TASK 14: PROGRESS REVIEW 4

16-681 MRSD Project 1 (Spring 2021)
Carnegie Mellon University

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Notes

- N/A

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Contents

1 Individual Progress

Description Since the last ILR (i.e. Progress Review 3 ILR), I calibrated the robot arm and validated the robot arm's accuracy in a pre-SVD test. Both tasks were performed in perparation for the upcoming SVD which is scheduled to occur by the end of April.

Upon prior inspection of the robot arm, the angle of the motor joints relative to the plane of the floor differed significantly from the defined motor joint angles in the URDF of the robot model. The difference was around 5-10 degrees of misalignment. The main task of calibration involved aligning the angle of each of the motor joints to be true to the geometric orientation of the motor joints in the URDF model. Using a digital angle measurement tool, the motor joint was rotated about its spatial position to align with the defined joint angle definition in the URDF .xacro file. The figure below (see Figure 1.1) displays an image of how the angle of the motor joint was measured with the digital angle measurement tool..

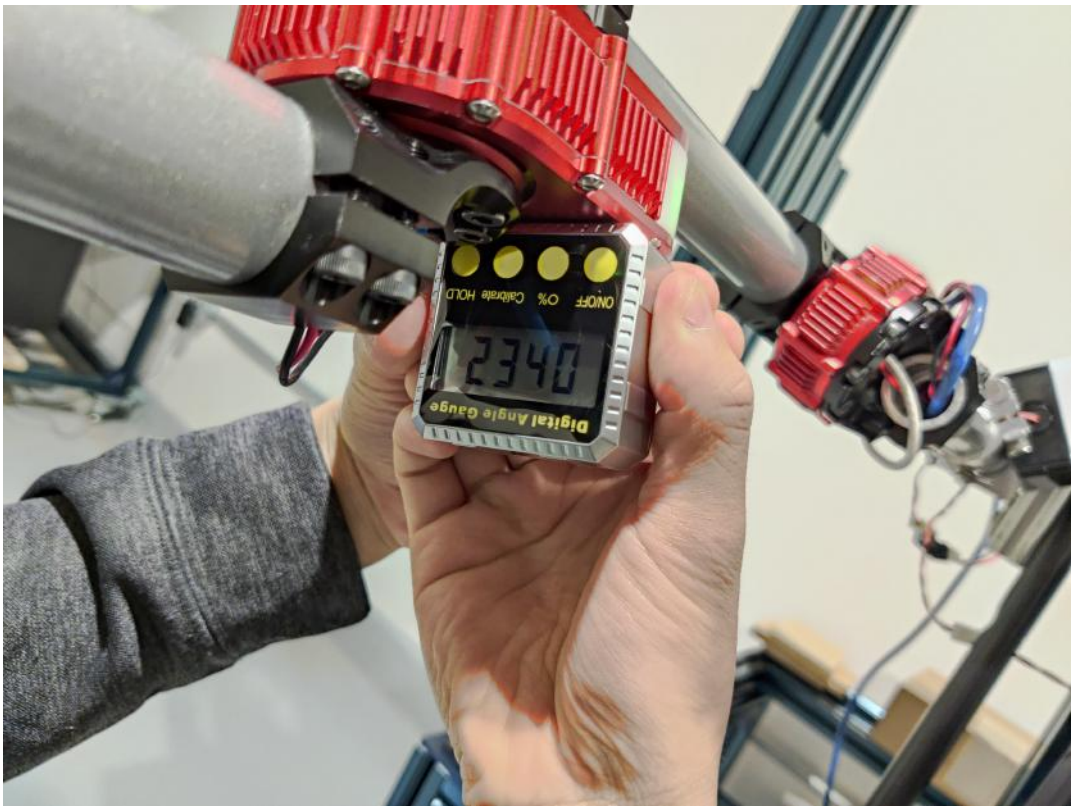

Figure 1.1: Motor joint angle measurement using digital angle measurement tool

In addition to calibrating the robot arm, I also worked with Jonathon Lord-Fonda and other teammates to run through the entire procedure of the SVD validation test for the actuated manipulation system. Based on a predefined, pre-measured point on a stand-up board that is a fixed distance in front of the robot, the arm will reach to that goal position. Because the predefined point is already marked on the board, the error will be measured using a tape measure and the error between the end points of the robot arm and the ground truth will be recorded.

The figure shown below (see Figure 1.2) displays one of several testing integration testing runs between the vision subsystem and actuated manipulation subsystem. In essence, the goal pose output from the goal setter node from the vision subsystem will be outputted to the actuated manipulation subsystem. The robot arm will plan a path to the goal position and execute that path. The integration has not been formally validated yet, and is still a work in progress.

Figure 1.2: Sample robot accuracy testing round

References

- N/A

2 Challenges

Description Currently, there are two main challenges: devising a plan to upgrade the degrees of freedom for the robot arm for FVD next semester and resolving major bugs in the impedance control controller. Given the 3 joints, the robot arm has 3 degrees of freedom. Through discussions and testing, we see this as a limiting factor for our FVD testing, especially during our integration testing. So we plan to design and install more joints on the robot to increase its range of motion in free space. Creating a design that incorporates the additional motor(s) will surely be a challenge by the end of this semester and the upcoming fall semester.

Another challenge is in implementing impedance control on the robot arm. We built some control code and ran some proof of concept testing on the arm and got some unexpected behavior. We spent significant time debugging through our program and are currently at a loss. We do not think the problem is in our theoretical implementation of the controller. We spoke with our advisor Julian and Oliver and their descriptions match how we are implementing our impedance controller. The problem is in implementing impedance control with the ROS packages we are using and the pipeline we are using. We are still trying to find the reason why the robot arm is not behaving as expected, but as of now we consider this endeavor to be a current challenge.

References

- N/A

3 Future Plans

Description My goal in the next progress review (i.e. the SVD) is to adjust motion planning timing thresholds in the code and to develop automation scripts for a more streamlined testing experience for the actuated manipulation system. The purpose of both tasks is to shorten the time taken to test the actuated manipulation system during the SVD.

In the current implementation of the motion planning portion of the actuated manipulation subsystem, there is a time interval threshold for the motion planner to set a path from its current state to a specified goal state. There are seldom occasions where the robot arm does get hung up on planning a path, but regardless I ought to shorten the time to wait so as to not waste time during the SVD. In addition, implementing automation scripts for the robot arm to traverse through several goal points would ensure a more streamlined and smooth testing process of the robot arm. For example, outputting one command to the terminal for the robot arm to go from the home position to the goal position would save significantly more time compared to manually inputting each checkpoint position to the goal on terminal.

References

- N/A

4 Teamwork

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

- **Husam Wadi**

  Husam's primary role is project/program manager. Recently, he soldered components onto the Power Distribution Board for the upcoming PCB demo next week. Working with Gerry, he performed validation and testing on the PCB. As always, he has been organizing meetings, managing timelines, and procuring supplies for the team.

- **Jonathon Lord-Fonda**

  Jonathon is leading the integration between subsystems and project validation process. Recently, he set up testing and validation procedures and executed them alongside each subsystem lead engineer. He also updated the validation plans since then in addition to working with the actuated manipulation subsystem to help implement impedance control.

- **Gerry D'Ascoli**

  Gerry is leading the voice subsystem of the project. Recently, tested, validated, and soldered the PCB with Husam as well as perform validation and testing on the board. Working with Jonathon, he performed pre-SVD testing and finalized the subsystem prior to the SVD.

- **Yuqing Qin**

  Yuqing is leading the vision subsystem of the project. Recently, she worked with Jonathon to test, validate, and finalize the vision subsystem before the SVD date. In addition, she has been working with the actuated manipulation subsystem to begin integrating both the vision and the actuated manipulation subsystem together.

References

- N/A