Individual Lab Report #6

Yichen Xu
9/17/2020

Team C: flyOctopus
Teammates: Zhaoyuan Huo, Gu Yi, Guan Zhong, Wanzhi Zhang

Individual Progress

My primary responsibility for this project is the UAV subsystem. My personal progress since the last ILR includes 1) validating/testing everything to make sure everything still works as intended after the summer break (UAV hardware and software) 2) help my teammate to integrate and test UAV UGV subsystems in simulation.

The first thing I worked on was to perform basic functional tests on everything we worked on last semester for the UAV subsystem. This is to make sure that we will find out potential issues like lack of damaged/missing hardware early on so we have enough time to deal with them without risk delaying milestones/schedules. Ths hardware testing includes manually inspecting the whole UAV and a manual field test. All modules are in good working order except for one of the four legs, which is bent during transportation. Good news that we do have spare parts for drone legs, so it shouldn’t affect our future field testings. The software testing includes familiarizing and running the navigation module and landing module that we implemented during the last semester, and everything is good to go. Additionally, I added sections of documentation that I found missing during the testing process.

Figure 1 Before and after the leg replacement

My second contribution was to help my teammate Aaron to integrate the UAV software subsystem with the UGV subsystem within Gazebo simulator. The UAV and UGV subteam has been working separately the whole time last semester. Integration is necessary to simulate the collaboration between the two, which is crucial for realizing our final project goal. While Aaron was the main contributor for this task, Yi and I helped him on the UGV and UAV software stack, respectively during the process. The major structure remained unchanged, but I did performed a few optimizations on the launch file and some of the ROS APIs for better scalability and performance.

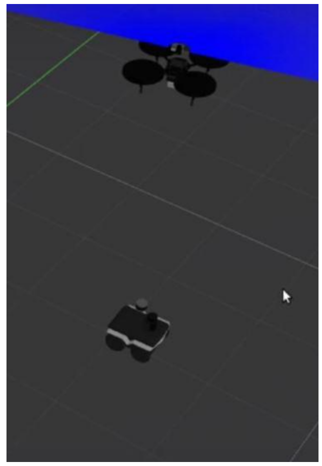

Figure 2. UAV and UGV in Gazebo

Challenges

There weren't any significant challenges as this is the first ILR for this semester when most of the work I did was reviewing the work we did previously. The major challenge for us as a team would be that we still couldn't get our hands on the UGV due to the missing safety protocol of our sponsor's lab. In addition, one significant challenge for the UAV subsystem in the future is the quality of laserscan generated by the stereo depth cameras, which is explained below under the 'Plans' section.

Teamwork

For our MRSD project, we have two people (Aeron and me) working on the UAV subsystem, one person (Zhaoyuani) working on the UGV subsystem, and two people working on the global planner (Wanzhi and Yi). Below would be the most recent responsibilities and work for each individual

Individual	Responsibilities and Work
Yichen (Me)	UAV hardware testing. Helped Zhong with integration
Zhong	Integrated UAV and UGV models in Gazebo simulator
Yi	Revised the implementation of UGV and helped Zhong with integration
Wanzhi	Designed and finalized global planner framework
Zhaoyuan	Team management, UGV/UAV landing module design

The main goal for each section is below:
UAV: Field-testing what we tested in simulation (obstacle avoidance and apriltag tracking)
UGV: Landing platform design/implementation. Get access to UGV hardware.

Global Planner: Start implementing the planner.

Plans

My goals for the UAV subsystem before the next PR includes: 1) Testing the laserscan generated by the depth camera (stereo images -> pointcloud -> laserscan) 2) field-testing of UAV obstacle avoidance 3) (If there's still time) field-testing of UAV landing on an Apriltag placed on the ground

The first goal involves configuring the depth camera module that is currently mounted on the UAV. Last semester we were able to successfully tune the camera parameters to generate 360 degree all-around point cloud using the stereo images stream. However, later in the semester after we moved everything onto simulation, we discovered that point cloud is not compatible with our obstacle detection algorithm. Moreover, the simulated depth camera in Gazebo has issues with generating accurate pointcloud. As a result, we decided to mount a Lidar onto our UAV virtually for the purpose of validating our algorithm, even though the UAV is not actually mounted with a Lidar yet. Thus, the plan for this semester is to first validate that the quality of laserscan generated based on stereo images is good enough for obstacle detection, and we will make a purchase of a Lidar/Laserscanner if that's not the case.

The second goal is field testing the obstacle avoidance feature of the UAV. The overall test should be similar to the test we performed in SVD in Gazebo, except we will start with fewer number of obstacles and simpler geometric shapes. To prevent any potential damage being dealt to the UAV during the process, we have equipped the UAV with propeller guards and increased the safety distance in our algorithm compared to that in simulation.

The last goal is landing on a stationary april tag placed on the ground. We won't proceed performing this test until we accomplish the previous two goals. This test will be very similar to the landing sub-test we did during SVD. The potential challenge here is the set of PID parameters that worked in simulation might not generate the same result in the real world due to noise and physics.