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Progress

Since the last ILR, I have been focusing on the software stack and helping out with various tasks. I helped assemble components of the LiDAR like cabling and a cable for the IMU. Specifically, I attached an ethernet header to the data lines in the lidar interface cable and an XT60 power connector onto the power lines. For the IMU I spliced a USB-TTL cable onto a Harmin Connector. Most of the time, however, went to supporting the rest of the team in getting things setup. Essentially moving things around with the team, helping test the power board by running software on the BRIX, helping out during calibration of Pixhawk and various other small tasks.

I spent some time working on software and getting the odometry script to work. Specifically, I modified the existing script to be more generalizable for different sensor setups. Initially, we took only GPS and lidar data for our first test run and I designed the original test script for that. Now the test script shouldn't be tied to specific sets of data and only compares Poses. You can see the output in Figure 1 as well as the visualization of the poses. I spent time on getting the code to playback bagged data much more quickly. Originally the bagged data was played back at a pretty slow rate even when set to process offline. Now, I interfaced with the ROS Bag API and directly read bag files to play them through the software. This substantially decreases the time it takes to process large bag files. What makes it better than just using rosbag play with a higher rate is that it is throttled by the speed of the BLAM algorithm. This means I can play the bag back as fast as our processing algorithm can handle it without worrying about playing too fast.

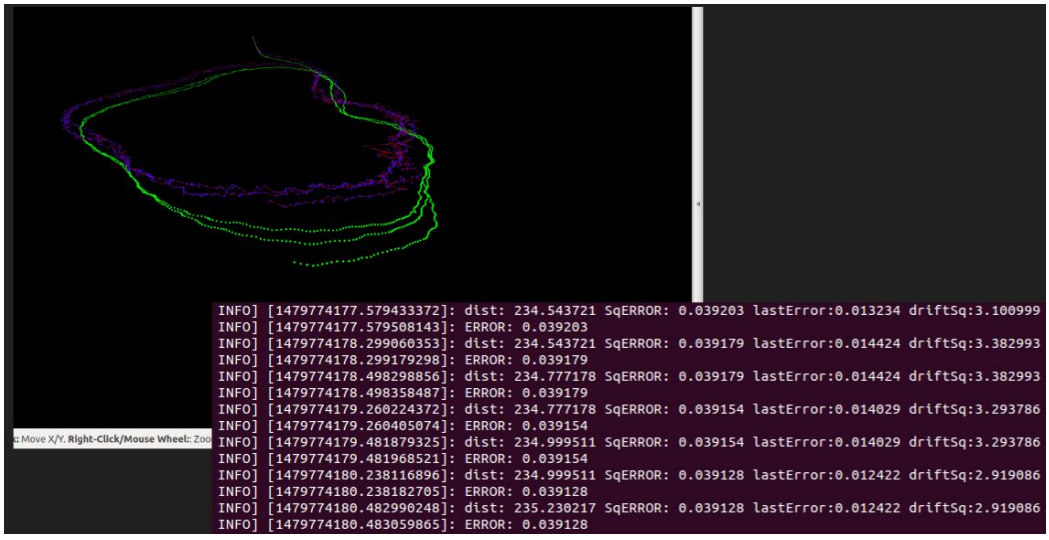

Figure 1. Odometry script output and Localization Comparison GPS in green

I spent some time reading up on a few papers in order to prepare for next steps in the next semester. I have started reading a paper related to spatial and temporal calibration of sensors so rather than relying on manual spatial measurements from CAD, we could write our own temporal calibration for the LiDAR and IMU. I have also started reading a paper on IMU pre-integration for visual and internal MAP estimates. For now, we have been mostly ignoring

our IMU in our SLAM algorithms. Hopefully, however, for next semester we can utilize its measurements in our state estimation. This paper also has lead me to think that using GTSAM, which we had only been using for loop closures thus far, will be an excellent library to use to produce a MAP estimate of our pose given all of the estimates we have seen thus far.

Challenges

I faced a challenge during the creation of the TTL wire. When we ordered the Harmin Connector we had accidentally ordered the crimping version which, unfortunately, requires a special crimping tool. The price for this tool is much more expensive than the price the company was asking for. I decided to try and solder in wires into the pins and press them into the connector. This was difficult as the gauge of the wire was slightly larger than recommended for the pins. Also, in general, it was difficult to fit the stranded wire into the connector and get the solder to flow. Eventually I got it to work but unfortunately, the specific version of TTL cable we had received was actually the wrong kind. It is supposed to get its logic level from the Vin set by the consuming device which assumes that the consuming device gets its power from another source. This type of cable did not work with our IMU, unfortunately. We have ordered more USB cables of the right type to use with the IMU and I will create the cable once they arrive.

Teamwork

Logan spent a lot of time on hardware integration, specifically getting all of the components onto the PDB. After completing it he worked on the power up check together with Maitreya. And then he worked on various hardware integration tasks. He also milled an aluminum plate for the sensor mount.

Clare worked on hardware mounting and integration as well. She spent time CADing and fabricating the mounts for the computer PDB and GPS. She also took apart and put the whole drone together after we accidentally stripped one of the parts of the chassis.

Maitreya worked on the Pixhawk side of things. He got the software running, calibrated the Pixhawk, and oversaw the flight test with the dummy payload. He managed the flight software and everything with that. He also made a Pixhawk serial to USB cable for us to plug into our computer to log data. He spent a lot of time testing out the PDB with various load tests to make sure it works in a variety of situations.

Plans

For the next week, I plan on continuing to help out with hardware integration and data collection tasks. Once we have the platform integrated and flying safely, we will head over to LaFarge and collect more data. I will then analyze the data and create a small presentation based on it. I will also spend some time working with ROS networking tasks to make sure we

can visualize data remotely and run through the FVE demonstration a few times to make sure everything works as expected.