

**Individual Lab Report #10**

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**Team A / Team Avengers**

**Teammates: Tushar Agrawal, Sean Bryan**

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## **I. Individual Progress**

Last PR, I demonstrated the UAV moving from point A to B while avoiding obstacles. Last couple of weeks, I have worked on developing lawn mover search for the UAV while avoiding obstacles. This involved iteratively tuning Navigation Stack parameters by testing. Below mentioned section describes in detail the technical aspects and the progress that I have achieved.

### **1. Lawn Mover search implementation with obstacle avoidance**

As described above, previously I had the UAV planning a path from position A to B and also avoiding obstacles during the path. As per our project requirements we require to search for the marker when the UAV reaches the vicinity of the destination house. Hence, as a strategy now our UAV will search for a marker by moving in a lawn-mower search pattern. We also need obstacle avoidance capability while this motion is performed.

I tweaked the code to send multiple goal positions instead of one. This wasn't difficult to code. However, the main technical trouble was to tweak the navigation stack parameters that is the Dynamic Window Approach Planner parameters so that the UAV followed the trajectory smoothly and also avoided obstacles.

I did multiple tests iteratively tweaking parameters of the planner. Summarizing the results of the tests:

When we flew the UAV at around 18m height the UAV followed the lawn mover path well. [Here](#) is a video of the same. However as we don't have obstacles that high we could not verify the obstacle avoidance subsystem at that height.

We are in the process of building our test obstacles which will be of height 6 m. Currently the flying height of the UAV to test it with obstacles in the environment was limited to around 2m (using our marker as obstacle). And at that height the UAV faced aerodynamics issue and could not autonomously follow the plan at that height. It kept reducing its height to gradually landing by itself.

Even when we managed to fly the UAV at around 3m height and bring obstacle in its path the UAV kept rotating and moving in different directions. I tuned the rotation limits of UAV and did multiple test on UAV to get rid of the issue.



Above shown is a picture of the test where UAV finds an obstacle while doing lawn mover search and tries to avoid it. Testing further the planner failed to produce path at times. In the coming days I will further play around with different planning parameters by looking at the reasons for which parameters cause this problem. This is the final step of the obstacle avoidance subsystem and I will do this in the coming week.

## **Challenges faced**

1. As described in the above section few one of the issue I faced was limited height at which we had to test the UAV. We will soon have our test obstacles as a result of which we will be able to solve the limited height and aerodynamics issue.
2. Also mentioned above is the issue of continuously tuning the navigation stack parameters so that the UAV follows the lawn-mover search while avoiding obstacles. This is an iterative process and with more tests I will be able to solve this problem. Currently, the flight time of our UAV is limited to around 15-20 minutes because we have 2 batteries each giving around 7-10min flight time. We have ordered 4 more batteries to get more flight time for testing.
3. During testing of the obstacle avoidance subsystem and the package delivery tests we had 4 crash flight. We broke many propellers and had to frequently do mechanical repairs which was a challenge. The reason behind the crash were: software bug, motor nut being

loose and critical battery while flying. Understanding the reasons behind the crashes has made us more cautious of identifying the issues and avoid them from happening again

## **II. Teamwork**

For this PR I helped Sean initially build the obstacles for our test environment. Sean has finished the major part of building the obstacles. We will soon have 2 obstacles of size 0.5mX0.5mX6m replicating trees and buildings.

I also helped Tushar for testing package drop using Odroid subsystem. He has built the complete system in which the UAV can takeoff autonomously with package, fly to destination gps location, search for the marker, land on the marker and autonomously drop the package.

## **III. Future Work**

I will further tweak the navigation stack planner parameters by doing more test flights also using the newly built test obstacles. As a result of this the obstacle avoidance subsystem will be completely functional and tested. Then, I will finish its integration into the main system which will include few code integration steps like changing the code for sending the goal from C++ to Python.