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COMP 558 - Assignment 3

Question 1

I used the “imtool” Matlab function to output the images and be able to look at pixel coordinates (x,y) of the images.

I then selected 8 matching points for each image and proceeded to estimate a fundamental matrix in the following way:

1) Data normalization.

2) Solving least squares problem to estimate the entries of F_{norm}.

3) Mapping these entries to the entries of F via a de-normalization matrix linear transformation on Fnorm.

4) Enforcing a rank 2 constraint on F by modifying its svd S matrix composition and replacing S(3,3)= 0;

Fundamental Matrix for Stereo 1 output:

Q1. Rank of Generated Fundamental Matrix is:

2

Q1. Fundamental Matrix for Image Pair #1 is:

[-0.0000 0.0000 -0.0057

-0.0000 0.0000 0.0041

0.0065 -0.0152 1.1846]

Fundamental Matrix for Stereo 2 output:

Q1. Rank of Generated Fundamental Matrix #2 is:

2

Q1. Fundamental Matrix for Image Pair #2 is:

[0.0000 -0.0000 0.0005

0.0000 -0.0000 0.0049

-0.0002 -0.0044 -0.1468]

Question 2

I generate a Fundamental Matrix for each of the image pairs through the following steps:

We run a RANSAC algorithm for which we establish a number of iterations, consensus_set limit and consensus_set criteria.

Also before the first iteration I do the following:

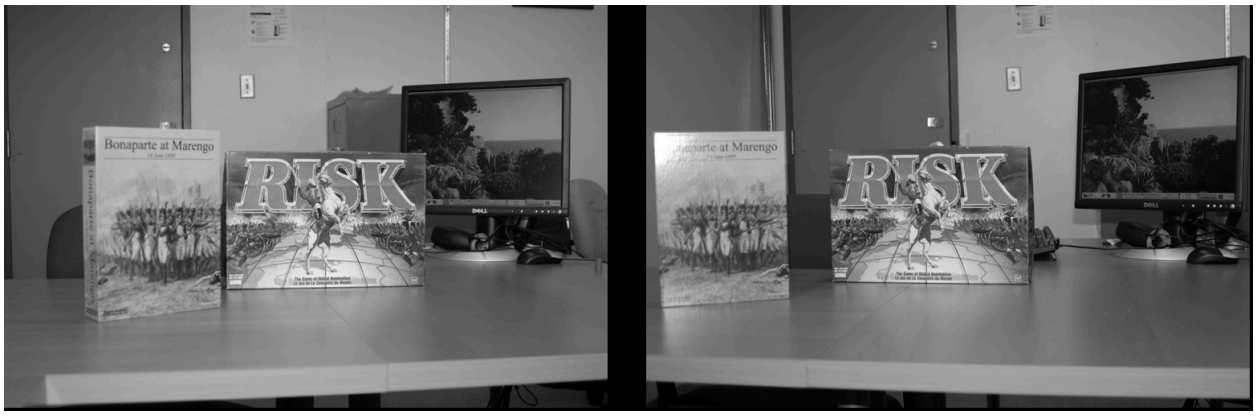
For each of the RANSAC iterations I do the following:

1.- Randomly select 8 SURF-points
2.- Generate matrix F with these points
3.- Iterate remaining SURF-points and check how many are in the consensus set by checking Epipolar constraint x2'*F*x1 = 0. (i.e. which and how many SURF points satisfy this constraint).
4.- If the generated matrix F is the best fit up to now then we store it as a good model.
5.- We output fundamental matrix with the largest consensus set refitted with points in the consensus set.

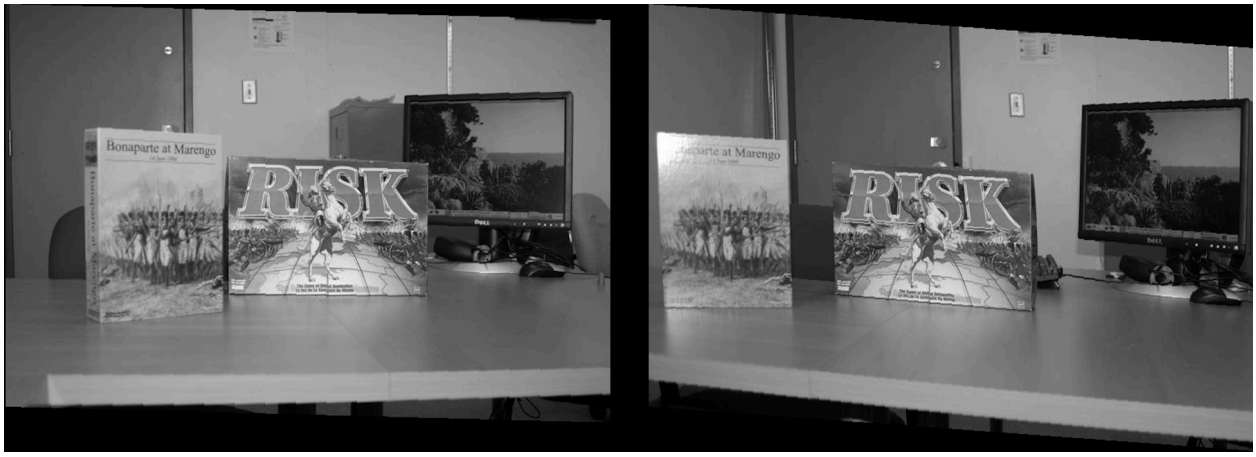
Question 3

Stereo Images (Pair 1):

Not Rectified:



Rectified:



Using Matrix F:

[-1.22385320147802e-10 -2.50616093221418e-08 0.000451599943821839;
7.81213585694305e-09 1.81365234376140e-08 0.00617765081138932;
-0.000203816506415516 -0.00776863296924383 0.291008688968557]

Stereo Images (Pair 2):

Not Rectified:

Rectified:

Using Matrix F:

[-1.53462543900070e-09 -3.81367453594227e-08 0.000959839530888257;
4.32486782071492e-08 -7.73082718392819e-09 -0.00701186455415368;
-0.000779682823153024 0.0069701620197716 5 -0.0364890075064721]

Question 4

(I = 1 for Pair 1, I = 2 for Pair 2).

Using the computed Fundamental Matrix Fi for each of the Stereo Images in Q3 that yield a good rectification result. We compute Essential Matrix E.

In this question we are given intrinsic parameters of both cameras (for each image pair), which we store in matrix Ki.

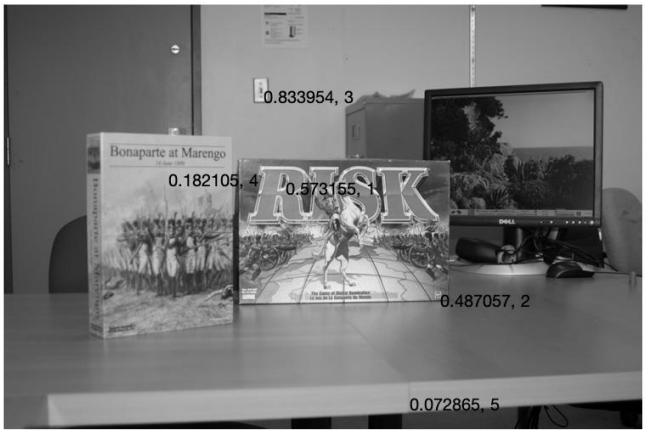
So we get that Ei = Ki'*Fi*Ki.

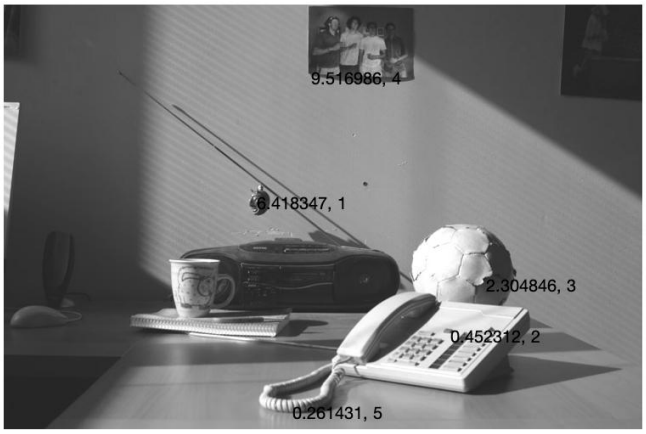
We extract the extrinsic parameters in the following way from Essential Matrix Ei.

- T is the right null space from matrix E (positive and negative)
- R is equal to U*W*V' or U*W'*V' where W is a defined matrix

I tried all possible combinations and determined which one gave the best results for each pair of images, to obtain a, b and c scalars. The optimal results are the following.

The further away a point is from the camera, the larger it's depth value is.



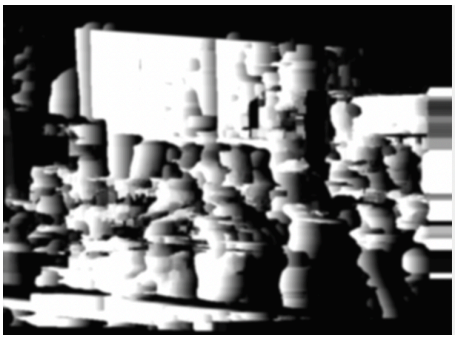


Question 5

I used a Lukas-Kanade 1D approach to compute image disparity and depth.

For image pair 1:

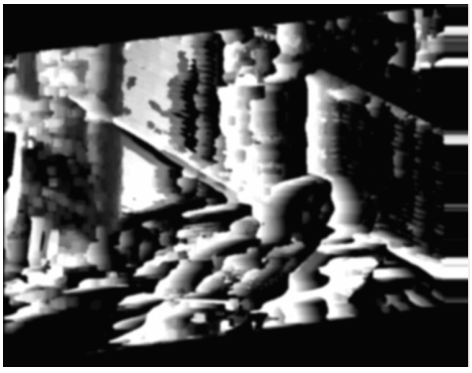
Disparity map:



Depth map:

For image pair 2:

Disparity map:



Depth map:

From the results I can gather that we get a better disparity and therefore depth map for image pair 2 since it's points don't vary too much along the x axis since we are using Lukas-Kanade1D Algorithm along that axis.

We have that the results aren't that clear for Image pair 1. This is due to a larger variation on corresponding points, camera from the right seems to have a more tilted

view of the 3D Scene which causes rectification to not be as accurate and therefore Lukas-Kanade can’t portray disparity and depth as correctly as it should.