Grasping Objects Big and Small: Human-informed Relationships between Grasp Type and Object Size

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Grasping Lab
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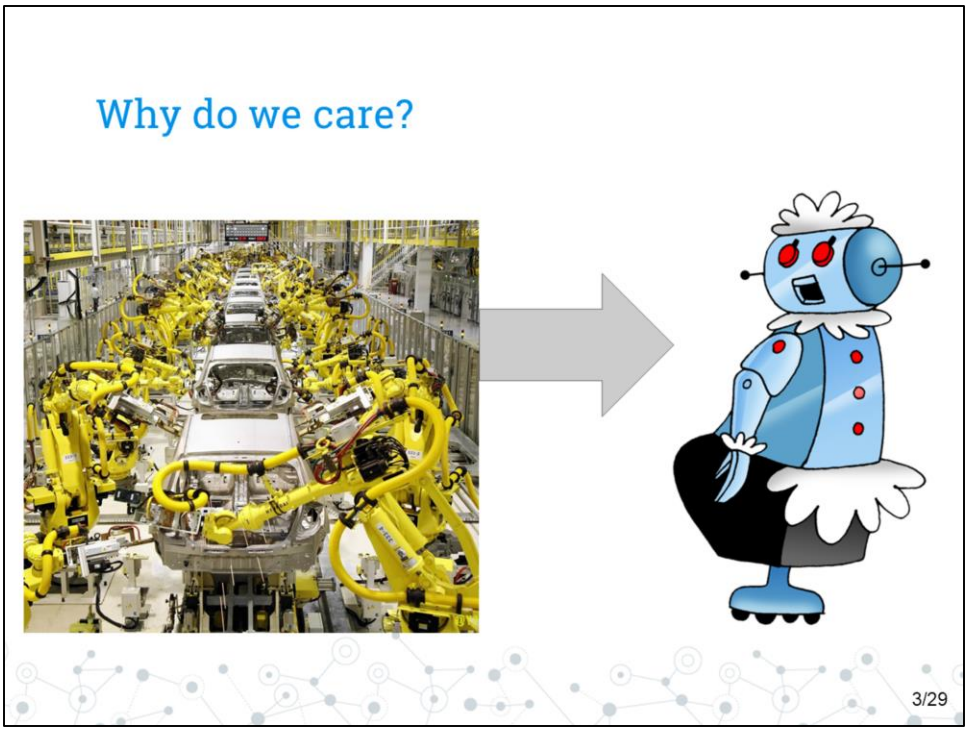
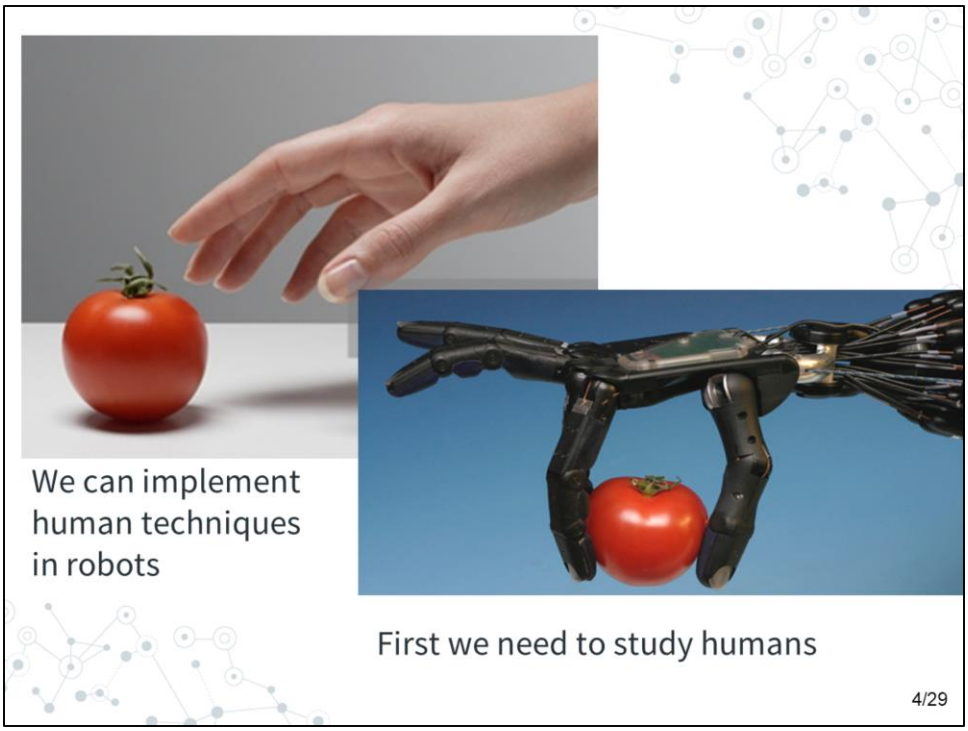
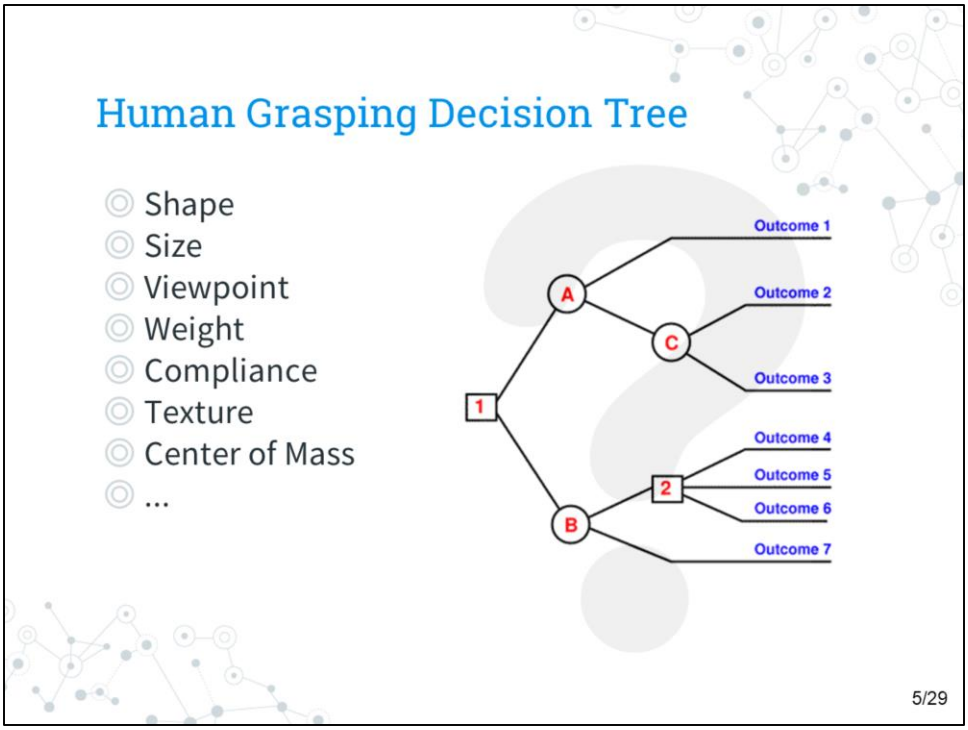
We often consider computers to be much better at a lot of tasks than humans
Computers are much better than math than humans
But some things, often the most intrinsic things for humans, can be really hard for robots
Grasping is one of those examples



Because a lot of our robot are good at one job- putting one piece on a car
But we have been dreaming of robot servants to do our chores for us
These robots need to be more flexible than just doing one simple job

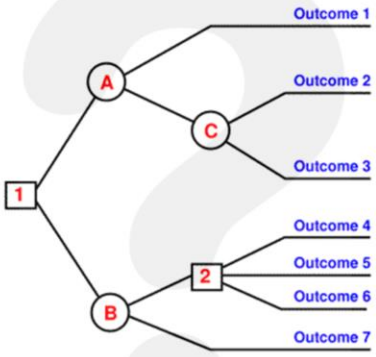


But because humans are really good at it, we can try to implement human techniques in robots
But first we need to study the humans



Size: height, width, extent, angle, curvature

Human Grasping Decision Tree

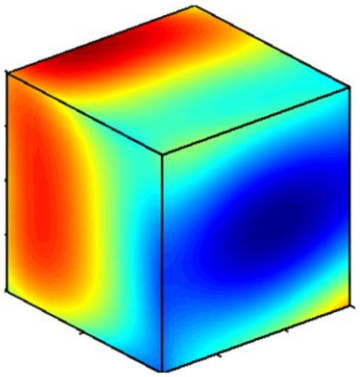


- Grasp Types
  - Wrist Rotation
  - Finger Spread
  - Hand Translation
- Metrics
  - Finger Closure
  - Distance of Palm from Object
  - Position of Palm to Center of Object
  - Surface Contact
- Control Strategies
  - Caging

Big Picture End Result:

Partition the Space

- so robots can make better choices about how to grasp different objects
- so robots can make more predictable grasps



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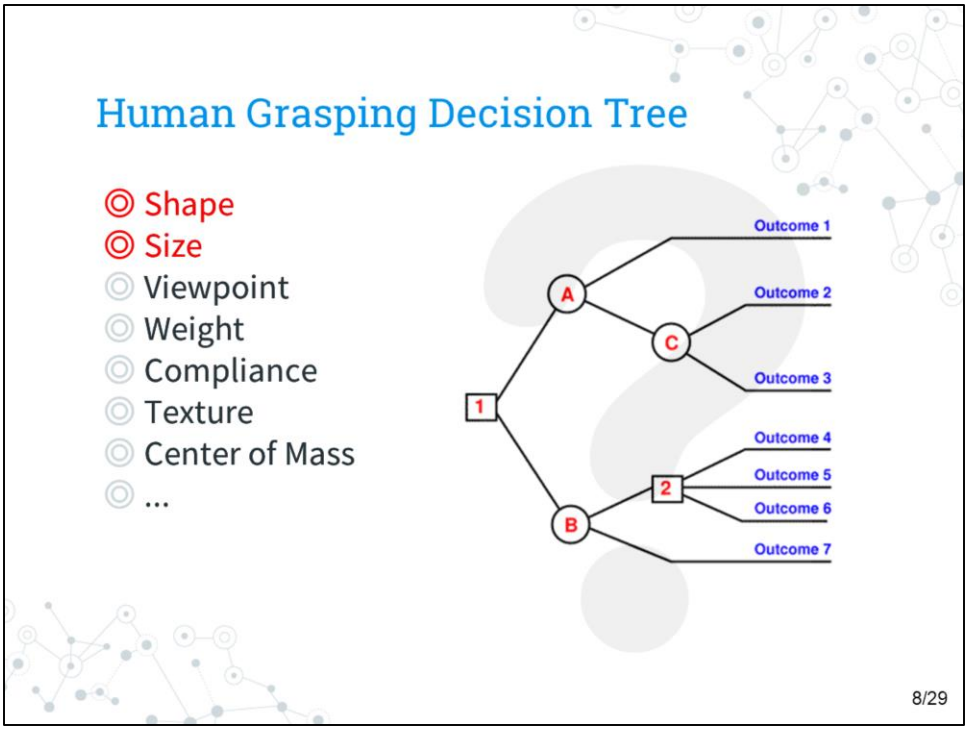
Ideally with



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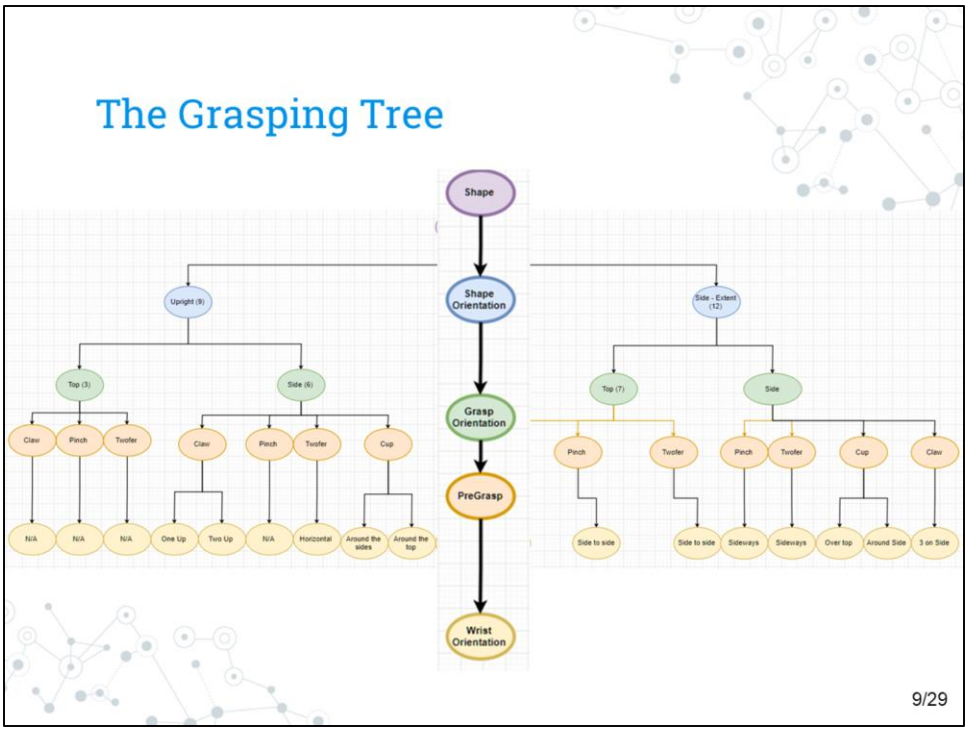
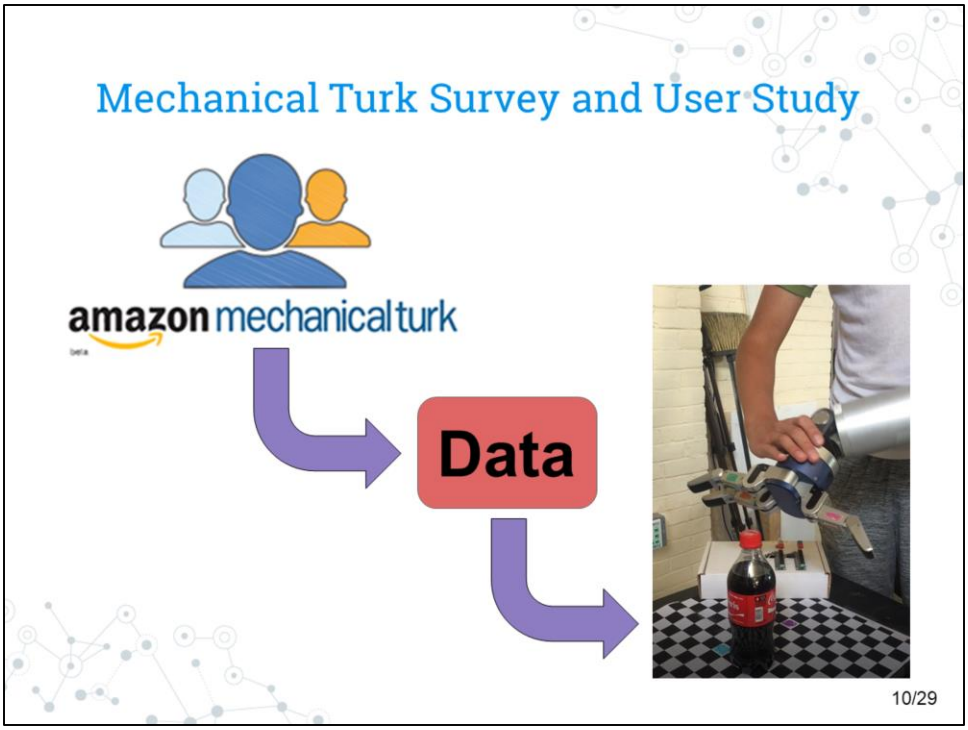


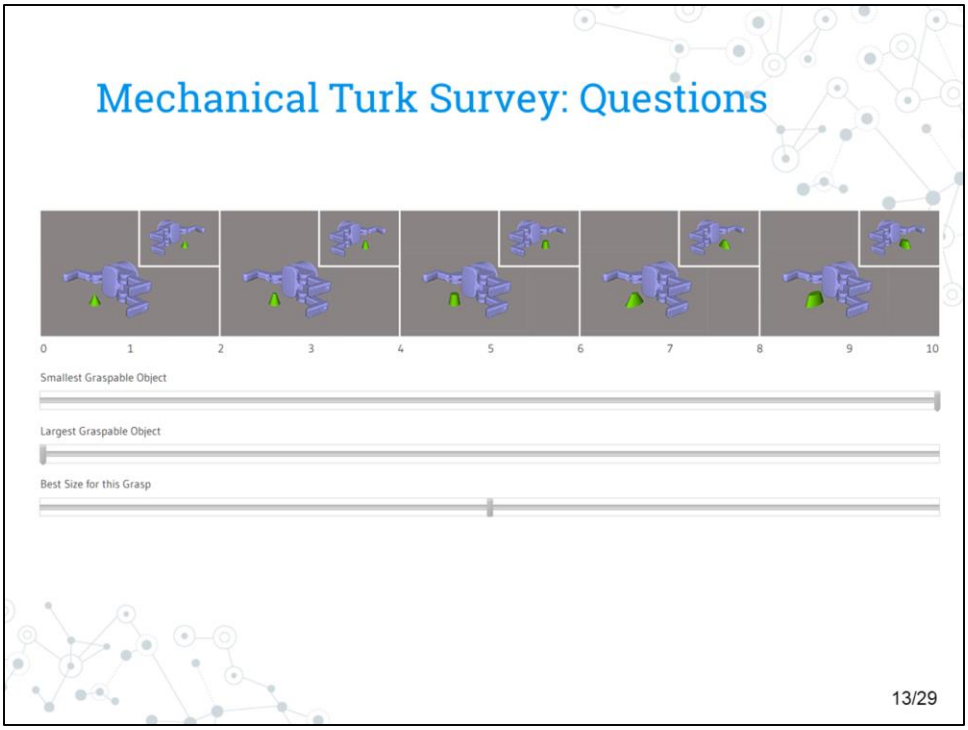
- 80% of objects can be simplified to very few geometric object: cylinder, cone, cube, ellipse
- These objects can also be rotated
- For each shape and shape rotation, we looked at which grasps would even be possible to do
    - Then we wanted to know which sizes of these shapes and grasps would be possible



- Use the MT to find the fuzzy boundaries
- Use the fuzzy boundaries to create physical shapes
- Use the new physical shapes to ask users about more variations in the object (Decisions) and to record their metrics

Training Video

Training Video



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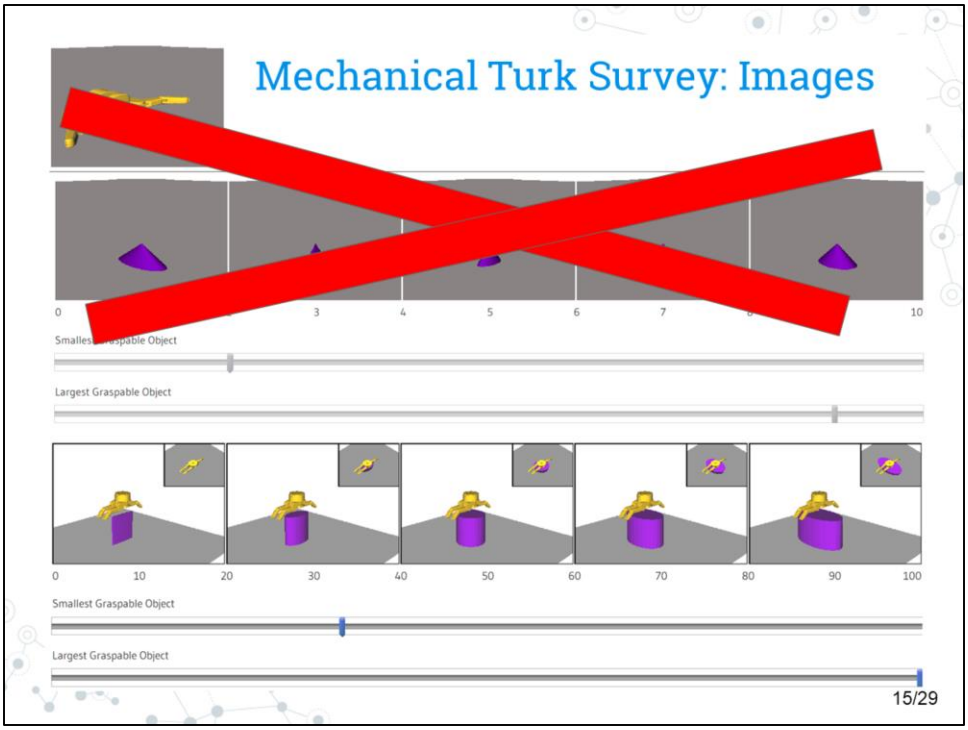

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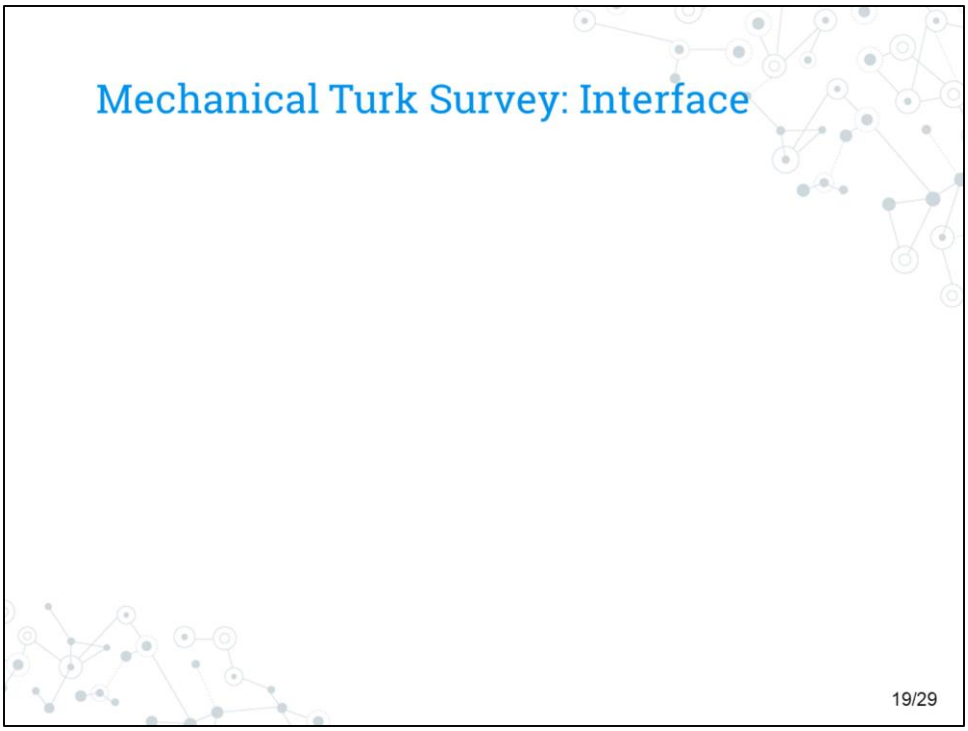
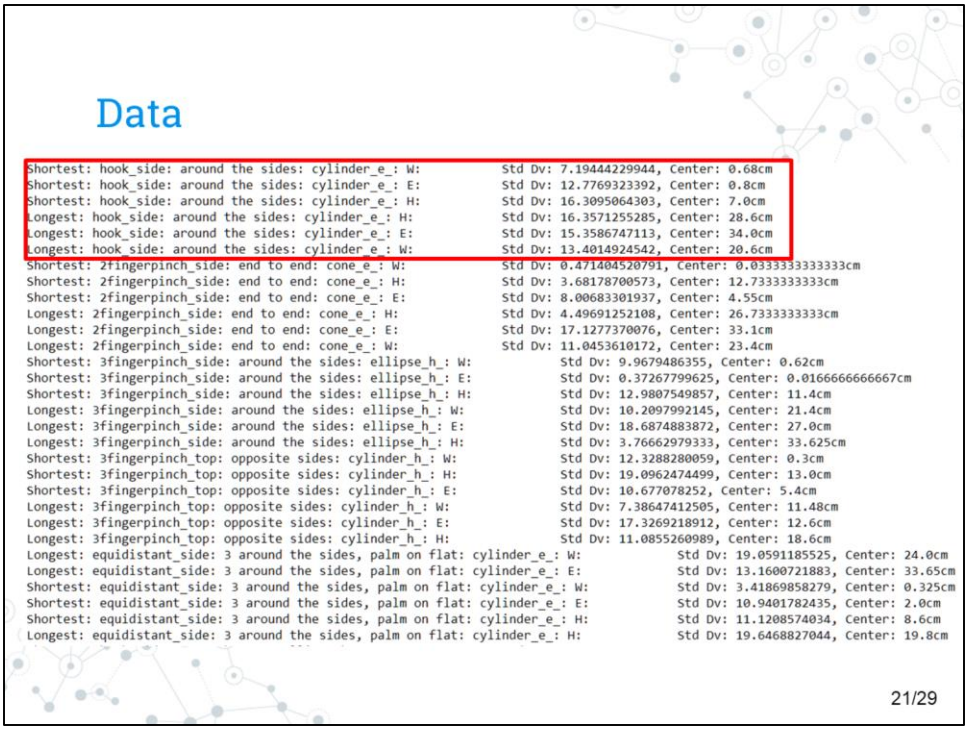


Training Video

Survey Challenges

- Making sure the survey is value adequate
- Making sure the training video is informative enough without being confusing
- Generating images



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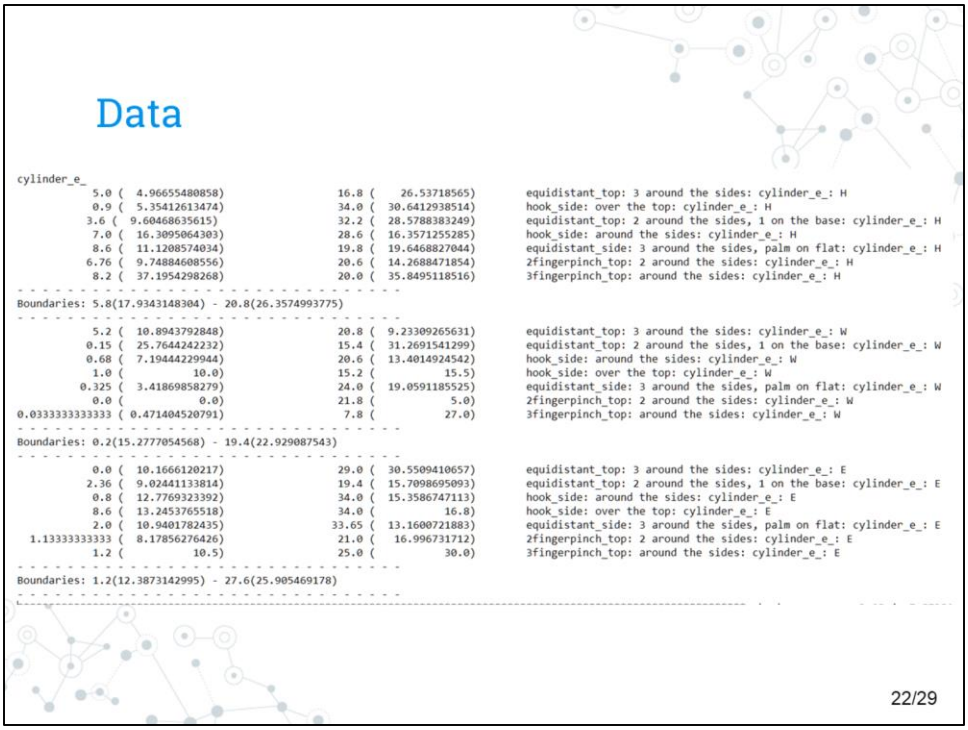

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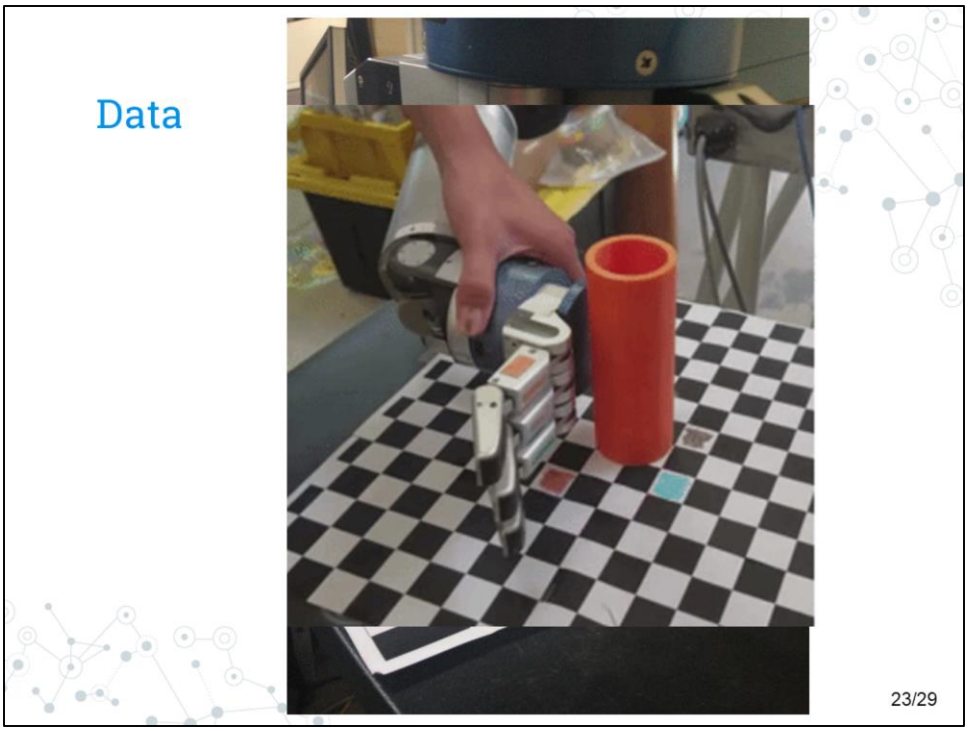

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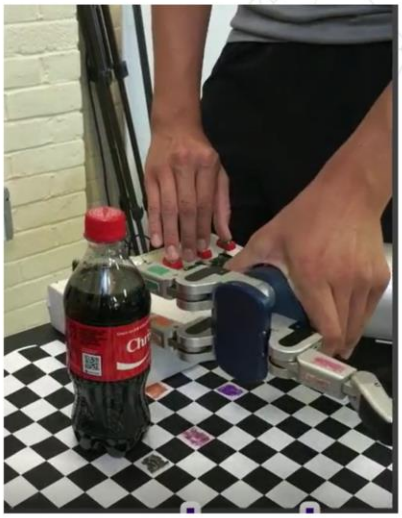
User Study Data

- We are looking in particular at metrics and survey inaccuracies
- Problems with the Barrett hand:
  - Grips are not very grippy
  - Finger pads are not compliant
  - Fingers are hard to control
  - No finger squeeze muscles
  - No grips on inside of fingers



User Study

- Create a preliminary protocol
- Iterate Through
  - Subjects manipulate the Barrett Arm
  - Constraints on viewpoint, finger position, and object orientation
  - Think Aloud Protocol
- Motion Capture

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Both eye tracking and motion capture data are used for analysis

User Study

Data?

◎ Not yet

Next Steps

- Finish gathering data from user study
- Analyze user study data
- Begin partitioning the space
- Continue to study other decisions involved in grasping


Questions?
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