Robot Vision and Navigation

Coursework 3 - SLAM Systems

Lourdes Agapito (l.agapito@cs.ucl.ac.uk) and Martin Rünz

Overview

Assignment Submission Date: 23:55 Friday 26th April , 2019
Weighting: 33% of module total
Final Submission Format: For this coursework **you will continue to work in pairs as you did for the previous courseworks.** Each group will submit a report in PDF format (see details below).
Assessment Format: the assessment will consist of an oral component (50%) and a written component based on the PDF report (50%).

Assignment Description

In this assignment you will download, install, run and evaluate a state of the art SLAM system.

- Orb-SLAM: http://webdiis.unizar.es/~raulmur/orbslam/ is a sparse, feature-based real-time SLAM system. You can download either ORB-SLAM or ORB-SLAM2, whichever you prefer. For those who had problems installing ORB-SLAM on a Mac remember that Martin prepared a version that runs on a Mac: https://moodle.ucl.ac.uk/course/view.php?id=40499&section=9

You will use the standard TUM RGB-D Dataset and Benchmark https://vision.in.tum.de/data/datasets/rgbd-dataset to evaluate the performance of the SLAM systems. Martin prepared some instructions for you which can be found here: https://moodle.ucl.ac.uk/pluginfile.php/4662455/mod_resource/content/1/tum_instructions.pdf
You can download the evaluation tools from the website: https://svncvpr.in.tum.de/cvpr-ros-pkg/trunk/rgbd_benchmark/rgbd_benchmark_tools/src/rgbd_benchmark_tools/
Martin has also pre-processed the two sequences (*fr2_xyz* and *fr3_long_office*) we want you to work with:

- http://visual.cs.ucl.ac.uk/pubs/cofusion/data/f2_xyz.zip
- http://visual.cs.ucl.ac.uk/pubs/cofusion/data/f3_long_office.zip

Part 1 (written component) - Download, run and evaluate a SLAM system (50%)

You will evaluate the SLAM system on the two sequences above and use the evaluation tools to compare the estimated rotation and translation parameters with the ground truth.

We want you to evaluate the **Absolute Trajectory Error (ATE)** which you can find a description for in the TUM evaluation site:
https://vision.in.tum.de/data/datasets/rgbd-dataset/tools#evaluation
There is also code to run this evaluation.
Compute absolute trajectory error (AT-RMSE):

```
./evaluate_ate.py groundtruth-poses.txt exported-poses.txt --plot plot.pdf
–verbose
```

This produces a PDF file with a plot that compares the estimated trajectory and the ground truth trajectory. We want you to run the SLAM system in three different ways and produce the evaluation plots in each case.
ORB-SLAM:

1. Run the system with off-the-shelf options, evaluate and obtain the ATE plot for both sequences.
2. Reduce the number of ORB features used by the system and test the impact on the estimation of the camera trajectory. Choose 3 levels of number of features (you will end up with 3 graphs per sequence). Your job is to go into the code and find the place where you can change the parameter/s that govern the number of features that are detected by the system.
3. Turn off the outlier rejection stage and evaluate again. Your job is to go into the code and find the place where you can switch off the function that rejects outliers and run the system without it. The performance of the system should suffer substantially.

You will submit a PDF report that contains:

a. **A detailed description of the *tracking* thread of the system** you have chosen. Only the tracking, not the mapping. You are expected to understand and describe how the camera trajectory (rotation and translation parameters) are estimated including a description of the energy minimization or the parameter estimation. You can refer to the paper associated with the system but do not plagiarise the text. Please always use your own words and always cite or acknowledge any sources that you have used. [(400 to 500 words)]
b. The **results of the evaluations that you have run**. You should include a description of each evaluation (see the list above) and the corresponding plots.

Part 2 - Oral demonstration (50%)

50% of the grade for this assessment will come from an oral component. Each student will demonstrate the running system on their laptop to us. The oral assessment will take place in the week starting 29th April. Each group will have around 15 minutes and must be able to:

1. run the system on one of the sequences (either one of the sequences above or one of your choice),
2. answer questions about the TRACKING thread of the chosen SLAM system
3. show the plots and answer questions about the evaluations.