Fundamental Matrix Estimation

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The goal of this Lab is to learn about how to estimate the Fundamental Matrix using two methods, which are

(i) Linear least square solution with unit constraint on one entry of F

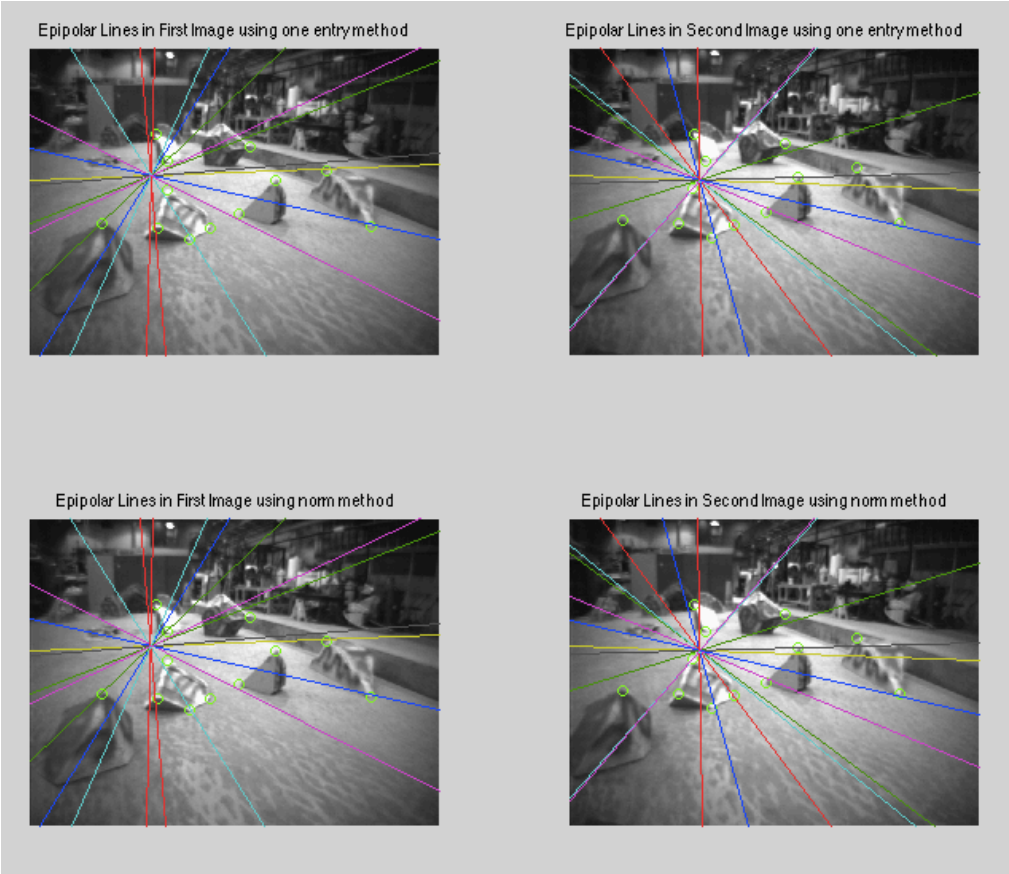
(ii) Linear least square solution with unit constraint on the norm of F

Then draw the Epipolar lines and calculate the Estimation Error.

Here are the results provided using above two methods for 4 sets (2 view-Images are equal to 1 set) of Images.

FOR 1ST SET OF IMAGES

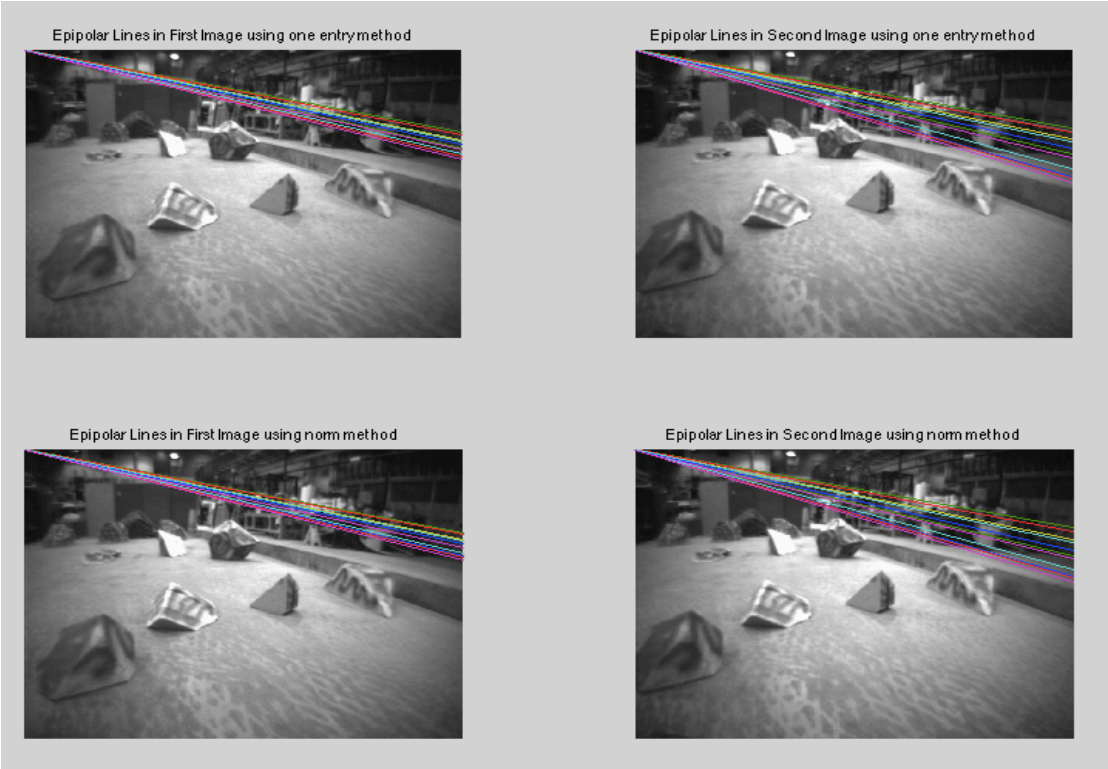
The below figure is without Normalization



These are the Fundamental Matrices and the Estimation Error

```
Fundamental Matrix by one entry of F method
   -0.0000   -0.0002    0.0488
    0.0002    0.0000   -0.0529
   -0.0498    0.0426    1.0000
Fundamental Matrix by norm of F method
   -0.0000   -0.0002    0.0490
    0.0002    0.0000   -0.0531
   -0.0500    0.0428    0.9952
The Estimation Error is
    0.0016
```

The below figure is with Hartley Normalization



These are the Fundamental Matrices and the Estimation Error

```
Normalised Fundamental Matrix by one entry of F method
    0.0041   -0.3499   -2.9846
    0.6303   -1.2695   11.2997
    2.8498  -11.3350    1.0002
Normalised Fundamental Matrix by norm of F method
    0.0040   -0.0441   -0.2502
    0.0381   -0.0487    0.9334
    0.2339   -0.9368    0.0228
The Estimation Error is
    0.0268
```

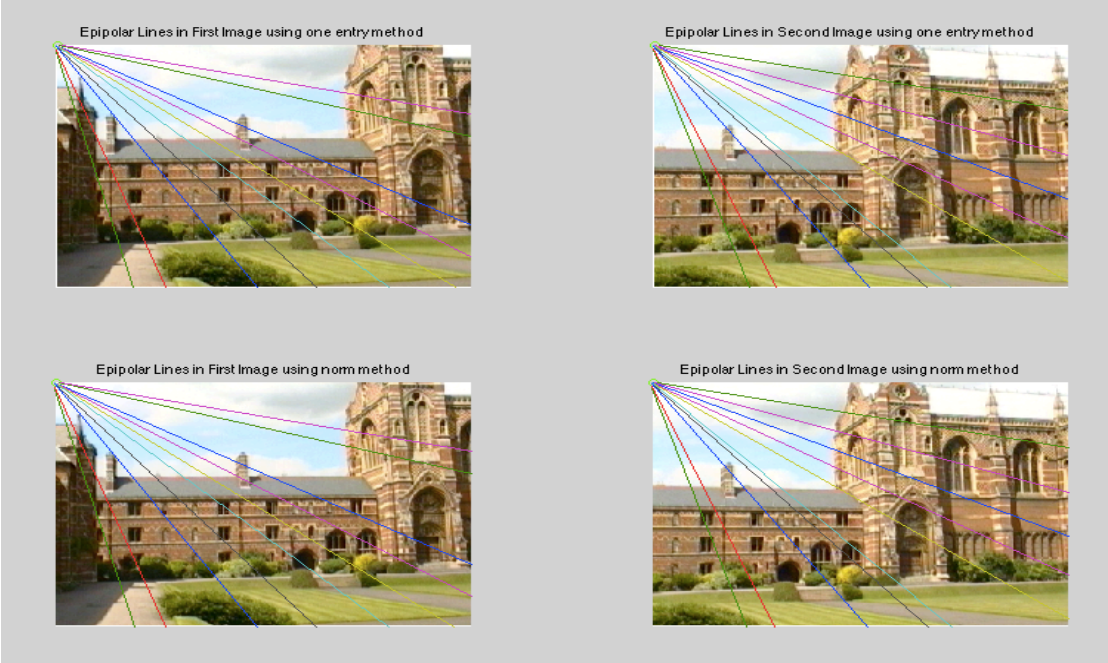
FOR 2nd SET OF IMAGES

The below figure is without Normalization

These are the Fundamental Matrices and the Estimation Error

```
Fundamental Matrix by one entry of F method
   -0.0000    0.0001   -0.0106
   -0.0001   -0.0000    0.0011
    0.0103   -0.0056    1.0000
Fundamental Matrix by norm of F method
    0.0000   -0.0001    0.0106
    0.0001    0.0000   -0.0011
   -0.0103    0.0056   -0.9999
The Estimation Error is
    0.0028
```

The below figure is with Hartley Normalization

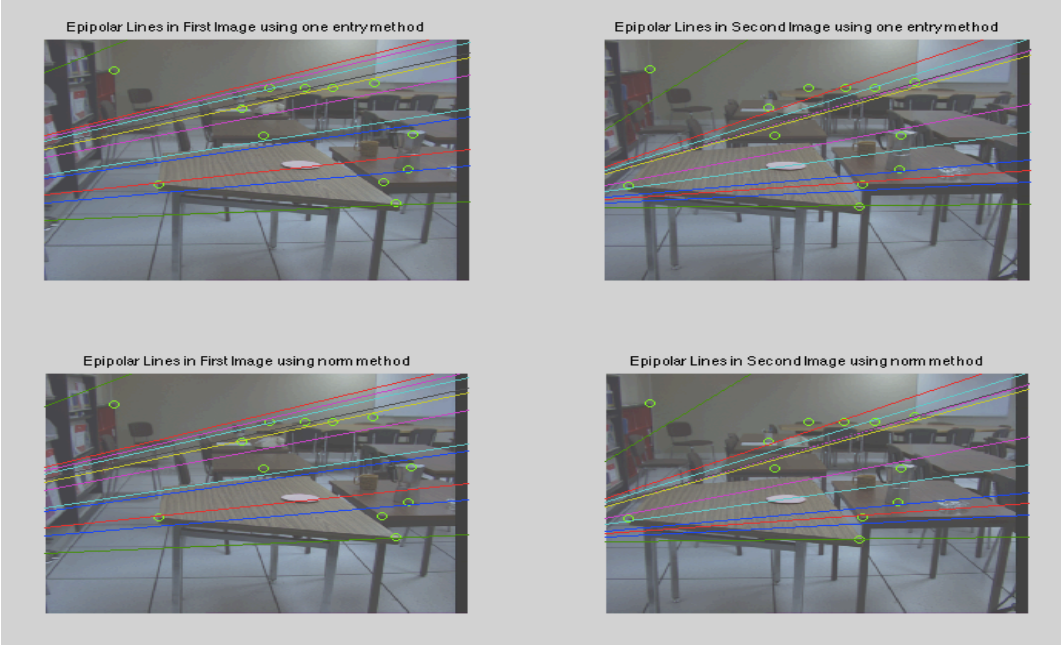


These are the Fundamental Matrices and the Estimation Error

```
Normalised Fundamental Matrix by one entry of F method
   -0.6725   12.2161   12.9282
  -11.9331   -0.4761  -24.9251
  -13.5513   24.5147    1.0272
Normalised Fundamental Matrix by norm of F method
   -0.0211    0.3921    0.4160
   -0.3881   -0.0116   -0.8062
   -0.4392    0.7907    0.0288
The Estimation Error is
    0.0346
```

FOR 3rd SET OF IMAGES

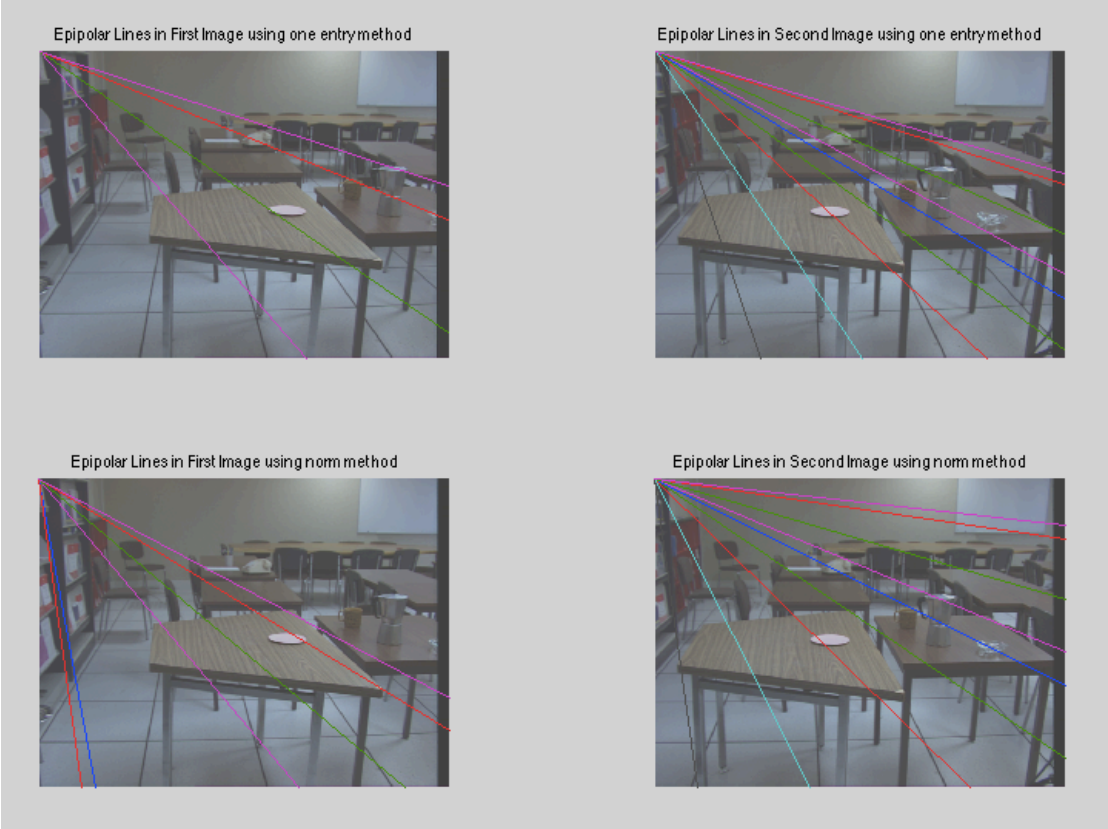
The below figure is without Normalization



These are the Fundamental Matrices and the Estimation Error

```
Fundamental Matrix by one entry of F method
    0.0000    0.0001   -0.0328
   -0.0001   -0.0001   -0.0205
    0.0248    0.0371    1.0000
Fundamental Matrix by norm of F method
   -0.0000   -0.0001    0.0324
    0.0001    0.0000    0.0217
   -0.0245   -0.0381   -0.9982
The Estimation Error is
    0.0042
```

The below figure is with Hartley Normalization

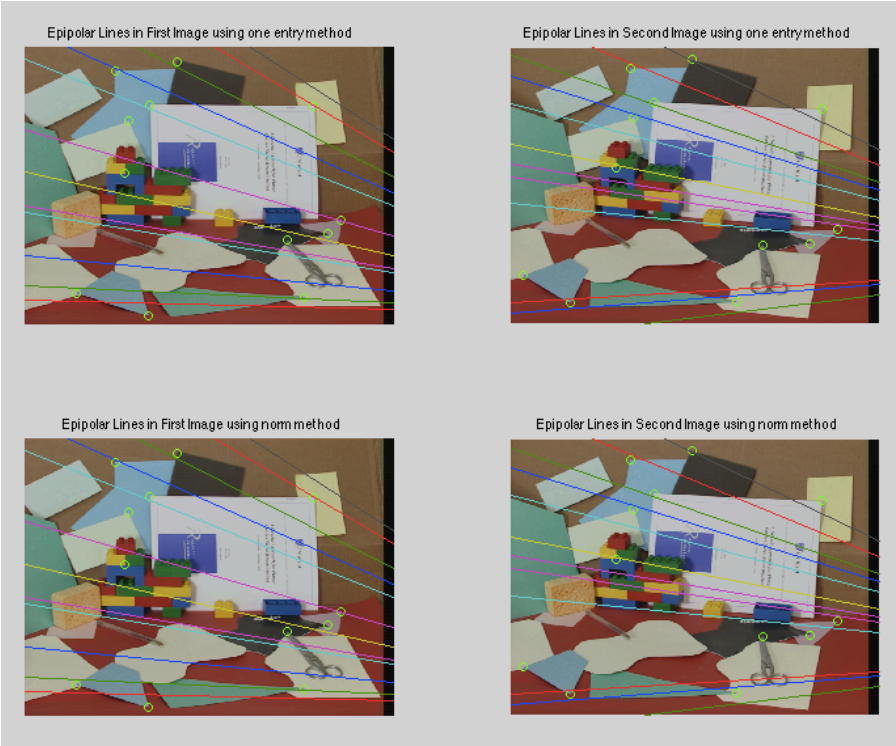


These are the Fundamental Matrices and the Estimation Error

```
Normalised Fundamental Matrix by one entry of F method
   -0.5334  -12.5999    4.8887
   12.1714    5.8323   -5.2958
   -5.4259    2.3438    0.4959
Normalised Fundamental Matrix by norm of F method
    0.1456   -0.8615    0.2879
    0.8265    0.2291   -0.2966
   -0.4413    0.2389    0.0221
The Estimation Error is
    0.4892
```

FOR 4th SET OF IMAGES

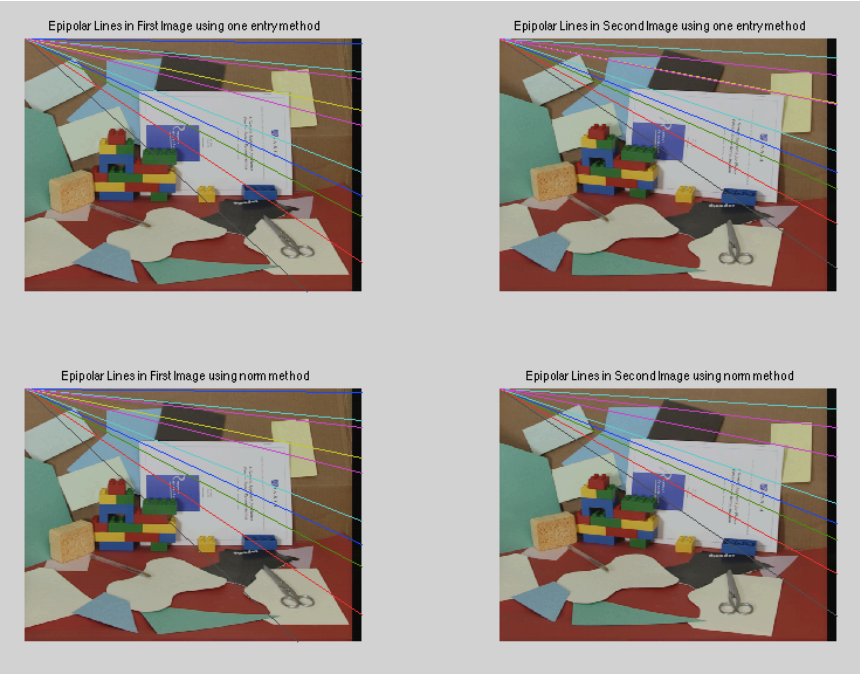
The below figure is without Normalization



These are the Fundamental Matrices and the Estimation Error

```
Fundamental Matrix by one entry of F method
    0.0000   -0.0000    0.0068
    0.0000    0.0000   -0.0213
   -0.0087    0.0190    1.0000
Fundamental Matrix by norm of F method
   -0.0000    0.0000   -0.0068
   -0.0000   -0.0000    0.0213
    0.0087   -0.0190   -0.9995
The Estimation Error is
    0.0018
```

The below figure is with Hartley Normalization



These are the Fundamental Matrices and the Estimation Error

```
Normalised Fundamental Matrix by one entry of F method
    0.1060   -2.5474    1.7910
    2.1824    0.3175   -8.4485
   -2.1708    8.2762    1.0242
Normalised Fundamental Matrix by norm of F method
    0.0115   -0.2885    0.2048
    0.2351    0.0598   -0.9321
   -0.2340    0.9173    0.0888
The Estimation Error is
    0.1827
```

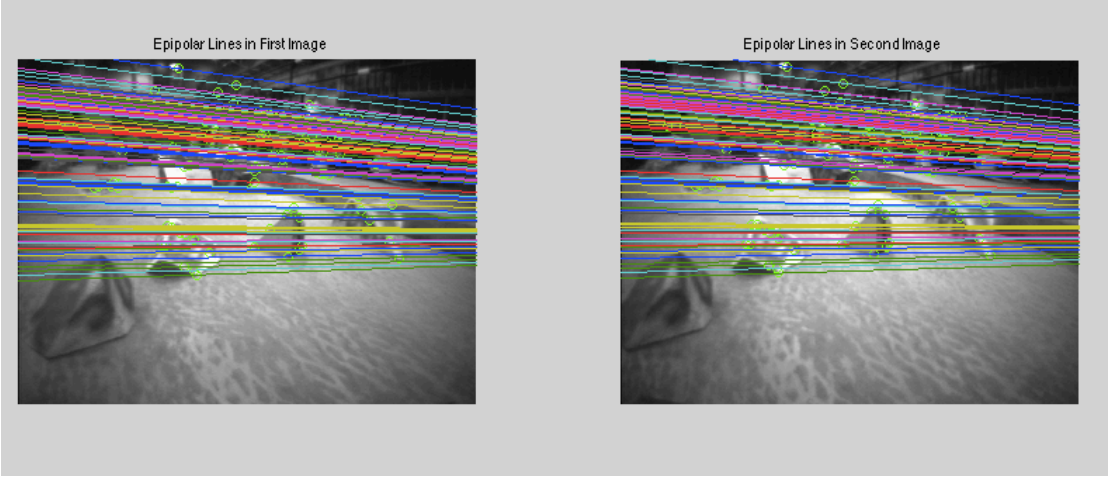
I think I have some drawbacks in the result figures because of my point selection.

Epipolar lines and Fundamental Matrix using Least Median of Squares Method

The Fundamental Matrix is given below

-0.0000	0.0002	-0.0484
-0.0002	0.0000	0.4022
0.0514	-0.4052	0.8345

The epipolar lines are given below for 1 set of Images



The advantages of the using the estimation methods are its simplicity for implementation and computational efficiency, but some methods are sensitive to noises in the point correspondences. This problem is especially serious when there are outliers in the point or feature correspondences. There are some robust estimation approaches to solve this kind of problems but they have some limitations.