Individual Lab Report #05

Progress Review #4

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Pit Navigator

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Individual Progress

Pit Navigator

Field Test

For the Pit Navigator project, I constructed a test plan for collecting data related to what the rover sees when approaching a brink. I evaluated the most important parameters and trimmed down the number of tests to only include the most important. The parameters I chose from were, rover speed, odometry hz, camera fps, camera settings, brink angle, approach angle, camera angle, software validation tests, and whether the robot goes over the brink or not. I focused on 2 camera angles, 2 brink angles, and 4 approach angles.

I chose these parameters for several reasons. Some parameters were dropped for hardware ease, like rover speed, odometry hz, camera settings, and camera fps. While the software validation tests were dropped to trim scope, and to not push the testing date back as the risk of not completing the software on time was too great. After trimming the parameters to the most important variables, it was time to determine what the values of the variables should be.

I started with 0 to 30 in increments of ten for the angles in pitch and roll but quickly realized that there was over 16 hours of data to record with that amount of tests. There was too much data to capture in a day assuming the test takes 4 times as long as the data captured. I lowered the increments until there were 2 angles for the camera. The camera was to be set at 0 and -35 degrees. The brinksmanship code worked better at 0 degrees, and -35 was the likely space-ready angle for MoonRanger. I lowered the brink angle degrees to unsafe slope and safe slope, where unsafe slope is any slope above 30 degrees, and safe slope is anywhere below that. I lowered the approach angles to 0,-20 pitch and 0,20 roll to represent traversable terrain that the rover might be on. The 20 degree roll could have the images flipped for -20 degree roll so that left and right slopes are captured at the same time. The resulting data capture time is about 1.5 hours so the test should take about 6 hours.

With the parameters verified it was time to determine how to accomplish each of these tests. We had originally picked gascola as our testing site because of the naturally occuring brinks that are quite high, but we were only able to fill 4 of our 16 tests at this location. There were many other locations scouted, like Frick park, 2210 wightman’s yard, another team members yard, anderson at schenley park, and some of the schenley park trails. Only schenley park trails proved to have enough locations to satisfy our variety of tests. The specific trail chosen was Pocusset Drive trail which had the potential to satisfy every test. By clearing brush and using it to create a slope we could create a 3 meter track to run our robot on. I needed to clear the branches 2 meters out in front of the robot and 1 meter on each side of the track to get accurate, non-noisy, moon-like data. I raked any leaves and removed obstacles to have the track surface be either dirt, gravel or broken blacktop. While Pocusset drive trail did not have the 20 degree roll slope that was required, it did have dirt, leaves, brush, and masonry that could be moved to create the approach roll angle, and in this way satisfied that requirement.

There were also tools and replacement parts required to ensure success of the test. Clearing brush required a high-viz vest, work gloves, sturdy rake, hedge trimmers, and a saw that I acquired from the project sponsor the day before the test. I also picked up Blue, and extra robot batteries from Neil Khera as replacement parts for our own robot. I also created and 3D printed mounts, two days before the test, for the computer and Realsense camera for attaching to Blue 2. These parts were essential to the smoothness of testing.

On the day of the test I helped with the final assembly of Blue 2, attaching and modifying the 3D printed mounts to fit the rest of the assembly. I also recorded the 3rd person videos of the rover during each test, and logged each rosbag to its corresponding test as shown in table 1.

Table 1: Bags Corresponding with Test

Speed = 5.97cm/s

CA = camera angle
PA = Pitch slope angle
RA = Roll angle
BA = Brink angle

Test name	bagfile	Actual angles
CA00 PA00 RA00 BA90	bag1.bag	0/P3/R5/40
CA00 PA00 RA20 BA90	bag5.bag	0/P3/R21/40
CA00 PA30 RA00 BA90	bag6.bag/2nd half	0/P18/R21/25-40
CA00 PA30 RA20 BA90	bag10.bag	0/P18/R21/25-40
CA35 PA00 RA00 BA90	bag2.bag	31/P3/R5/90
CA35 PA00 RA20 BA90	bag3.bag	31/P3/R21/40
CA35 PA30 RA00 BA90	bag9.bag	31/P18/R21/25-40
CA35 PA30 RA20 BA90	bag12.bag	31/P18/R21/25-40
CA00 PA00 RA00 BA20	bag6.bag	0/P5→20/0-6/20
~~CA00 PA00 RA20 BA20~~	—	~~0/~~
CA00 PA30 RA00 BA20	bag14.bag	0/P5→20/0-6/20
~~CA00 PA30 RA20 BA20~~	—	~~0/~~
CA35 PA00 RA00 BA20	bag7.bag	31 P15/R4/0
~~CA35 PA00 RA20 BA20~~	—	~~31~~
CA35 PA30 RA00 BA20	bag13.bag	31/P15/R4/0
~~CA35 PA30 RA20 BA20~~	—	—

Can't get with roll procedure

Can't get with roll procedure

Challenges

Pit Navigator

Field Test

There were a number of mini challenges that were overcome during this field test. Trimming down the tests to a workable amount was a difficulty that Jordan Ford helped me figure out. Having done field tests before, he let me know what was possible to do in a day and the 4x rule for data capturing, and that I should drop the camera settings as seterpo vision doesn't care what it is looking at but people do, so it was better to have good looking images and videos for the whole test.

I spent 24 hrs printing the mount for the computer to go on Blue 2, but when it was time to assemble on the day of, the pan tilt mount was in the way a little bit on the corner, and the screws were not long enough to attach the cap to the mount. From my experience with 3D parts I knew that both of these problems could be fixed quickly by melting the plastic away in the specific spots with a soldering iron, and prevented the test from being delayed 24 hours while we waited for new parts to print.

When it came time for the 20 degree roll tests, we discovered that using leaves and brush was not going to create the surface that the robot could drive on. Justin and I found broken masonry slabs nearby up the trail and used those to create the slope, shown in Figure 2. This was unplanned and while it worked for half of the 20 roll tests, it was not able to cover the other half. The total number of tests gathered was 12/16, with the lowest priority tests not captured. There were 10 essential tests that were captured to call the test a success.

Figure 1: The Improvised Slope of Masonry Bricks

Teamwork

Pit Navigator

Individual	Main	Sub	Description
Alex W.	Field test	Building Blue	Fleshing out the simulation visuals and adding some parts to blue.
Awadhut T.	Record Rosbags and set up code for robot	Running Blue 2 during test	Set up ssh on computer, connected the imu, wheel odometry and rosbags
Justin M.	Build Blue 2	Preventing Blue 2 from falling	Finishing Blue 2 and holding the rope during the test.

Plans

Pit Navigator

Simulation

With the next check in being the spring validation demonstration (SVD), there is a lot to do for the simulation portion of this project. The local and global planner has had minimal work accomplished on it and is one of the main goals of the upcoming SVD. I will need to create a heightmap of the lacus mortis pit, develop the obstace map based on the traversable slopes, update the global waypoints, and finish the pipeline in the simulation. This will be difficult for my computer unless the simulation somehow gets faster, possibly by dual booting ubuntu onto my desktop, which I have failed to do 3 times before while almost killing my pc every time.