

## EE5346 - Autonomous Robot Navigation

Fall 2021

Homework #6 (5%)

Due: December 31 at 23:59

Loop Closure Detection with BoW  
(Revised)

1. Read Section 10.3.2 (“Practice: Creating the Dictionary”) of the textbook. Install the DBoW3 library at <https://github.com/rmsalinas/DBoW3> on your computer. Build the executable of `feature_training.cpp` that comes with the textbook with `cmake` and run

```
$ build/feature_training
```

to make sure that you can duplicate the results and build a BoW dictionary from the 10 training images using DBoW3. Is the dictionary you build in this step the same or different from either of the two dictionaries that you downloaded from the book github?

2. Read Section 10.4.2 (“Practice Part”) of the textbook. Build the executable from `loop_closure.cpp` that comes with the book with `cmake` and run

```
$ build/loop_closure (not “build/feature_training” as in the book, which is a typo)
```

to make sure that you can duplicate the results of computing image similarities and retrieving similar images with the DBoW3 library. Experiment with using the larger dictionary, `vocab_larger.yml.gz`, to compute image similarities. Compare the outputs you obtain from the two dictionaries and record differences – if any – when using two dictionary sizes.

3. Download the `rgbd_dataset_freiburg1_room` sequence of the TUM dataset from [https://vision.in.tum.de/data/datasets/rgbd-dataset/download#freiburg1\\_room](https://vision.in.tum.de/data/datasets/rgbd-dataset/download#freiburg1_room). Note that there are 1,362 images in this sequence, corresponding to roughly 45 seconds in real time. Revise `loop_closure.cpp` so that it is able to handle this sequence of images. No need to rebuild dictionaries.
  - a. Run `loop_closure` on this sequence with the small dictionary (`vocabulary.yml.gz`) first and then with the larger dictionary (`vocab_larger.yml.gz`). Record the times of image recognition of the four cases: two methods of comparing images – “with images” and “with database” – and two vocabulary sizes.
  - b. The images in this sequence are labeled with their time stamps and, in sequential order, they correspond to image #1 to #1362. Now, using the larger vocabulary (`vocab_larger.yml.gz`), find the top loop closure candidates for the following five images: #231, #531, #813, #981, and #1461. For a candidate to be valid, it must *not* lie within the past 60 images (e.g., image #530 *cannot* be a loop closure candidate for #531 since  $531 - 530 = 1 < 60$ , representing an image in too recent past, and robot/camera has not moved much since). Inspect the corresponding candidate images.

### SUBMISSION:

The homework will be submitted through *blackboard* as always. For this assignment, you should submit (i) observations from Questions 1 and 2, (ii) four retrieval times in Question 3(a), (iii) five loop closure candidates in Question 3(b) in terms of their image #’s and (iv) the source code for Question (3). Put answers to (i)-(iii) in the header section of the source code of (iv) and upload the `cpp` file as your submission to *blackboard*.