Assignment 5

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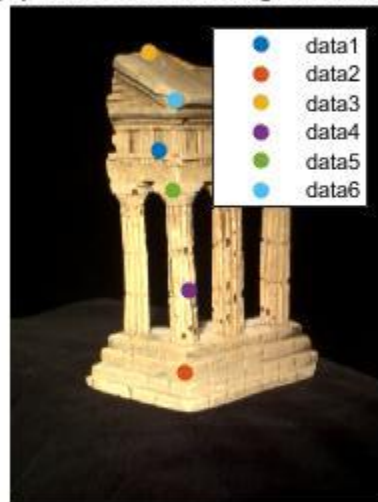
3.1.1

The recovered fundamental matrix is

$F =$

```
    0.0000   -0.0000   -0.0000
   -0.0000   -0.0000    0.0005
    0.0000   -0.0005   -0.0018
```

Below is the visualization of epipolar lines

Epipole is outside image boundary   Epipole is outside image boundary

data1
data2
data3
data4
data5
data6

Select a point in this image   Verify that the corresponding point
(Right-click when finished)   is on the epipolar line in this image

3.1.2

- The similarity metric here is calculated using Euclidean distance based on the difference of RGB values of different windows.
- Obvious mismatchings often happen on the poles. One possible explanation is that the similarity score is based on the RGB value inside the window. As the black ground is

black and its value is 0, one miss-matched background element would have a huge influence and the algorithm will try to save one miss matched background point rather than having more similar brighter points.

Select a point in this image
(Right-click when finished)
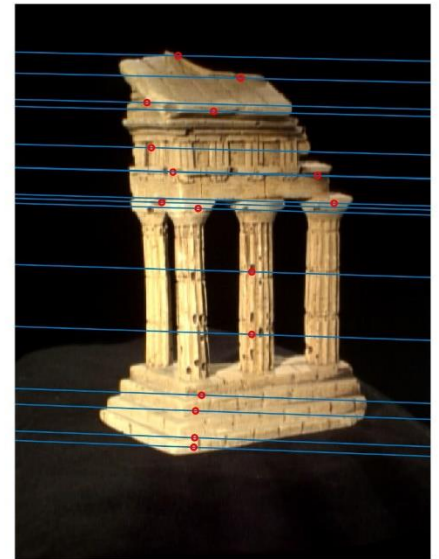
Verify that the corresponding point
is on the epipolar line in this image

3.1.3

The estimated essential matrix is:

$$
E =
\begin{bmatrix}
0.0044 & -0.0400 & -0.0207 \\
-0.1543 & -0.0009 & 0.7253 \\
-0.0002 & -0.7343 & -0.0013
\end{bmatrix}
$$

3.1.4

- There are 4 extrinsic matrixes to choose from after passing the essential matrix to camera2() function.
- The correct extrinsic matrix is the one that returns the greatest number of correspondences. In this case, the 4th extrinsic matrix is the correct one as it has 288 correspondences.
- The re-projection error calculated using mean Euclidean is 0.6003 for pts1 and 0.6063 for pts2.
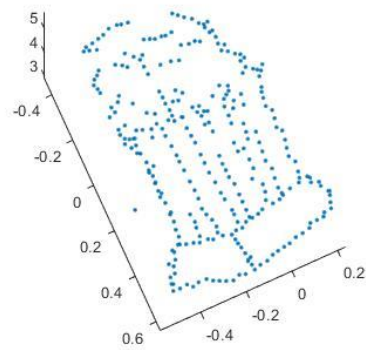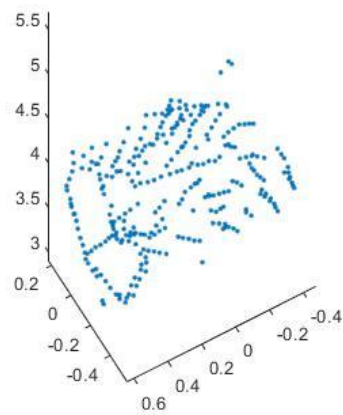
```
pts_err1 =

    0.6003


pts_err2 =

    0.6063
```
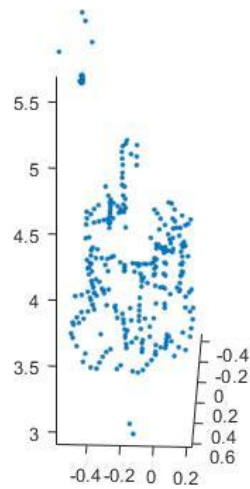
3.1.5

Front side view of the reconstruction:
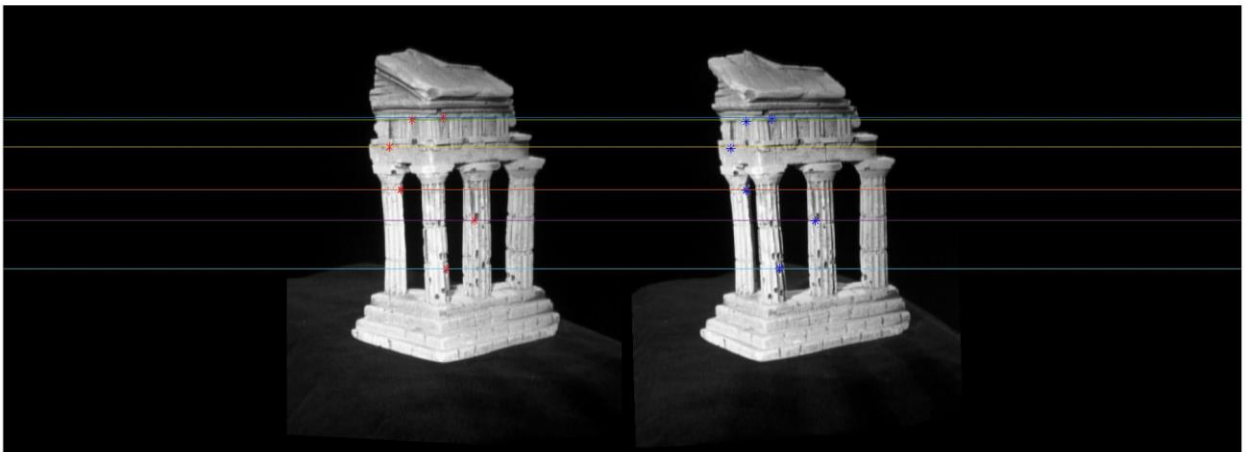

Side view of the reconstruction:

Top-bottom view of the reconstruction:

3.2.1

Below is the result of running testRectify.m on temple images. As shown below, epipolar lines are horizontal and points are lying on the same line.
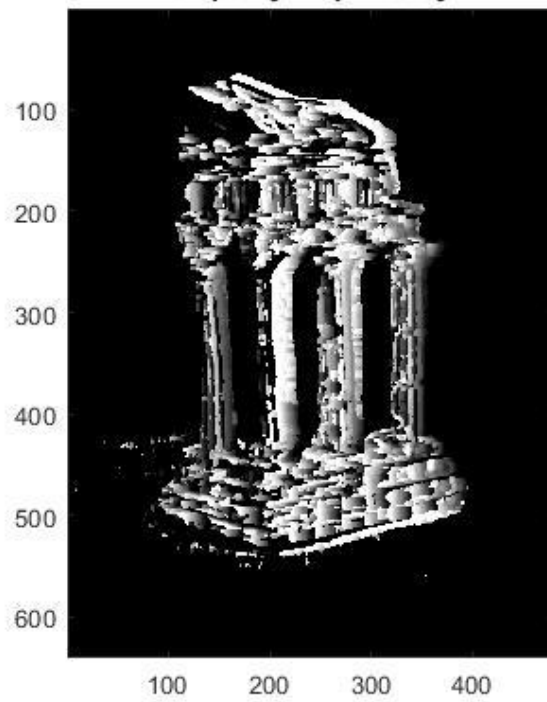

3.2.2

After several experimenting with windows size, the optimal cropping coordinate for the left rectified image is [445 0 480 640], and the optimal cropping coordinate for the right rectified image is [40 0 480 640]. Below are the result images of the disparity map without and with using the rectified images.
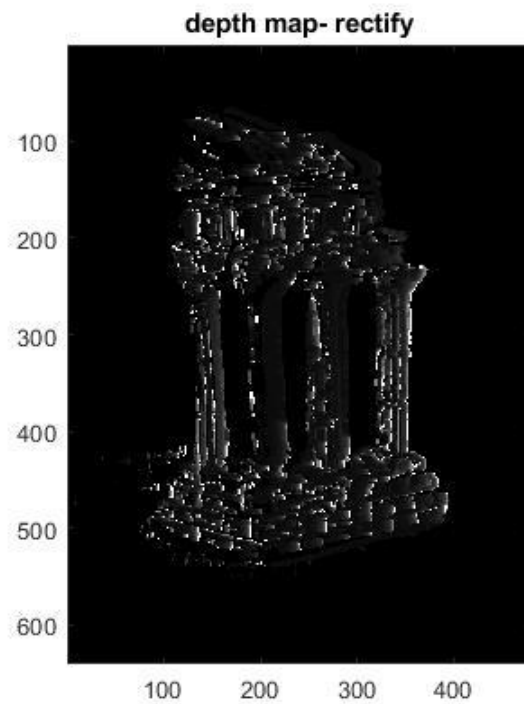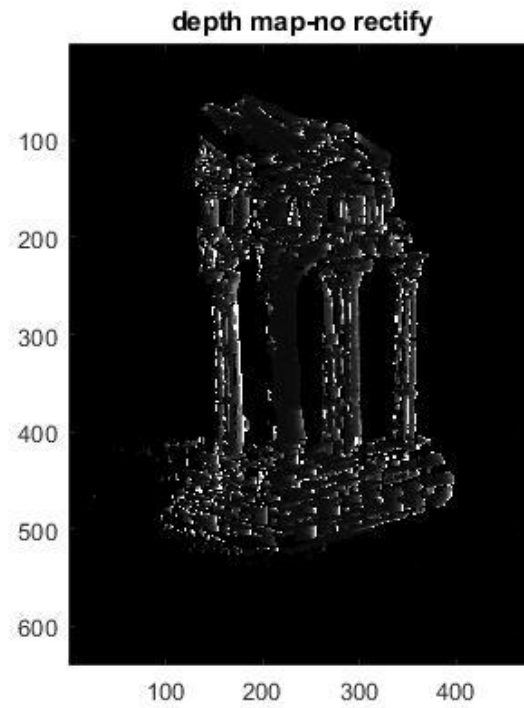
disparity map-no rectify
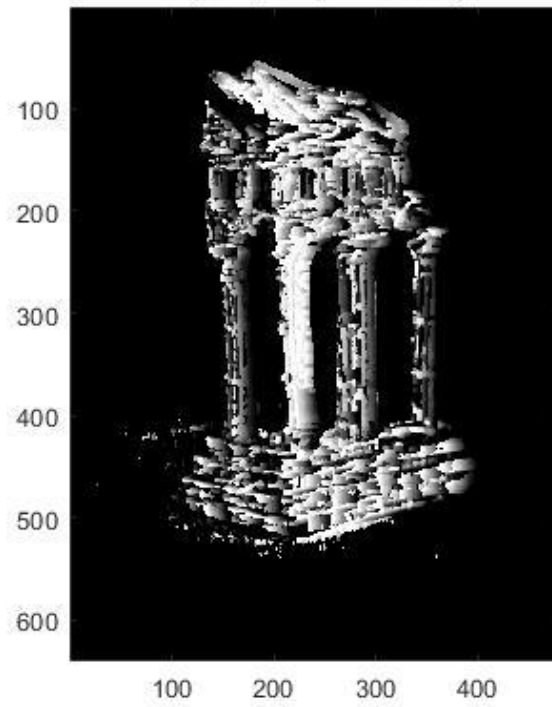
disparity map- rectify

3.2.3

Below are the result images of the depth map without and with using the rectified image.

depth map-no rectify

depth map- rectify

3.3.1

The error of estimated camera matrix P is shown below:

```
Reprojected Error with clean 2D points is 0.0000
Pose Error with clean 2D points is 0.0000
------------------------------
Reprojected Error with noisy 2D points is 2.7919
Pose Error with noisy 2D points is 0.4982
```

The error of estimated K,R, and t is shown below:

3.3.2

```
Intrinsic Error with clean 2D points is 0.0000
Rotation Error with clean 2D points is 0.0000
Translation Error with clean 2D points is 0.0000
------------------------------
Intrinsic Error with noisy 2D points is 0.5541
Rotation Error with noisy 2D points is 0.0901
Translation Error with noisy 2D points is 0.1712
```

3.3.3

The image is annotated with given 2D points (red points) and projected 3D points (blue circles)
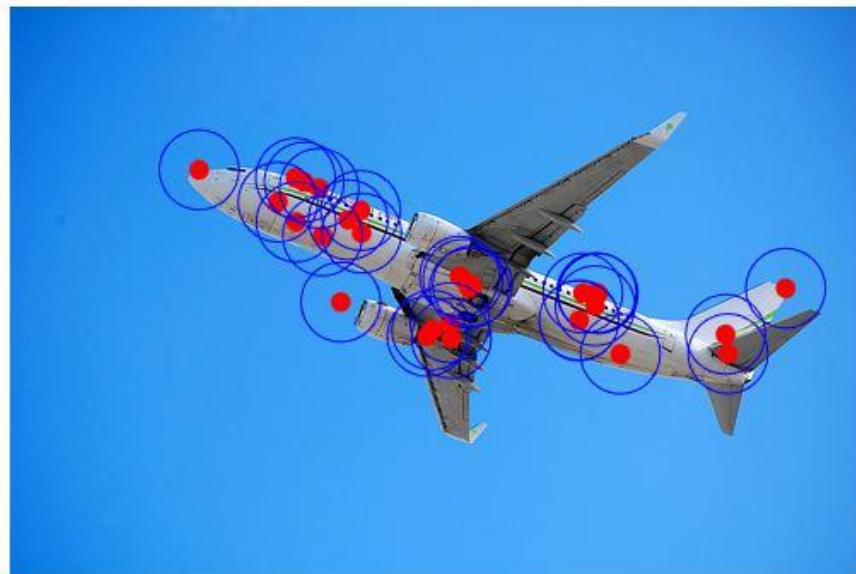
The image below is the demonstration of the CAD model rotated by estimated R.
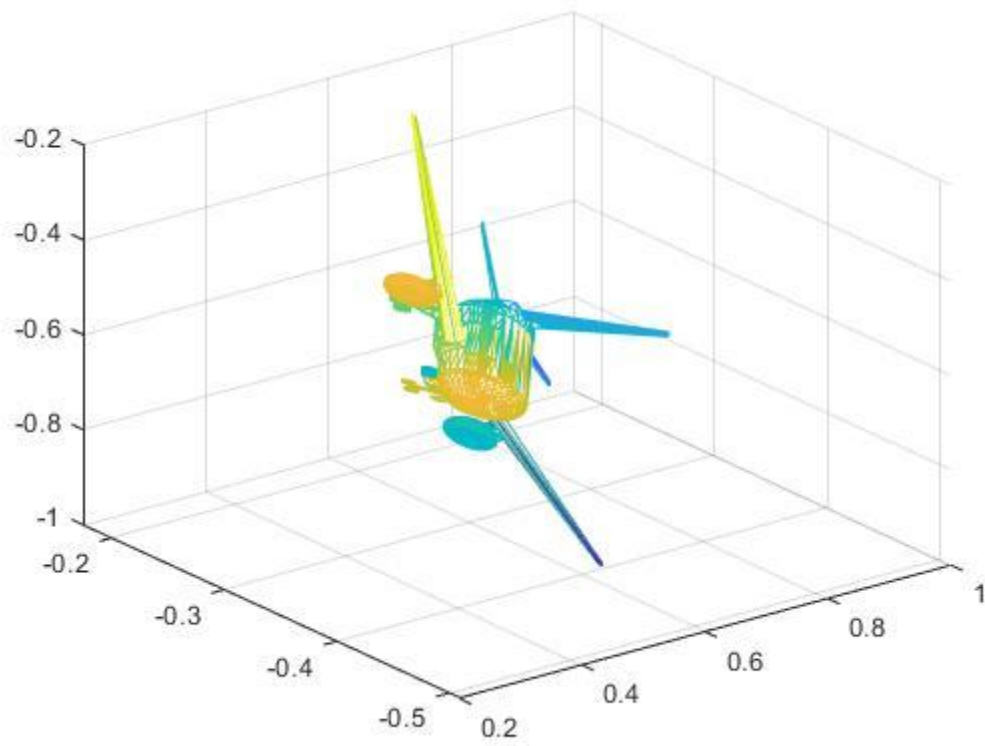
The image below is the demonstration of the CAD model overlapping with the image.