Human Assisted Robotic Grasping

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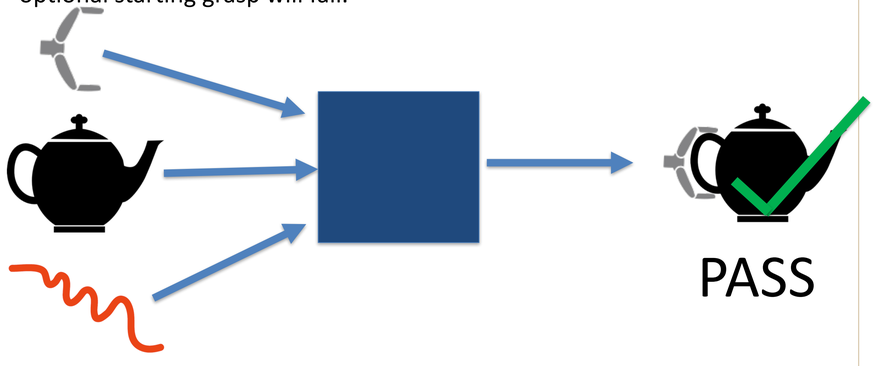
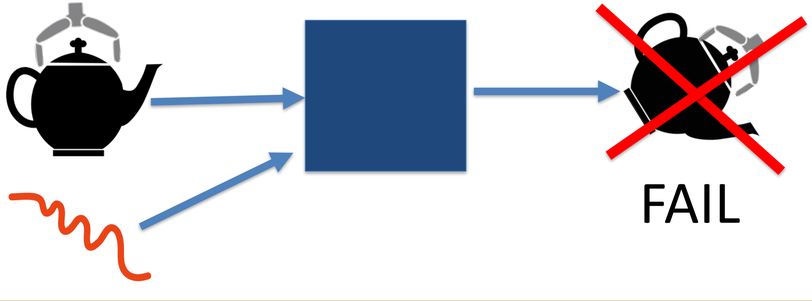
Background

Over 10% of the US population are dependent on other individuals for their daily survival. This includes elderly, disabled, and children who through no fault of their own are stuck in nursing homes, rehabilitation centers, and daycares. Current solutions require another individual to take care of these people, and as we know, humans are not always reliable. In the future, humanoid robots will be able to give these individuals the independence they once had. However, this requires the ability for robots to properly grasp objects.

Goal

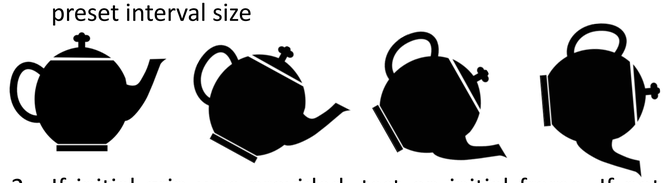
The purpose of the project is to create a program that will aid robots in determining the best grasp for a given task. Provided an object, task trajectory, a gripper, and an optional starting grasp, the program will determine the best grasp for the trajectory, or determine where the optional starting grasp will fail.



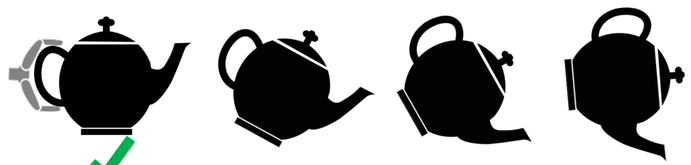


How It Works

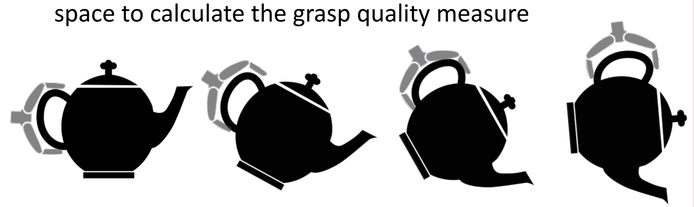
1. Given Trajectory, discretize the motion of object by preset interval size



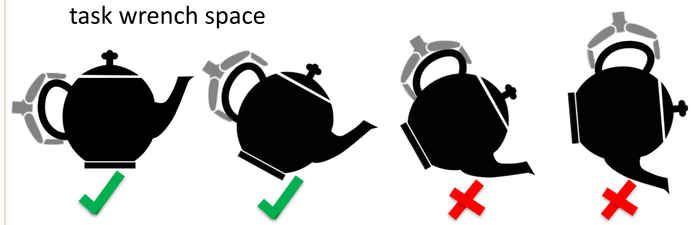
2. If initial grip was provided, test on initial frame. If not, generate initial grasp using eigengrasp planner on initial frame



3. Analyze grasp on each frame, generating a grasp wrench space to calculate the grasp quality measure

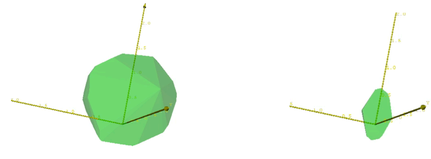


4. If any frame fails the quality measure, notify the user. If not, return the initial grasp to the user, and generate a task wrench space



What is a GWS & TWS

- A Grasp Wrench Space (GWS) is a 6 dimensional convex polyhedron that represents all forces and torques that can be applied to an object in a given grasp
- A Task Wrench Space (TWS) is a polyhedron that represents all forces and torques that must be withstood by a given grasp for a provided task. This can be seen as a “combination” of multiple GWSs.
- A TWS can either be 6 dimensional and actually be the combination of GWSs, or it can be 7 dimensional where the first 6 dimensions are GWSs and the 7th dimension is time.



Conclusion

- This project has culminated in a detailed understanding of current robotics simulation software including GraspIt! And OpenRAVE
- While the goal was not achieved, significant progress has been made in extending and modifying GraspIt’s API
- The discritization code has been created and generates multiple GraspIt! Worlds for analysis
- GWS and quality measures can be extracted, but generating a TWS is still a work in progress and is a significant undertaking
- Future work includes adding articulation to the trajectory plans as well as connecting this analysis to Pablo Bolton’s work. This would allow us to see if robots are better at generating grasps than humans intuitively do