Assignment4 - 16720 Computer Vision

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1 Part I

1.1 Q1.2

Since the principal points O and O' are only shifted by some τ_x they are parallel to x. For simplicity, assume that the cameras are normalized. Then, the essential matrix would be:

$$E = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & -\tau_x \\ 0 & \tau_x & 0 \end{bmatrix} \tag{1}$$

Since, $l_1 = p_2^T E = [0, a, b]$ and $l_2 = p_1^T E = [0, a', b']$, clearly these lines are parallel to x axis.

1.2 Q1.3

The reflection we capture from the mirror is the same as having a camera capturing a picture to the point that the reflection is located in the mirror. We have that (using the same labels as in the lectures):

$$p^T F p' = 0 \tag{2}$$

And because of the symmetry of the viewing, namely the angles that they form are equal and the view that we get from the first (original camera) can be thought of as the reflected image on a mirror, we get:
$p'^T F p = 0$
Translating both parts of the last equation and comparing with the first we get that $F^T = F$.

2 Part II

2.1 Q2.1

```
    0.0000   -0.0000   -0.0006
F = 0.0000    0.0000   -0.0006
    0.0007    0.0007   -0.0278
```

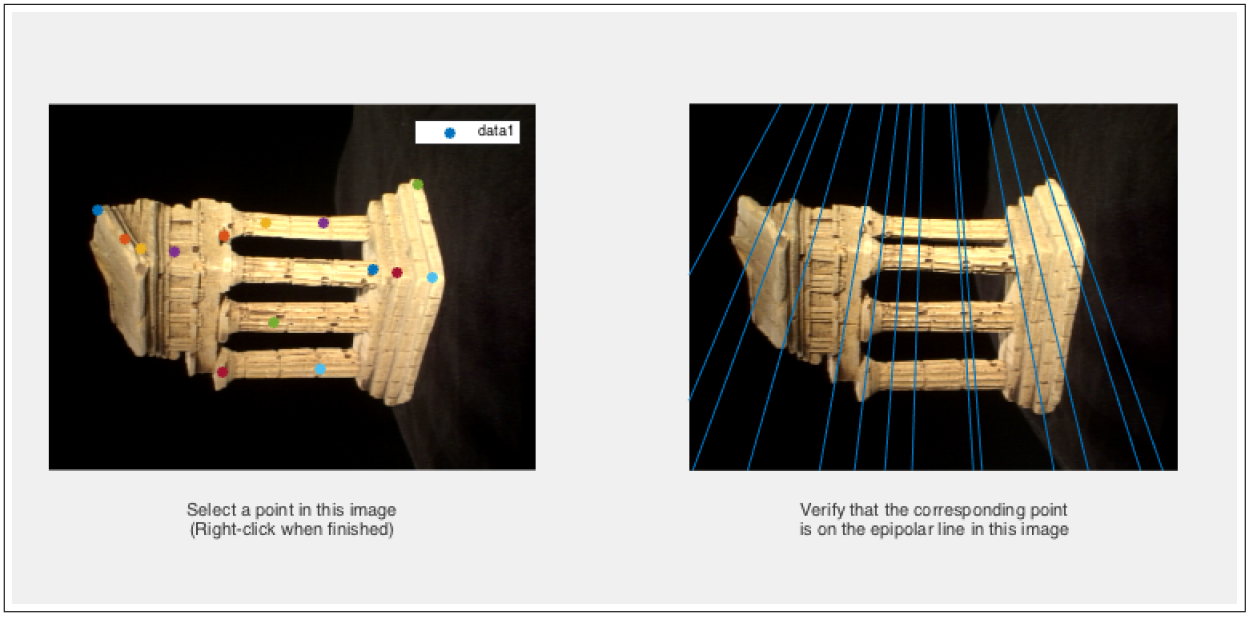


Figure 1: Output of eight point algorithm.

2.2 Q2.2

```
F = 0.0000   -0.0000   -0.0003
    0.0000    0.0000   -0.0003
    0.0003    0.0003   -0.0085
```

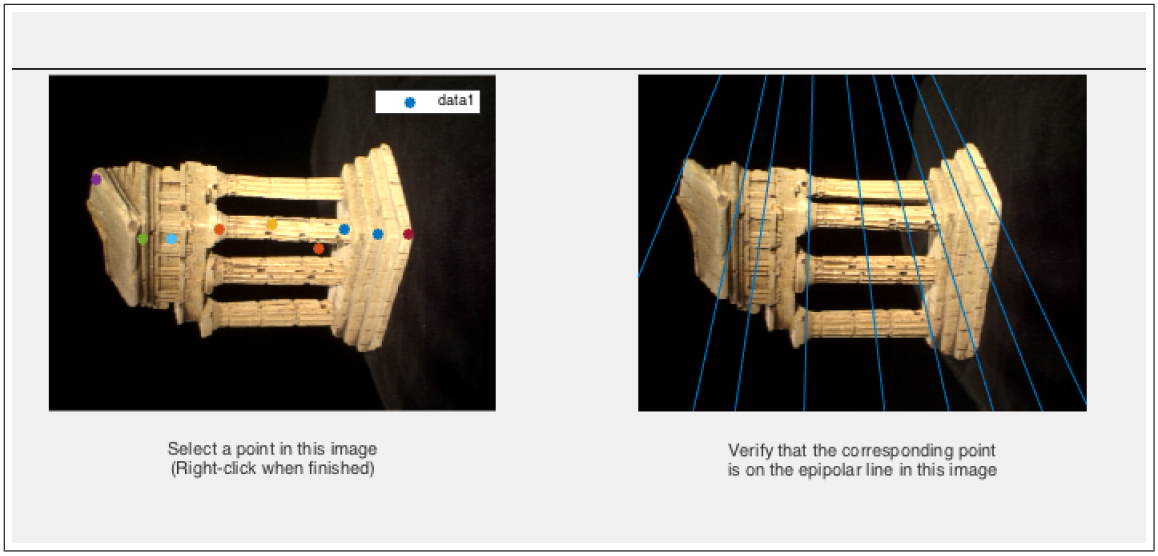


Figure 2: Output of seven point algorithm

2.3 Q2.X

The error function is simply $p_1^T F p_2 = 0$ where p_1 and p_2 are points in the two images. The inliers are all those that are close to within a small threshold close to 0.

2.4 Q2.3

```
E = 0.0066   -4.5883   -1.6937
    4.3096    0.2121   -0.0468
    1.7443    0.1373    0.0000
```

2.5 Q2.6

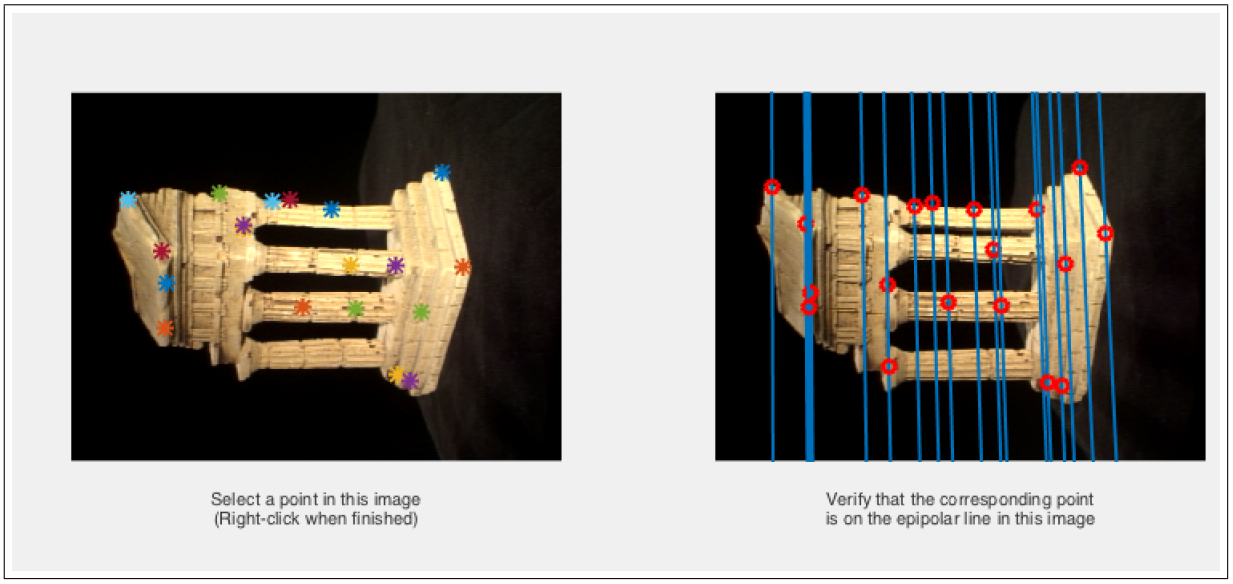
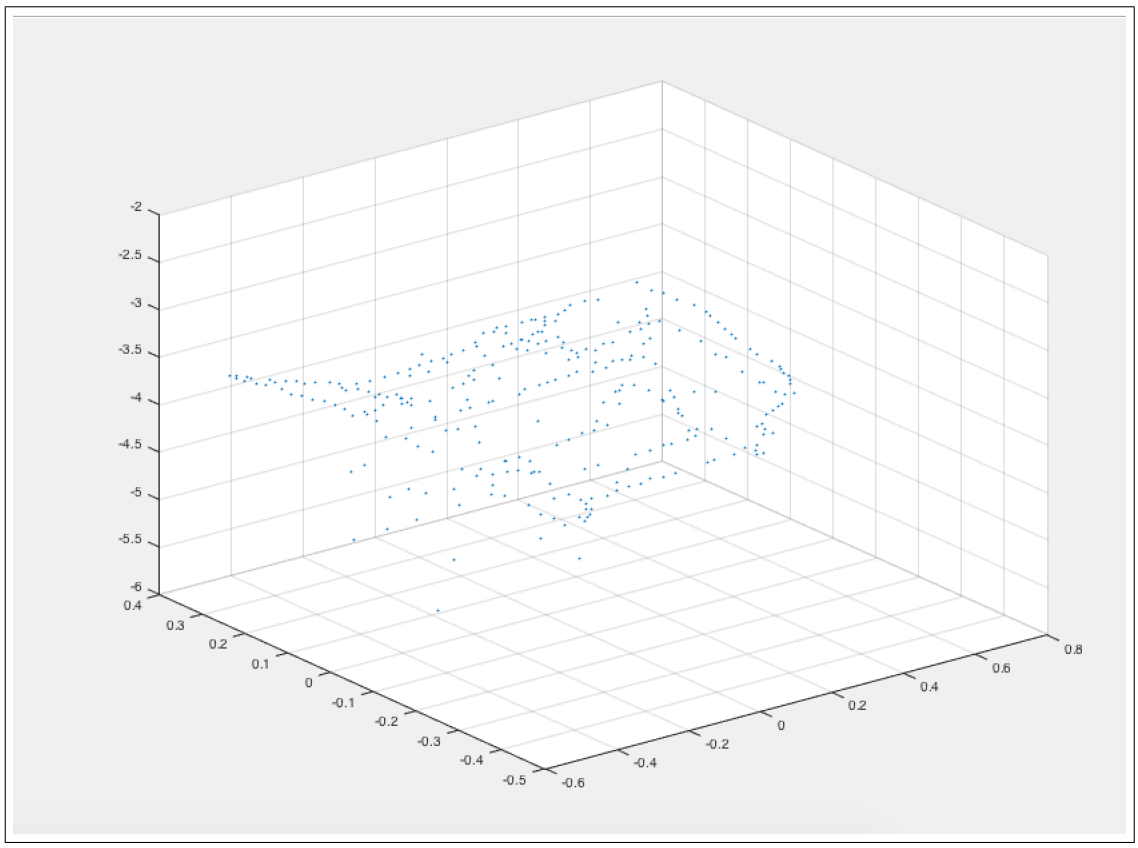
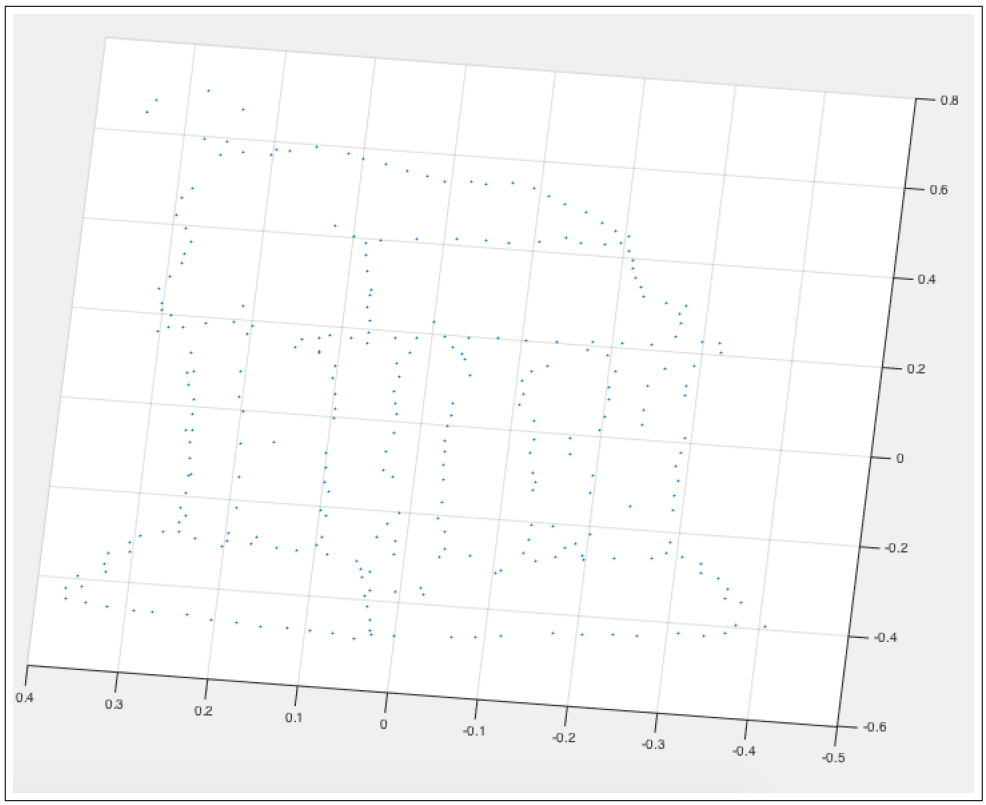
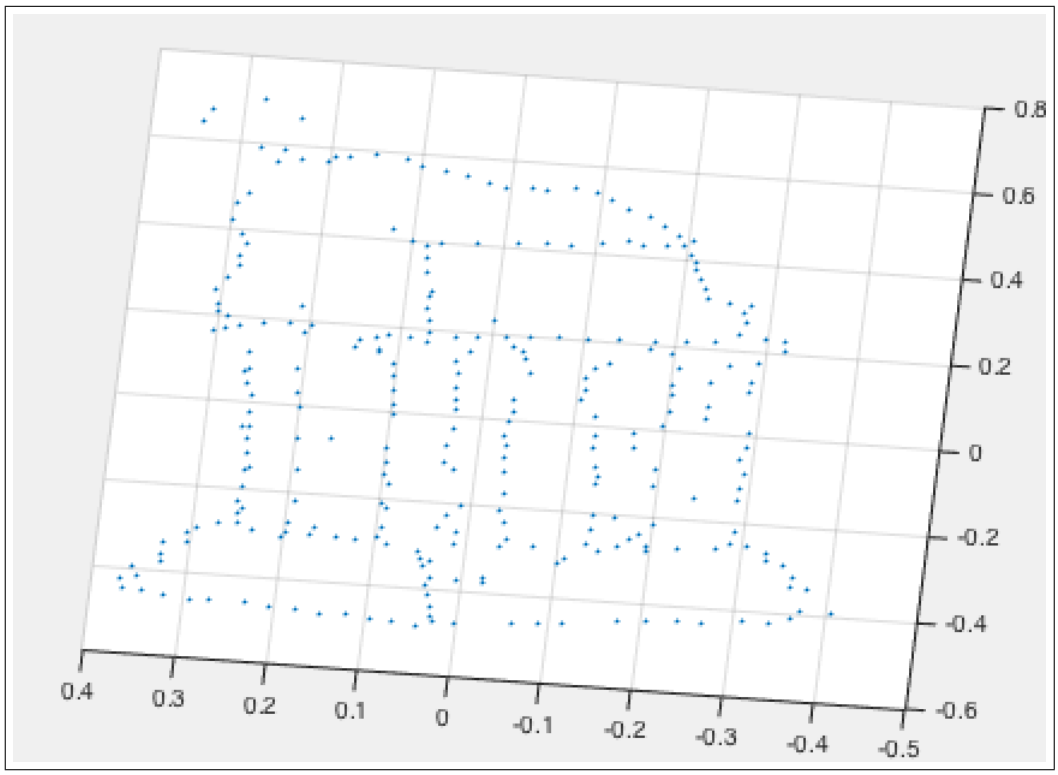


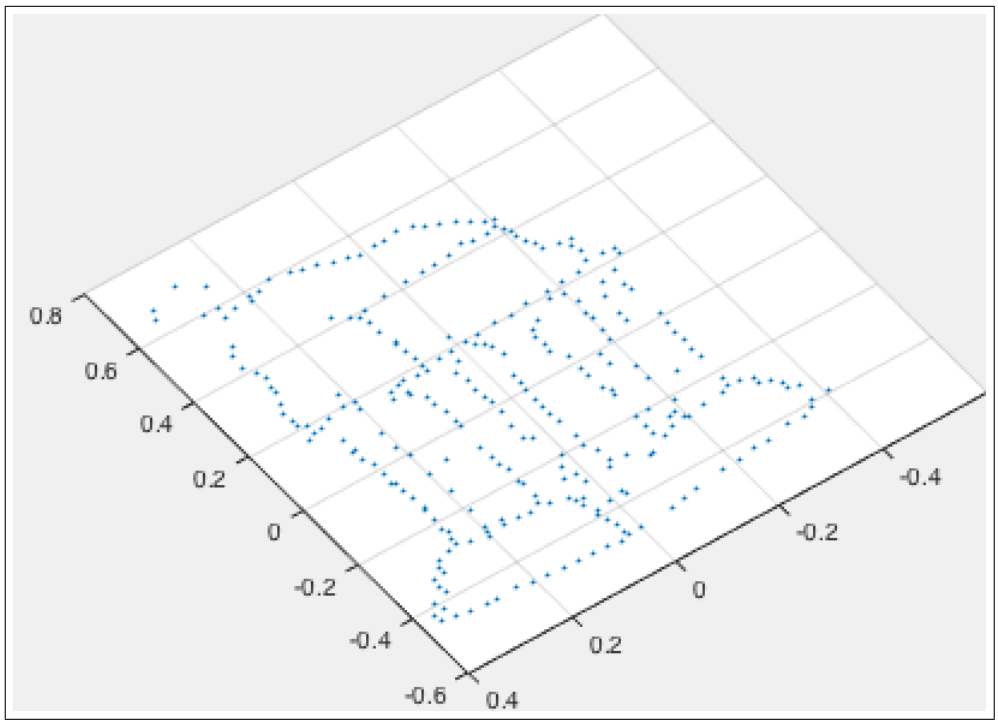
Figure 3: Epipolar matches

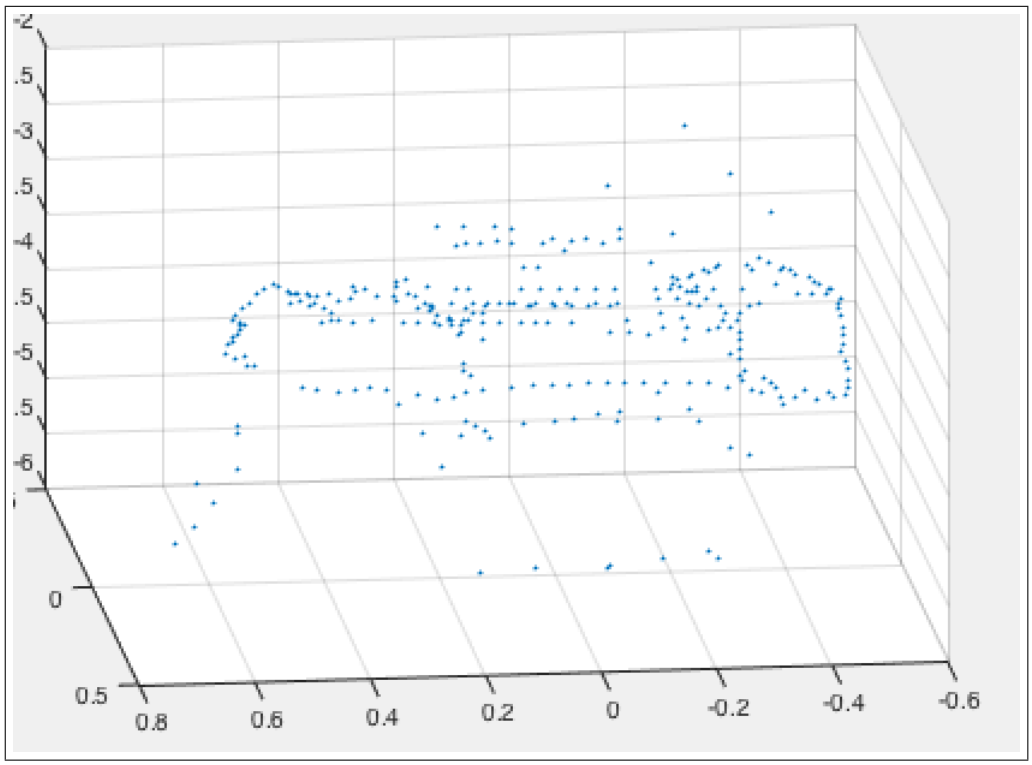
2.6 Q2.7




0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5


0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5


0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0.4
0.2
0
-0.2
-0.4


-2
.5
-3
.5
-4
.5
-5
.5
-6
0
0.5
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6