PROGRESS REVIEW 8

16-682 MRSD Project 2 (Fall 2021)
Carnegie Mellon University

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Notes

- N/A

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Contents

1 Individual Progress

Description Since the last progress review, I performed hands-on testing with various cardboard robot arms I created during the last progress review. This was done to get a general understanding of the dynamics of each robot arm design. In total there were three cardboard creations: one 4 degree-of-freedom (DoF) arm, and two different 5 DoF arm designs. Pictures of the cardboard prototypes are shown in the Figure below (see Figure 1.1). Based on my observations during hands-on testing, I determined the 4 DoF arm was capable of covering just as many task space points as the two 5 DoF arm designs. Though this minor testing session, there did not seem to be any noticeable improvement when using a 5 DoF arm over a 4 DoF arm.

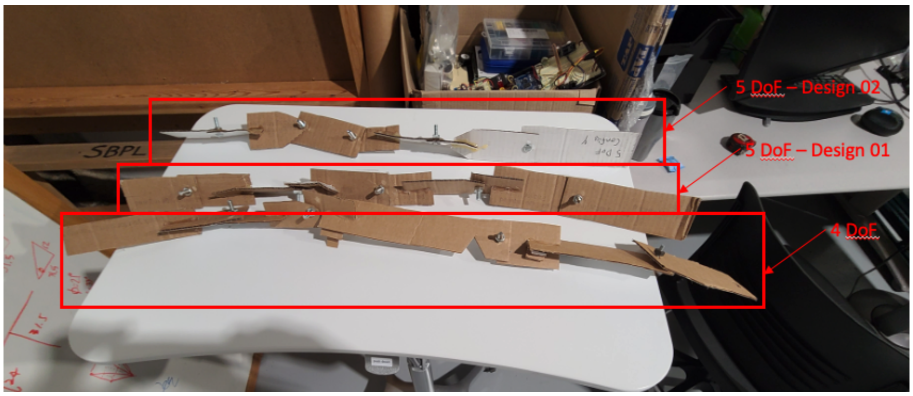

Figure 1.1: CoBorg end effector actuating to user's hands

Based on Jonathan's simulation Python code, I ran the mechanical task space simulation against the various new designs of robot arms as well as the original base 3 DoF arm: some variations of the 4 DoF arm and the two 5 DoF arm configurations. The results from the mechanical task space simulation showed there was a marginal 0.5 - 1.0 percent increase in task space accuracy with using a 5 DoF arm over a 4 DoF option. Compared to the hands-on cardboard testing, the simulation results confirm there was a small benefit to using a 5 DoF arm as opposed to a 4 DoF in regards to task space coverage. A screenshot of the task space simulation plot for the 4 DoF design is shown below (see Figure 1.2). The green colored points indicate 3D goal positions that that proposed design can reach while the red colored points indicate 3D goal position the proposed design cannot reach.

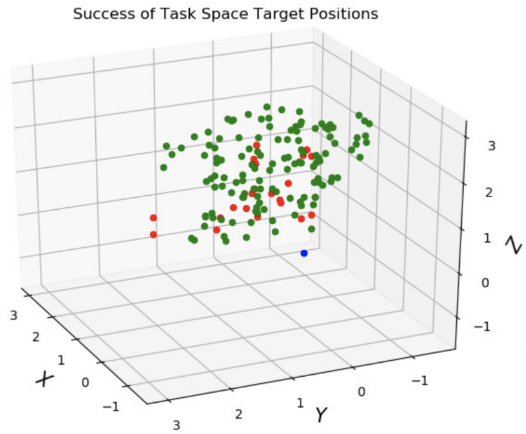

Figure 1.2: CoBorg end effector actuating to user's hands

From the cardboard testing, mechanical task space testing, and simulated reruns of actuated manipulation SVD testing, I tabulated a trade study to compare the various arms with each other and with the existing 3 DoF arm design. In the end, the 4 DoF arm design won out based on the marginal task space accuracy increase from the existing 3 DoF design. The 5 DoF arm designs was not selected because the significant increase in power and weight with adding an additional motor was not worth the marginal task space accuracy improvements compared to the 4 DoF arm design.

References

- N/A

2 Challenges

Description The main challenge encountered this progress review was mainly the delivery delay for our new hardware materials. Tracking information on those shipments are unknown as the materials were shipped via UPS ground shipping, which does not offer tracking information. For now, carbon fiber tubing has arrived to the lab which will be used to build the new robot arm design.

Coding efforts and software milestones will still continue for the actuated manipulation subsystem, but code will not be able to be finalized until the robot arm is tested against the new hardware framework.

References

- N/A

3 Future Plans

Description By the next progress review, I will build the new 4 DoF robot arm using carbon fiber tubes as linkages. I will also work with Jonathan on developing the stabilization aspect of the smart manipulation actuated manipulation code. In addition I will also work on the obstacle avoidance and resolved rate features with Gerry.

References

- N/A

4 Teamwork

Description The division of work between each member of the team is as follows:

- **Husam Wadi** Husam is the project manager of this team. He led the CAD redesign of the COBORG and 3D printed all components for prototype testing. He also procured the necessary HEBI motors and accessories to expand the DoF of the robot arms. He is also in constant collaboration with Gerry to design and set up the electrical subsystem for the new COBORG framework.
- **Jonathan Lord-Fonda** Jonathon is leading the integration between subsystems and project validation process. He led the creation of the new task space requirements for the COBORG. In effect, he led the creation of the mechanical task space simulator for the actuated manipulation system, and worked with Yuqing to develop the vision task space simulation immediately after. He also worked on the test plan deliverables for this semester.
- **Gerry D'Ascoli** Gerry is the lead for the voice subsystem. Gerry and I worked on the obstacle avoidance feature set by configuring and fine tuning Octomap settings. Gerry and I also worked on developing code for the resolved rate stabilization code, which is apart of the smart manipulation actuated manipulation code. Gerry and Husam are in constant collaboration to design and set up the electrical subsystem for the new COBORG framework.
- **Yuqing Qin** Yuqing is leading the vision subsystem of the project. She and Jonathon worked on developing the vision task space simulation to refine the vision task space requirements. Yuqing has also built out the vision hardware trade study to analyze and determine the best way to mount the camera hardware on the COBORG in order to get the maximum coverage of the task space. She has also been researching alternatives to our current YOLOv4 hand detection model to find a more lightweight option that will still perform up to our requirements.

References

- N/A