ILR05 - Progress Review 4

Justin Morris
Teammates: Awadhut Thube, Alex Withers
Team G: The Pit Crew

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1 Individual Progress

Since the third progress review, my most significant accomplishment has been getting Blue 2 assembled and functional ahead of our planned field test, which took place at Schenley Park on April 3rd. In this endeavor, I had the assistance of Jordan Ford, a PhD student who has been involved with the PitRanger project since its inception. He was able to identify additional components that were necessary to finish assembling Blue 2, and provide some assistance and materials for wiring the various components together. We were also able to borrow the original Blue, several 14.8 V batteries, and a battery charger, which were essential for our test.

Assembly of the gearboxes and installation of the motor controllers had already been completed by the time of the third progress review. The major remaining tasks in Blue 2's assembly were to integrate the pan/tilt turret and controller, mount the main computer, and power every component from the battery. I measured and drilled holes to mount the various components and the turret, soldered the battery plug, and routed wires (with help from Awadhut and Jordan) to all the powered components.

Once assembly of Blue 2 was complete, Awadhut and I performed tests of the teleoperation and image collection code in order to ensure that everything was in working order ahead of the test. We also tuned the four wheel motors using the BasicMicro Motion Studio software. When we had verified that all necessary functionality was present, and that we could collect all the necessary data in a rosbag, we proceeded to Schenley Park to begin our field test.

At the testing site, which had been identified by Alex, we set up to perform each of our tests. During the testing phase, my primary responsibility was to ensure the safety of Blue 2 by holding onto the rope that was attached to its chassis. I was also prepared to correct any mechanical issues that arose during the test, since I was the one with the greatest degree of familiarity with Blue 2's mechanical systems. However, no such issues occurred, other than swapping out the battery halfway through testing to make sure that the voltage would not drop too low.

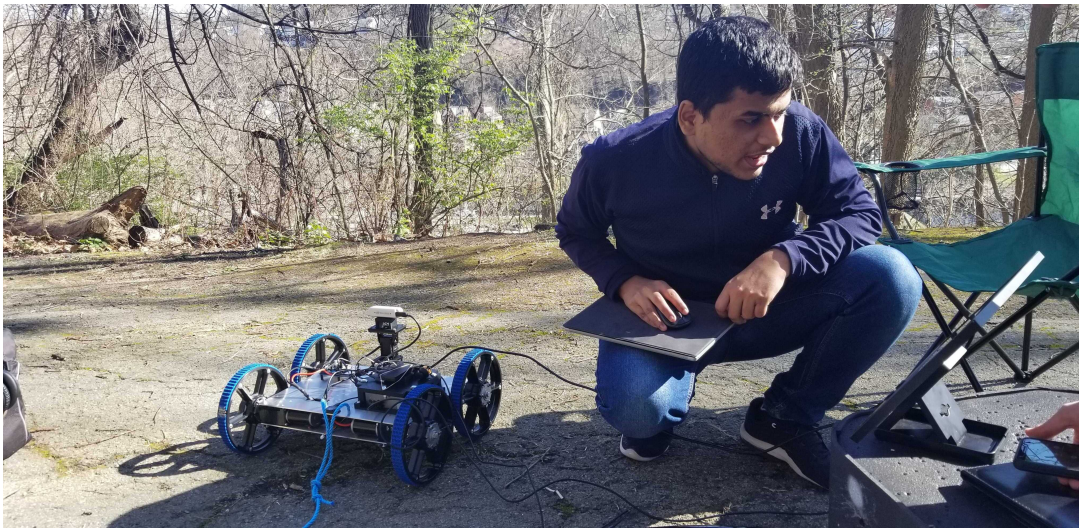

Figure 1: Awadhut (right) connects to Blue (left) in order to check that all ROS nodes are publishing correctly during our field test in Schenley Park.

My last contribution to the test was the implementation of a simple piece of code to drive the pan/tilt turret to some preset positions defined by Alex in our test plan. I based this on one of the tutorial programs provided by the makers of the Arbotix-M board which controls the turret servos. A joystick which came included in the turret kit was attached to the board to adjust the turret angle between tests.

2 Challenges

While the actual field test went exceedingly smoothly, the process of preparing the rover was not quite as easy. On the morning of the field test, while tuning the motor PIDs, we observed that the rear left wheel was not turning when the motor activated. This was an issue that Blue had encountered before, but we did not have the time to troubleshoot it. Luckily, we were able to swap a motor from Blue onto Blue 2, which ran smoothly for the duration of the test. After the field test was complete, I disassembled the gearbox and tightened a set screw on the motor shaft, and upon reassembly the motor was able to turn the wheel properly.

The TX2 computer was a component that presented many challenges. Up until the time of the field test, Awadhut had been struggling to install the RealSense SDK on the TX2, but continually encountered version incompatibilities. Ultimately, we made the decision to use an alternate computer that Awadhut had been running his stereo image pipeline on as our main computer for the test. This required us to install all the necessary teleoperation code on this computer, and design a 3D-printed cage with which to mount it to Blue 2. Luckily, this computer had several advantages over the TX2, including additional USB ports and an integrated WiFi module, which ultimately made our field test run more smoothly. Nonetheless, however, we were troubleshooting the integration of this computer with Blue 2 until a few hours before the test.

3 Teamwork

The successes we have achieved since the previous progress review would not have been possible without my teammates. Both of them assisted me in preparing Blue 2 for testing, and performed their roles efficiently during the actual field test. During the field test, Awadhut was in charge of teleoperating Blue 2 and running the data collection. Alex designed the test plan, managed the rest of the team to make sure we followed that plan, provided supplies (portable monitor, chairs, a rake, etc.), and documented the test with his phone.

Alex developed the test plan for our field test with input from Red Whittaker and other members of the Pit Explorer team. He thought of several test variations in order to capture a broad spectrum of data about conditions the rover might encounter on the moon. Red gave his test plan and our execution of it high accolades. Alex also scouted the location in Schenley Park that we ended up using for our test. Finally, he designed and 3D-printed the cage that held our main computer.

Awadhut has lead the process of creating the brinkmanship pipeline that was the reason behind this field test. He ensured that all the relevant odometry and camera data was collected during the test to make the process worthwhile. After the test, he has performed post-processing on that data in order to generate the point clouds that we can use to test the brinkmanship code, as well as some visualizations that aptly demonstrate the results we achieved. While his initial post-processing attempts were impressive in their own right, he has continued to tweak the pipeline in order to reduce noise as much as possible and produce the best output.

4 Plans

Our next major milestone is the Spring Validation Demonstration. We have three demonstrations that we have established, each of which requires additional preparation and development. Personally, I will be most closely involved in the Image Capture and Brinkmanship tests. In addition, we will need to resolve the obstacles to running our code from the TX2 that still remain, since the TX2 is closer to the computer that will be used in the eventual lunar mission and so we are committed to using it in our platform.

The Brinkmanship test will be similar in appearance to the field test discussed above. However, the major change will be that rather than intentionally driving the rover over the brink, we will use the brinkmanship functionality to have the robot stop itself automatically when it senses that it has crossed a proximity threshold

that we will set based on the results of the previous field test. I will work with Awadhut to design this threshold and integrate it into the rover's existing teleoperation code.

I am leading the development of the code for the Image Capture demonstration. The first step will be to design code to control the pan/tilt turret by sending commands from the main computer. Next, I will reference the Programming Familiarization assignment to create code that identifies the position of AprilTag markers in the images collected by the RealSense camera. To connect these two functions, I will transform the detected marker positions into instructions for the turret such that the turret aligns the marker with the center of the camera image. Lastly, I will write code to stitch various images together into a single panorama. With this code in place, I will set up a test with several AprilTag markers at positions as described in our test proposal, and perform the test with Blue 2 to collect a panoramic image by tracking those markers with the turret.