Robot Object Manipulation Taxonomy

Team


Abitamim Bharmal


Anusha Karandikar


Allison Li


Shree Madan


Krishna Suresh


Piplup

Demo Video

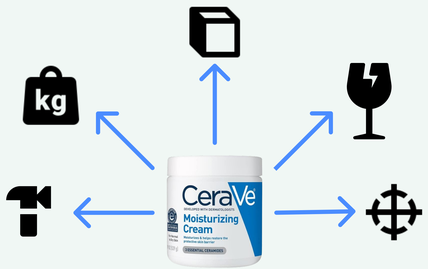
Challenge

Amazon receives **thousands** of new unique products a day, requiring a variety of robot grippers to handle.

How do we determine which object requires which gripper?

Approach

1. **Break down** an object into its attributes



2. **Classify** an object into a **workcell** type

Stations each with a gripper & defined limitations

Grippers

Planar

Suction

Tactile

Taxonomy

Workcell Type

Object Property

- Mass
- Shape
- Rigidity
- CoM

Each cell is a dedicated evaluator which outputs a graspability score and confidence for a workcell.

Evaluator

Score: How likely is it that the workcell can pick up the object?

Confidence: How confident are we in the score?

Framework is extensible to new types of object properties and new workcell types

Graspability scores and confidences are merged for each workcell.

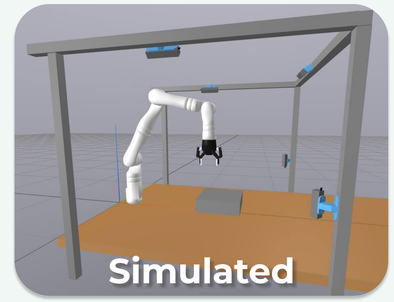
Weighted Ranking Generator

Scores are weighted by logistical factors such as workcell cost or availability

Selected Workcell:

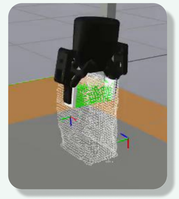
Implementation

We developed an end-to-end simulated and real autonomous robot object manipulation stack and used our findings to inform our taxonomy framework.

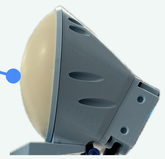


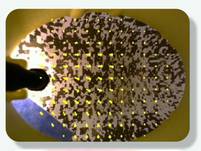
We implemented various forms of sensing methods to measure object properties and demonstrate our taxonomy framework.

Using 5 Intel Realsense Camera and ML to sense 3D geometry and perform graspability analysis.



Deformable Tactile Sensor





Custom built and open-source Punyo tactile sensor to sense through interaction.

Olin College of Engineering

Faculty Advisor: Lawrence Neeley

amazonrobotics

Liasons: Greg Longtine & Nathalie Hager