SfM

Homework 2 for ASU CSE 591 Perception in Robotics

February 4, 2018

1 Introduction

Structure from motion (SfM) is a classic computer vision problem which is an imaging technique for estimating three-dimensional structures from two-dimensional image sequences. In this home work, we will implement first phase of SFM pipeline as learnt in class. Please problem statement and algorithm implementation from this homework.

2 Problem Statement

We are giving you 150 images and their corresponding SIFT [1] features. For each image, you need to find 5 another images from rest 149 images which are closest match. To read more about the structure of SIFT files and how to read them, please download SIFT demo from here: OR http://www.cs.ubc.ca/~lowe/keypoints/siftDemoV4.zip. Write a 1 page report about your implementation.

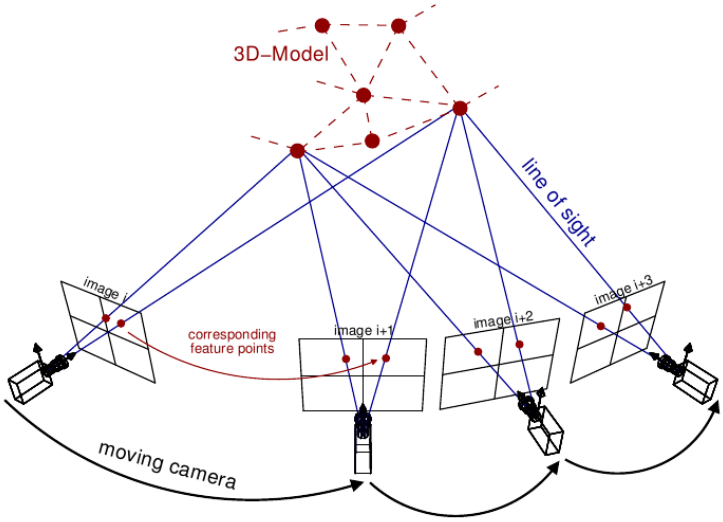
Why do we need matches in pair? Kindly take a look at Figure 1. If we have closest pair of images, we can triangulate the 3D points from image pairs.

3 Implementation algorithm

You will be provided with a C++ code template where you have to populate the functions. But you can code it in any language you like. We recommend you to use OpenCV library. But feel free to use any other library. You have to implement following functions:

1. Read SIFT files of images.
2. Implement matching algorithm.
3. Creating a scoring method about how close an image pair is.
4. Write output to a CSV file. Refer to file structure below. You will also have an example_output.csv file for better idea.

Figure 1: Incremental SFM image pairs



Why we need closest 5 images? That's a goood question. Your matching algorithm can be different than ours. Also there can be outliers. So one of those 5 images is **truly** the closest pair. You will get 1 point if image has closest match in top 5 images returned by you. Total points you can score is 150.

4 Grading policy

1. Implementing given functions: 20%
2. Result CSV file: 60%
3. Report: 20%

5 Files and file structure

In this homework, you have following files:

1. images.zip: You will get 150 images. They have been resized to 320x240 so that you don't hand pick them for this homework. Also, we want you to use SIFT files provided by us instead of just calling OpenCV's SIFT extractor.
2. sifts.zip: SIFT files for each image. let's say an image is 'IMG_001.JPG' corresponding SIFT file name will be 'IMG_001.JPG.sift'. These SIFT files contains features extracted from 1920x1080 images.

3. Homework.pdf: The PDF you're reading right now.

4. example_output.csv: Example output file. Structure is defined below.

Output file structure: Your output file should be a CSV file, strictly coma separated. It should have exactly 151 rows and 11 columns. First row should be the header, rest 150 rows are reserved for 150 input images.

Column headers:

1. ImageName: Name of image file.

2. FirstMatchImage: Name of the image which is your first match.

3. FirstMatchScore: You should return the score from 0-100 as integer value only.

4. SecondMatchImage: Name of the image which is your second match.

5. SecondMatchScore: You should return the score from 0-100 as integer value only.

6. ThirdMatchImage: Name of the image which is your third match.

7. ThirdMatchScore: You should return the score from 0-100 as integer value only.

8. FourthMatchImage: Name of the image which is your forth match.

9. FourthMatchScore: You should return the score from 0-100 as integer value only.

10. FifthMatchImage: Name of the image which is your fifth match.

11. FifthMatchScore: You should return the score from 0-100 as integer value only.

We are asking for scores because if we have a doubt about your implementation, we can ask you to run your code so that it produces similar results.

References

[1] David G Lowe. Distinctive image features from scale-invariant keypoints. *International journal of computer vision*, 60(2):91–110, 2004.