ME751 Final Project Proposal

Problem statement: This project will use Project Chrono in order to develop a friction model and simulations involving a common linkage-driven robot gripper with a cylindrical handle (e.g. toaster oven, fridge). It is my hope that running simulations will give us insight as to how we should dictate our gripper force control loop to properly interact with the object.

Motivation/Rationale: We have developed a method for recognizing directions of slip when a user performs a demonstration using instrumented tongs. Our intent is then for the robot to perform a similar action. A major challenge is that slip is hard to control as it involves modulating forces to allow prescribed levels of motion. Grippers also commonly have only unilateral force sensing and control capabilities. Given the lack of available sensing, I think this is a great opportunity to use simulation to better understand the interaction of the gripper with the object to be able to think about control strategy without having to explicitly instrument the gripper further.

How you plan to go about it:

- Complete a subset of the Chrono tutorials to get familiar with the interface
- Model the kinematics of the gripper and perform a kinematic analysis that demonstrates the functionality
- Set up a friction/contact problem with penalty/complementarity methods for simulation
- Prototype a control strategy based on the simulation results
- (If our hardware gets fixed – optimistic) Try to compare with some experimental results

ME751 aspects the proposed work draws on:

- Modeling of constraints: Gripper mechanism
- Kinematics/Dynamics Analysis
- Friction and contact

How you will demonstrate what you accomplished: This is similar to the deliverables, but I should be able to provide a complete report that details the results and investigations of the simulations and any pertinent results. I will likely be continuing the related work into January (if it makes it into a paper, I will send it over!)

Team member[s]:

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Deliverables:

- Report of Results
    - More detailed background and brief relevant literature review
    - Diagrams for kinematic modeling
    - Kinematic simulation results and verification
    - Key results from penalty/contact simulations
    - Discussion of control strategy
- Github repository with all code and instructions for how to run simulations

Other remarks: I know we already chatted briefly, but very interested in your feedback. While I think this seems like a good plan for now, once I get into it I may want to tweak a few details.