Universiteit Antwerpen

Progress Report Week 6

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Abstract

In order to save time and reduce the risk of crashing the ErleCopter, all algorithms should be tested in a simulator before implementing them. For this purpose, we will work with Gazebo. The drones' trajectory can be scripted using mavros. We research multiple SLAM algorithms such as LSD SLAM [1], RGB-D SLAM [2], ORB SLAM2 [3] and OctoSLAM [4] to map an indoor environment. The data that was gathered using SLAM can be stored in an OctoMap [5].

1 Progress

1.1 SLAM conclusion

In the past few weeks, I have tested a number of visual SLAM algorithms such as LSD SLAM [1], RGB-D SLAM [2], ORB SLAM2 [3] and OctoSLAM [4], in order to find the most valuable algorithms for my thesis.
In my further research, I will be using RGB-D SLAM for a number of reasons.

- Native OctoMap support
- Many parameters that can be set, so that the algorithm can work in many enviroments
- Dense point cloud, which is useful when mapping an indoor environment with a lot of detail

Again, it has to be noted that the drone trajectory was not optimal until now. However, I have made some progress on this topic, so I will render more tests on LSD SLAM and RGB-D SLAM to have a better comparison with loop closures.

1.2 Drone Trajectory

1.2.1 Yaw rotation

Optimizing the drone's trajectory and control was my main goal for this week. I was not able to control yaw rotation up till now. This week, I found a method to achieve this.
Based on a tutorial by Erle-Robotics (`http://docs.erlerobotics.com/erle_robots/erle_copter/examples/overriding_radio_controller`), I have tried to override the rc channel for yaw. However, for some inexplicable reason, it was impossible to override the rc channels. The fix for this was a complete reinstall of Gazebo, ROS Indigo, etc. Basically I started my project from scratch. Luckily, I could use my progress reports from the past weeks for guidance, so the entire reinstall only took me 2 hours.
This drastic measure had some advantages as well. By reinstalling Gazebo and APM Planner, I noticed that there was a more recent version of APM Planner available which allows me to run a simulation simultaneously with APM Planner. Now, I can control the simulation with APM Planner and a PS3 controller!
Also, RC overrides are functional now. When I override rc channel 3, the Erle-Copter rotates! The movement is pretty unstable though, I will test if yaw rotation in the real world shows the same stability problems. This can be a useful validation for my simulation scripts.

(**Note:** for future scripting of trajectories, it is interesting to have a better understanding of the physics of a quadcopter. A detailed explanation can be found at `http://blacktieaerial.com/the-physics-of-quadcopter-flight/`)

2 Planning week 7

- Validate simulation flights in the real world
  - Prepare the indoor environment with nets to catch the drone in case it would crash.
  - Is yaw rotation as unstable as in simulation?
- Record a new bagfile in simulation, using a better trajectory
  - Write trajectories in c++ code
- Create a simulation model of the real world environment
- Connect camera to Erle-Copter and create a bagfile of a real environment
- ...

References

[1] Jakob Engel, Thomas Schöps, and Daniel Cremers. LSD-SLAM: Large-Scale Direct Monocular SLAM. *Computer Vision ECCV 2014*, pages 834–849, 2014.

[2] Felix Endres, Jurgen Hess, Nikolas Engelhard, Jurgen Sturm, Daniel Cremers, and Wolfram Burgard. An evaluation of the {RGB}-D {SLAM} system. *2012 {IEEE} International Conference on Robotics and Automation*, 2012.

[3] Raul Mur-Artal and Juan D. Tardos. ORB-SLAM2: an Open-Source SLAM System for Monocular, Stereo and RGB-D Cameras. 10 2016.

[4] Joscha Fossel, Daniel Hennes, Daniel Claes, Sjriek Alers, and Karl Tuyls. {OctoSLAM}: A {3D} mapping approach to situational awareness of unmanned aerial vehicles. *2013 International Conference on Unmanned Aircraft Systems ({ICUAS})*, 2013.

[5] Armin Hornung, Kai M Wurm, Maren Bennewitz, Cyrill Stachniss, and Wolfram Burgard. {OctoMap}: an efficient probabilistic {3D} mapping framework based on octrees. *Autonomous Robots*, 34(3):189–206, 2 2013.