Università degli studi di Genova

DIBRIS

Informatics, Bioengineering
Systems Engineering, Robotics and System Engineering

Computer Vision

Assigment 3

Report Laboratory 6

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1 Introduction

This assignment is done by Andrea Chiappe and Fabio Guelfi. The main code is in the Lab6.mlx. The goal of this laboratory is to estimate the Fundamental Matrix F starting from two pairs of stereo-images.
We divided the the assignment into two parts:

- Starting from a set of corresponding points we wanted to estimate the fundamental matrix F. So we implemented the function *8-point algorithm* whit and without the normalization of this points. Then we applied this function given in input the two sets of point and evaluate the correctness of all the results;

- Starting form a pair of stereo images we implemented the *find matches algorithm*. Then the point returned by the function are given as input of the *Ransac* function that estimate the optimal Fundamental matrix.

2 Results

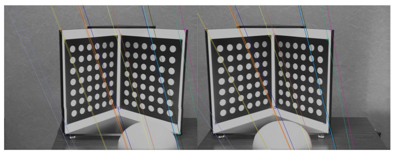
8-point algorithm

The first function we implemented was the 8-point algorithm. This function take as input the set of correspondence point of the two images and return the fundamental matrix. Our goal is to check that the epipolar constraints $(x')^T * F * x = 0$ is satisfied for every points.
The value 0 is unrealistic due to the computation, so we have to consider a threshold. We computed both for normalized or not normalized points. The difference is that:
when we apply the epipolar constraints for all the pairs of the fifteen points that we have in the origin, without normalization, we obtain that the mean of the constraint is around 0.290. Instead, with the normalization of the points the mean of all the epipolar constraints is around 0.0019. We save every result of the epipolar constraint for each pair of point in an array and then calculate the mean only for understand a possible value of the threshold and for do a comparison between the normalization and not.
So in the normalized value is less than in the not normalized one. This is what we expected because we use the normalization of the point for have a more numerical stability and make the fundamental matrix estimation process more robust, thereby reducing the impact of outliers and improving the accuracy of the result.

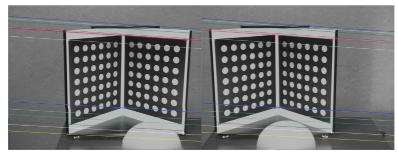
After calculating the F matrix and check the epipolar constraints, we use the function *visualizeEpipolarLine* for print in the two images the epipolar line and check the computation of the F matrix visually. In our case, having in the two images the perfect same point, the result is good, every point is in the epipolar line in correct way.

The last check is to find and print on the images the epipole, for understand where the plain of the two point intersect the two images plan.

Figure 1: Not normalized and normalized 8-point algorithm F computation



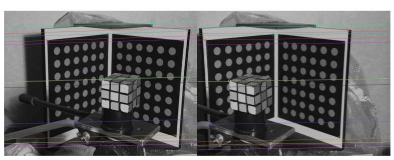
(Not normalized)



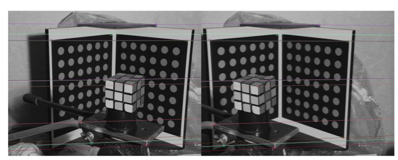
(Normalized)

It is possible to observe that the epipolar lines in the two Fundamental matrix computation are completely different. That's why the not Normalized one (figure a) failed because most of the image is repeated locally always the same. This problem can be solved, as shown in the figure on the right, using the normalization precondition.

Figure 2: Not normalized and normalized 8-point algorithm F computation



(Not normalized)



(Normalized)

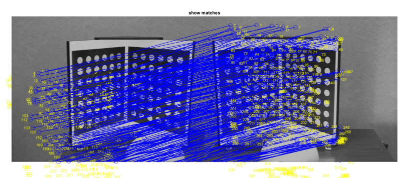
It is possible to notice that, in this case, there is not a big difference in the computation of the epipolar lines between the two Rubik's images. This is because the Rubik's cube can be seen as a reference for the points estimation.

Find matches and Ransac

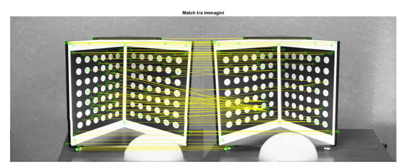
For this part we start from a pairs of stereo images. The goal was to found some point in common through the *find matches function* and put this point as input of *ransac* function, that will calculate the optimal Fundamental matrix F.
We have implemented some Matlab built-in functions to compare our results with the correct ones of the computation (the *findmatchesMat function* has

been taken from a Stack Overflow Suggestion).

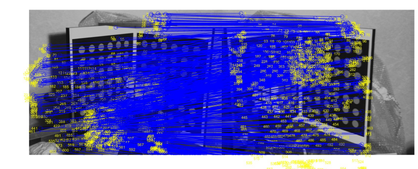
Figure 3: find matches SIFT comparison



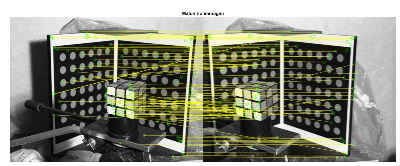
(find matches)



(Matlab function)



(find matches)

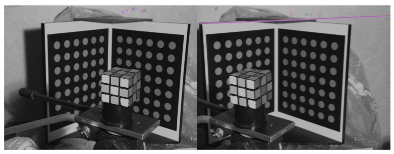


(Matlab function)

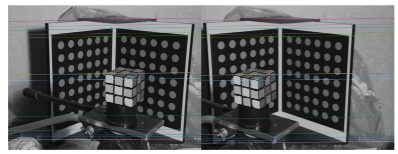
In the images before we could see that the left images don't have any good matches. Our our thinking was about the presence of lots of circle inside the images and the algorithms couldn't catch the same point in the other image.

The matches founded by the *findMatches function* are given as input parameters to the *Ransac function*. But having wrong matches, it is impossible to have the right computations of the *Ransac algorithm* to estimate the best Fundamental matrix F.
We think that the problem could be also the noise of the images (beyond the problems encountered with the *find matches function*), because the threshold used is 0.008 and we don't think that it can be too big (the noise and the threshold choice are the parameters that impact more in the *Ransac* computation).
As we could see also in the images, we calculate the epipolar constraints $(x')^T * F * x$ and the result is different to 0. The mean we calculate of all the point we try the constraint is about 2.955 instead of around 0.

Figure 4: ransac rubik comparison



(ransac)



(Matlab function)

In this last case on the left there is the solution obtain using *ransacF function*, and given as input the value of the *findMatches function*. So the result and the computation of the F matrix is wrong. In the right part there is the matlab built-in function we use for calculate the F matrix.