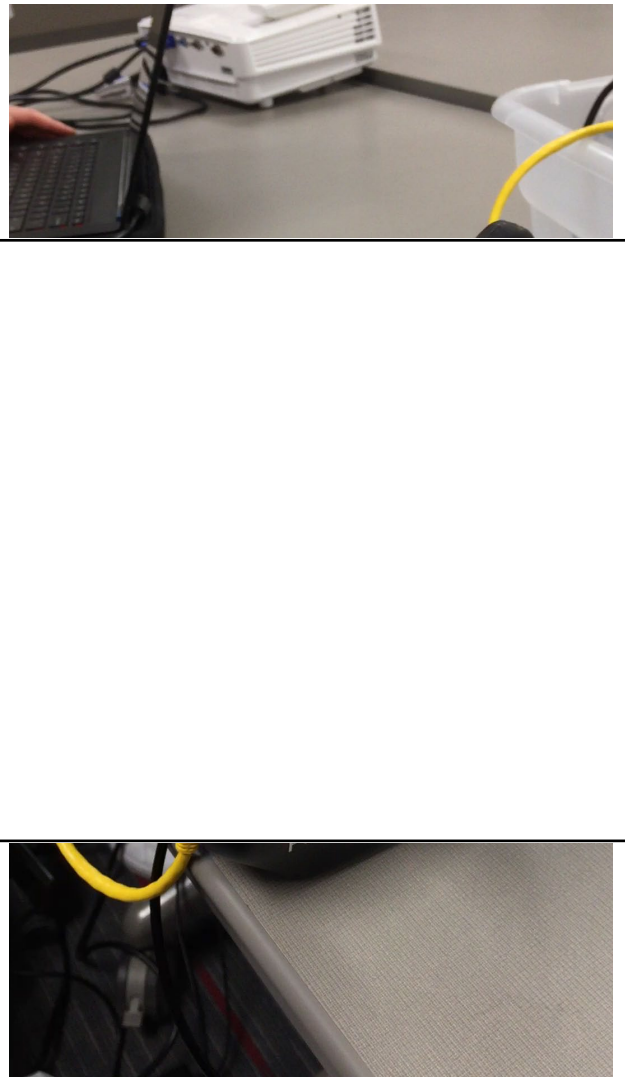


$$\Delta\theta = g(u)$$

$$F \in \mathbb{R}^s_{\geq 0}$$

Difficulties

- Feedback Control “Signal”
  - Low γ gives slow damping
  - High γ leads to chattering (thrashing)



Autonomous, 1x Speed

Video: LL4MA

Software

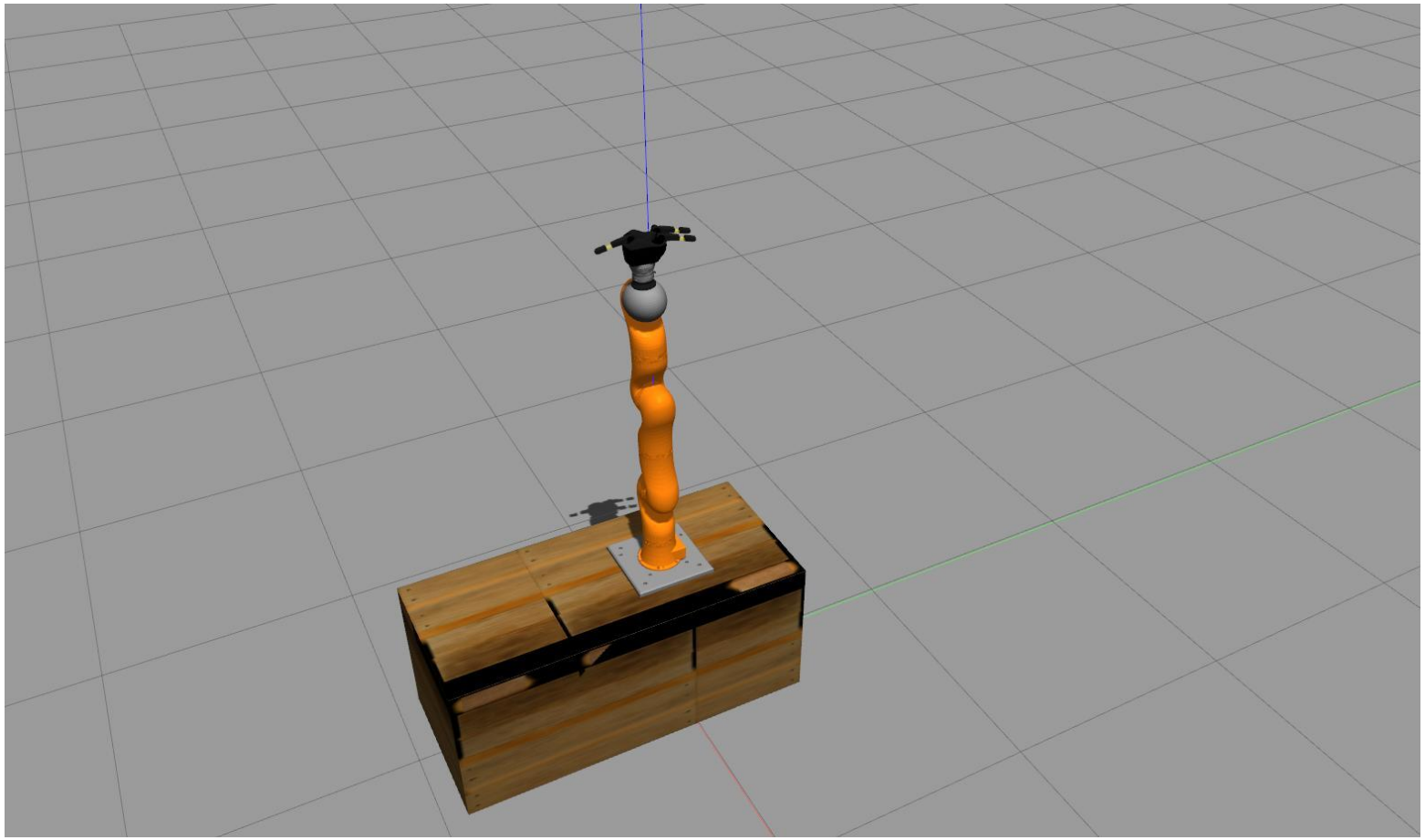
- OS: **Ubuntu 16.04 LTS**

- Controller: **Python 2.7**

- Robot Communication: **Robot OS (ROS) Kinetic**

Images: [6]-[8]

Results



Future Work

- Improve Controller
  - Optimization
  - Fit compliance of a surface
  - Placement on soft surfaces
- Add Inference
  - Detect instability in “Unload” phase
  - Predict starting positions [8]

References

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6. R. S. Johansson and J. R. Flanagan, “Coding and use of tactile signals from the fingertips in object manipulation tasks,” *Nature Reviews Neuroscience*, vol. 10, pp. 345–359, May 2009.
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