

Manipulation

Saurabh Gupta

Today's Class

- Task, and challenges in manipulation
- Discussion about the role of learning for manipulation tasks
- DexNet 2.0 Paper

Example Tasks

- Tidying up a table
- Folding laundry
- Taking out keys from pocket
- Inserting key into lock
- Cutting a potato
- Scrubbing a dish

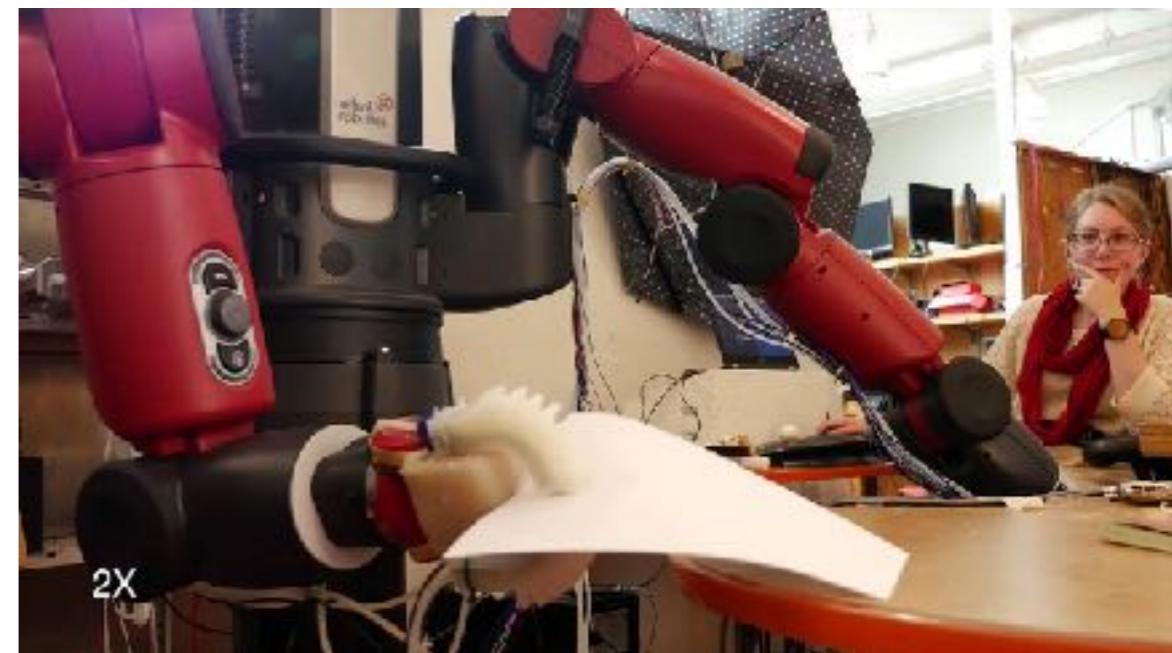
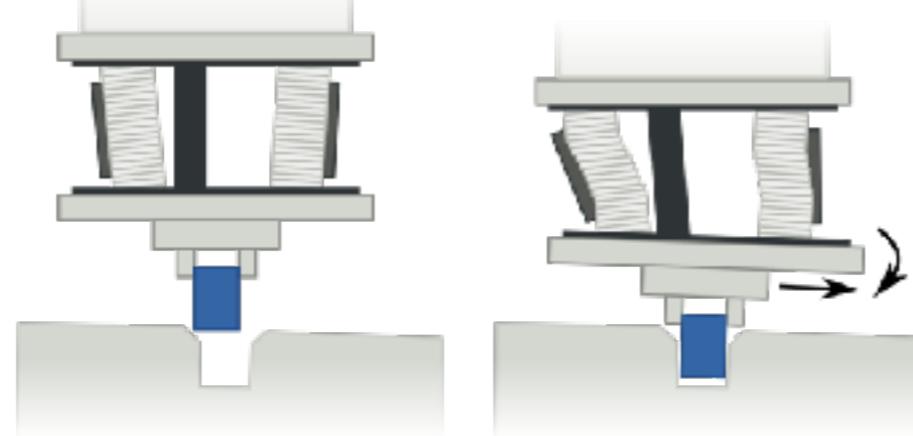


Tasks

- Programmed motion
- Compliant motion
- Structured pick-and-place
- Unstructured pick-and-place
- Mechanical assembly and task mechanics
- In-hand manipulation
- Non-prehensile manipulation
- Whole body manipulation
- Task-oriented grasping
- Manipulation of deformable objects
 - cloth, granular media

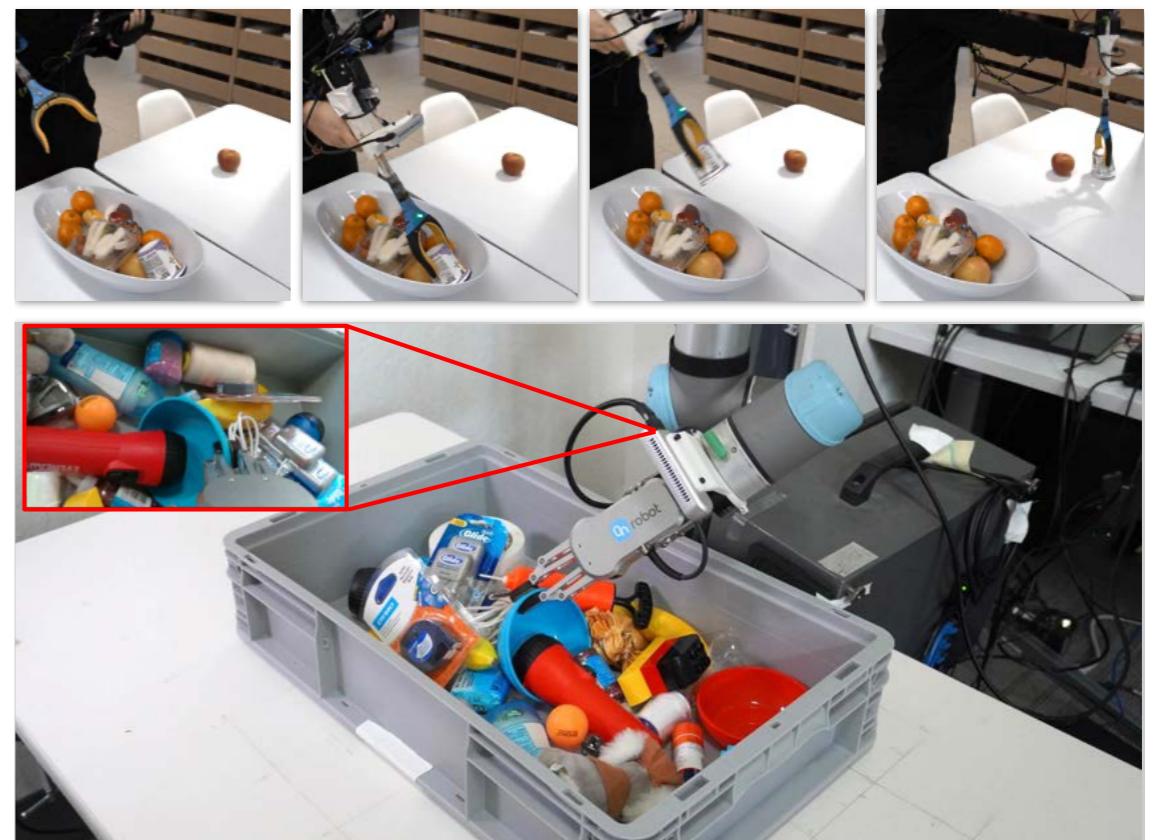
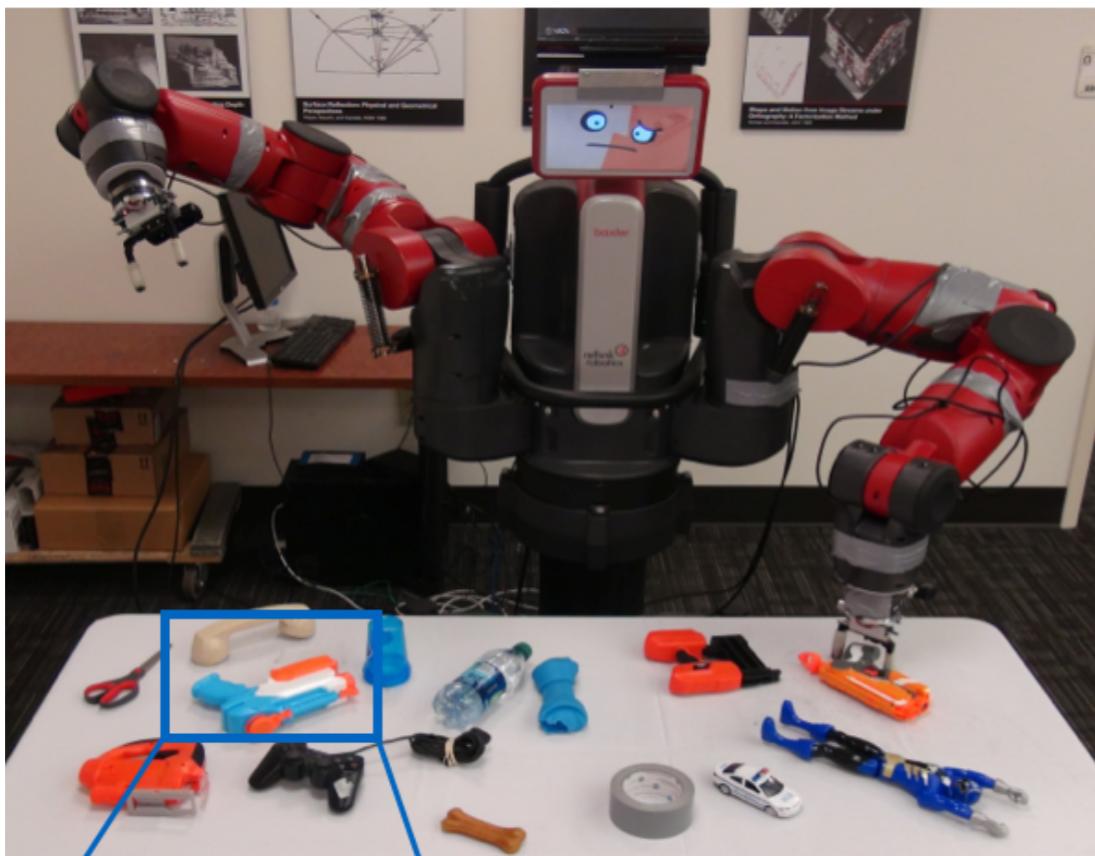
Actuation / End effector design

- Parallel jaw grippers
- Task specific end-effectors
 - Eg: Suction cups, remote Center Compliance for peg insertion
- Multi-finger hands
- Soft robots



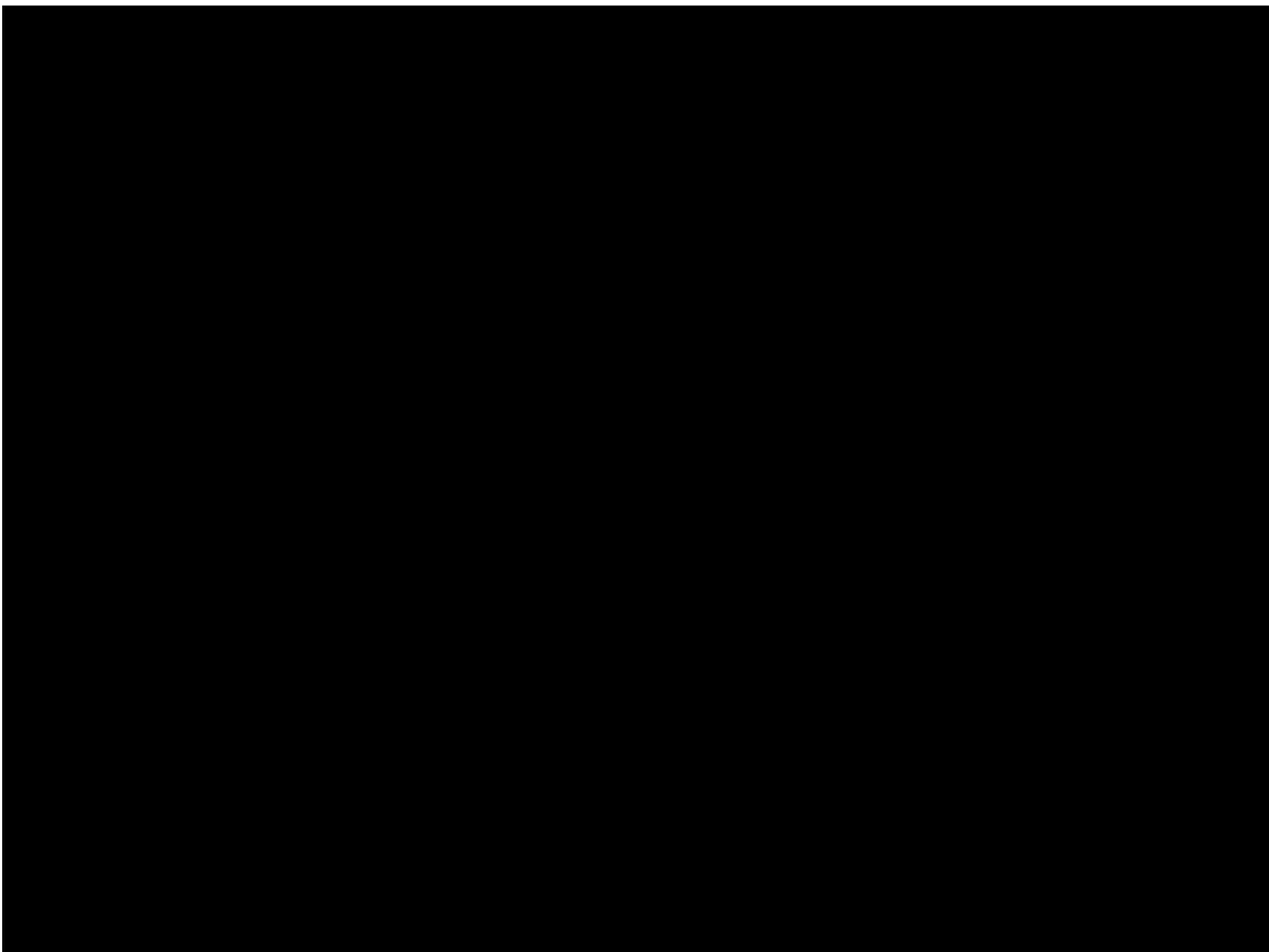
Sensing

- Over head camera / hand-in-eye camera, etc.



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- Just visual sensing may not be enough, eg: consider inserting a key in cold



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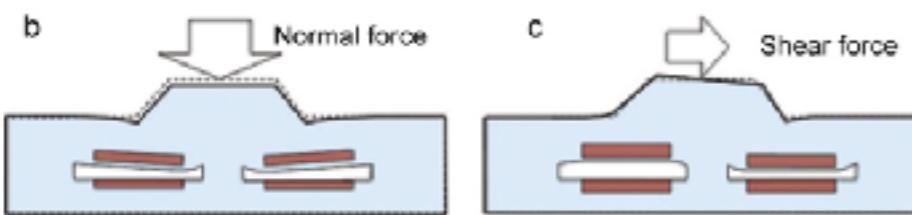
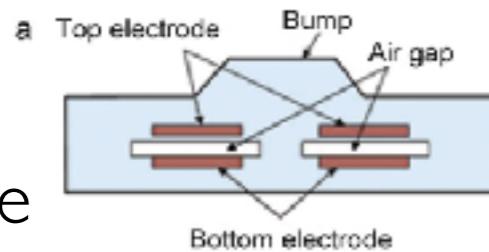
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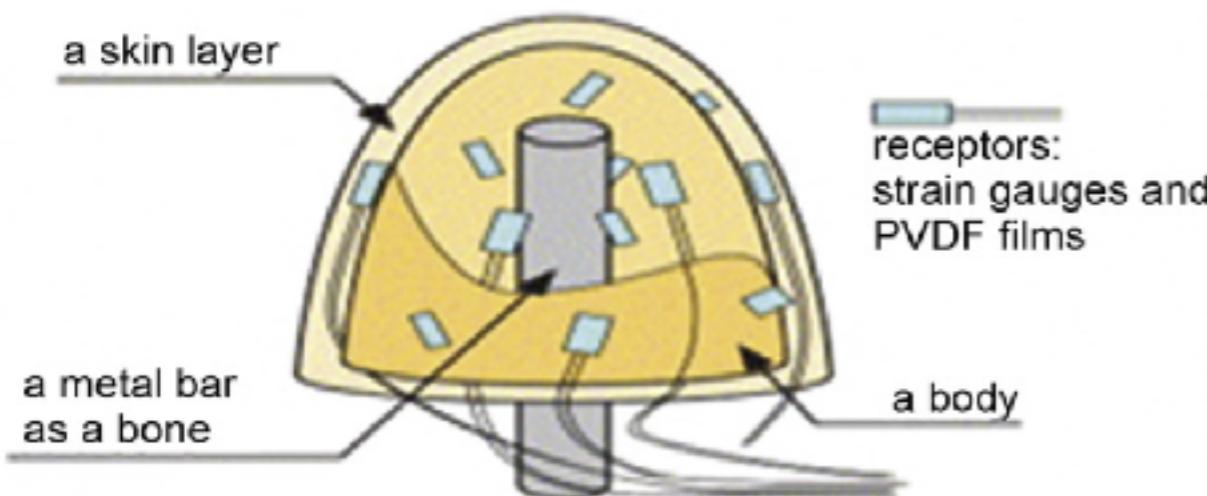
Sensing

- Over head camera / hand-in-eye camera, etc.
- Just visual sensing may not be enough, eg: consider inserting a key in cold
- Tactile sensing / haptic feedback may be crucial

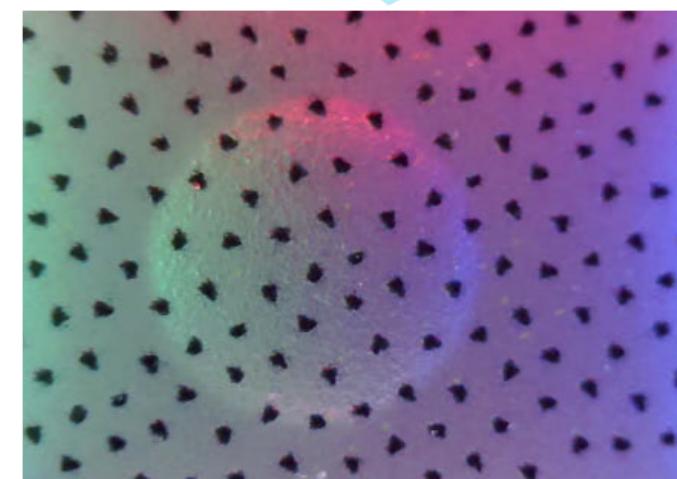
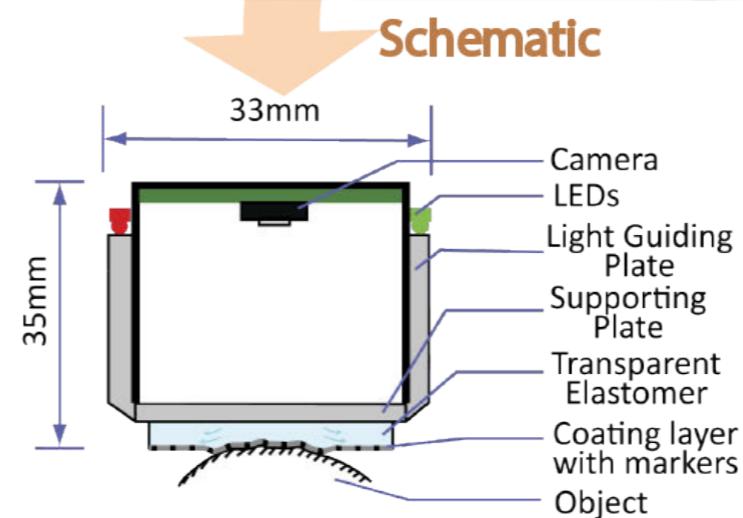
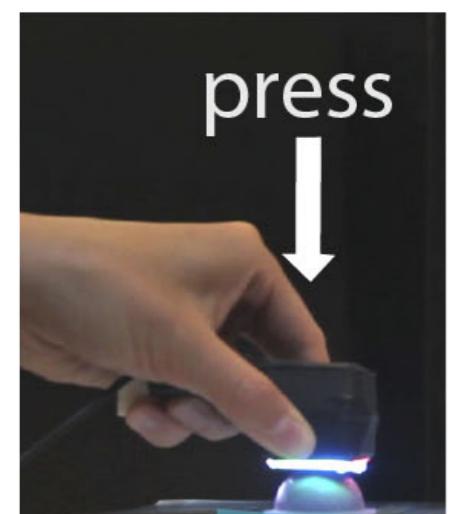
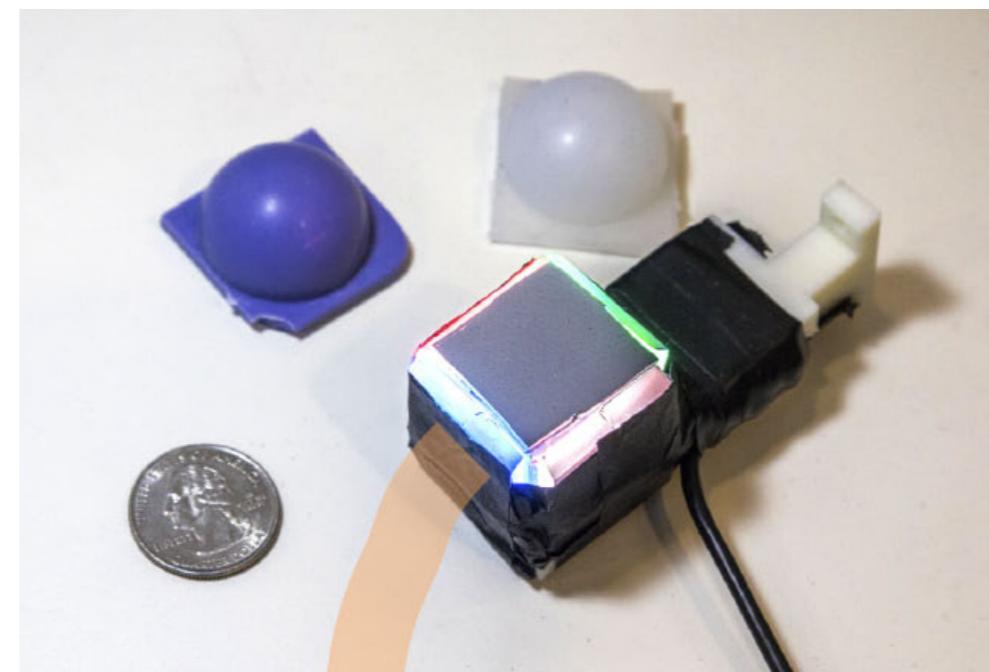
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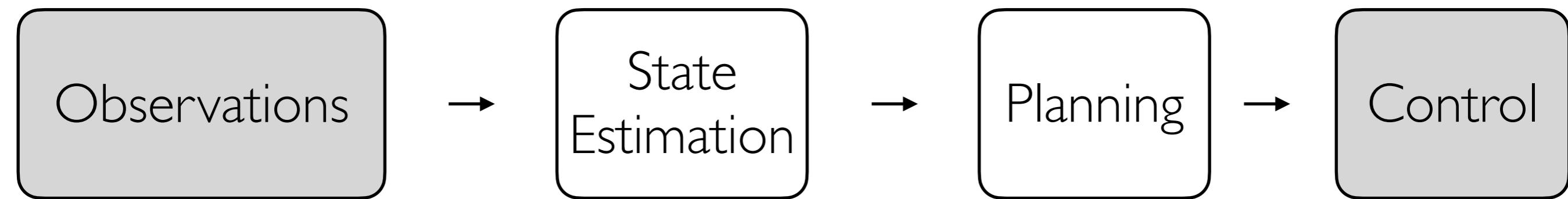
Piezoelectric



Optical tactile sensors



Typical Robotics Pipeline



Manipulation



Observed Images



6DOF Pose



Grasp Motion
Planning

Discussion

- What, if any, are some ways in which classical techniques may fall short for manipulation tasks?
- Would it be possible to fix any of these via machine learning?