Assignment 2

Computer Vision 2014-2015
University of Bern

1 Binocular Stereo (Due on 18/11/2014)

The purpose of this assignment(credit to Prof. Agam [1]) is to implement a binocular stereo vision algorithm: first locating and drawing epipolar lines of an uncalibrated stereo pair and then structure reconstruction from an uncalibrated stereo pair.

- The input image should always be converted to grayscale before processing it.
- You may NOT use the OpenCV function which directly implements the algorithm you choose. You may, however, use it for verification purposes. You may use other OpenCV functions as necessary.
- You need to evaluate the performance of the algorithm you choose using test data. The results of your evaluation should be included in your report. Try to determine the strengths and weaknesses of the algorithm.
- For submission instructions and the necessary format of the report please refer to assignment 1 specifications.

[1] http://www.cs.iit.edu/ agam/

1.1 Epipolar lines estimation [50 points]

1. Take two pictures of the Zytglogge in Bern city center, rename them as "left.jpg" and "right.jpg" and place them in the folder "pics'. **[2 points]**
2. Complete the file "main1.m" to allow the user to specify a set of corresponding points in the images using the mouse. **[4 points]**
3. Using the set of corresponding points specified by the user, complete the function "eightPointsAlgorithm.m" that estimates the fundamental matrix relating the two views and display the estimated matrix. Normalize the points before computing the fundamental matrix and make sure that the estimated fundamental matrix is a rank 2 matrix. **[30 points]**
   Resources: http://en.wikipedia.org/wiki/Eight-point_algorithm
4. Complete the file "main1.m" and let the user select a point in the left image, and display the corresponding epipolar line in the second image. **[7 points]**
5. Complete the file "main1.m" to compute and display (numerically) the coordinates of the left and right epipoles. **[7 points]**

1.2 Model reconstruction [50 points]

A calibrated image pair with a dense correspondence and known intrinsic/extrinsic parameters is available on ILIAS (Folder 'Matched Points'). For this pair you should:

1. Using the provided corresponding points, complete the file "main2.m" and estimate the fundamental matrix relating the two views and display the estimated matrix **[5 points]**. Make sure that the estimated fundamental matrix has a rank of 2. Using the knowledge of the intrinsic parameters compute and display the essential matrix. **[5 points]**
2. Using the essential matrix, complete the file "main2.m" to estimate up to an unknown sign the rotation and translation between the views and display them. Note that the true extrinsic parameters are provided so that you can verify your computations. **[25 points]**
3. Complete the file "main2.m" to reconstruct the 3D points using the obtained rotation and translation and choose a consistent solution. **[8 points]**
4. Complete the file "main2.m" to show the reconstructed points as a 3D cloud with a method of your choice. Generation surfaces between the points is not required. **[7 points]**

NOTICE: The corresponding points are described in a text file. The first line in this file contains the number of matched points. Subsequent lines contain the description of pairs of corresponding points. Each pair of corresponding points is described by 4 coordinates: x_r, y_r, x_l, y_l, where (x_r, y_r) and (x_l, y_l) are corresponding points.

What to hand in:

1. Your personal written and commented **Matlab code** (zip file). Make sure all results and images are displayed via the main scripts "main1.m" and "main1.m". The code should run without errors or warnings and should not crash, otherwise there will be a penalty at the final assignment mark. The mark does not depend on performance, however if the code takes too long to run (e.g. because of many *for* loops) a penalty will apply again.
2. A **PDF report** (same format as the template of assignment 1).

For any questions feel free to post on the ILIAS Forum, contact the TA (Daniele Perrone) in class or fix an appointment at perrone@iam.unibe.ch.