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Progress

Over the last week I spent a lot of time diving into software and the code base. I examined BLAM and determined it's rough structure. BLAM has roughly 4 large functions. It computes "Odometry" or a state estimate by comparing the previous scan to the current scan. This is then fed into a "Localization" function which integrates the incremental Odometry state estimates. It then tries to localize this integrated state estimate within the map. Next it performs a Mapping function by taking in the integrated state estimate and the point cloud and putting them into a map. The fourth major function is Laser Loop Closure. This function takes in scans and the integrated estimate and attempts to find old, similar scans that were taken near our current state estimate and compute a Homography between them. This function then revises our map based on this Homography. Also, in order to quickly process large point clouds, BLAM applies a filter to incoming point clouds so that these algorithms can run much quicker. This structure is depicted in Figure 1.

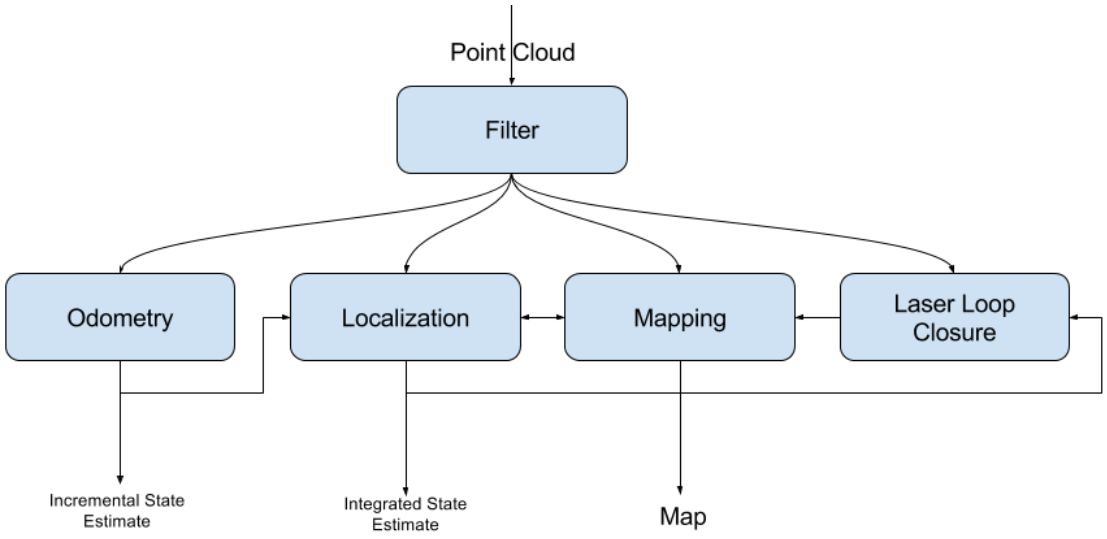

Figure 1. BLAM Software Structure

I determined that there was an issue in laser loop closure function as it didn't generate and loop closure nodes. I stepped through the code using GDB to determine that a counter variable of the type unsigned int was initialized as the INT_MIN. This made the counter variable initialized to a very large size. Without going into deeper details, this incorrect initialization made it impossible for loop closures to occur.

Next I created a Git repository for version control and granted access to my teammates. I also spent time creating a test script to measure odometry performance of the lidar scan vs the GPS ground truth. This was a pretty simple script that just measured the euclidean distance between poses provided by the GPS and BLAM. I am still in the middle of testing and would like to add visual markers instead of just a printing out the MSE of the data so it isn't complete just

yet. The other piece of work I did was writing a test launch script which started up BLAM as well as the GPS broadcaster and Odom compare node.

Challenges

It was a challenge to write the odom comparison test node because the bagged LiDAR data has no specific orientation and we did not have a compass to orient the LiDAR data to true north. This presents a challenge because the GPS data is oriented to true north which means I need to determine the correct orientation of the LiDAR odometry method. To do this I make the assumption that the odometry is good enough that it can generate an okay path. I then just rotate the pose estimates of the LiDAR data to align it such that it gives me the smallest MSE. This is the MSE I use as a benchmark. There are a few problems with this in that there could be a smaller MSE that uses a rotation that is not the correct rotation. I believe this is a small risk because the data we collected has a “center of mass” very far from the starting point. I.e. many measurements are taken far away from the original start location so the error on all these points is very high if the rotation is not correct.

Teamwork

Clare worked on CADing various parts and worked on the sensor mount design. Maitreya worked on the Power Board Schematic. Logan helped Clare with mechanical design and Maitreya with electrical design and focused on Project management.

Plans

For this next week I plan on helping the team with the push to CAD the whole robot and investigating BLAM loop closure issues. I think specifically I will be CADing the battery on the robot. On BLAM loop closures I have discovered that the loop closure code is still not running. I’m not sure whether it’s because the code is still broken or if loops are not being closed. I will continue to debug it to see where and why the loop closures are not happening.