Project 3
3D Reconstruction

I would like to use 1 free day late submission for this assignment

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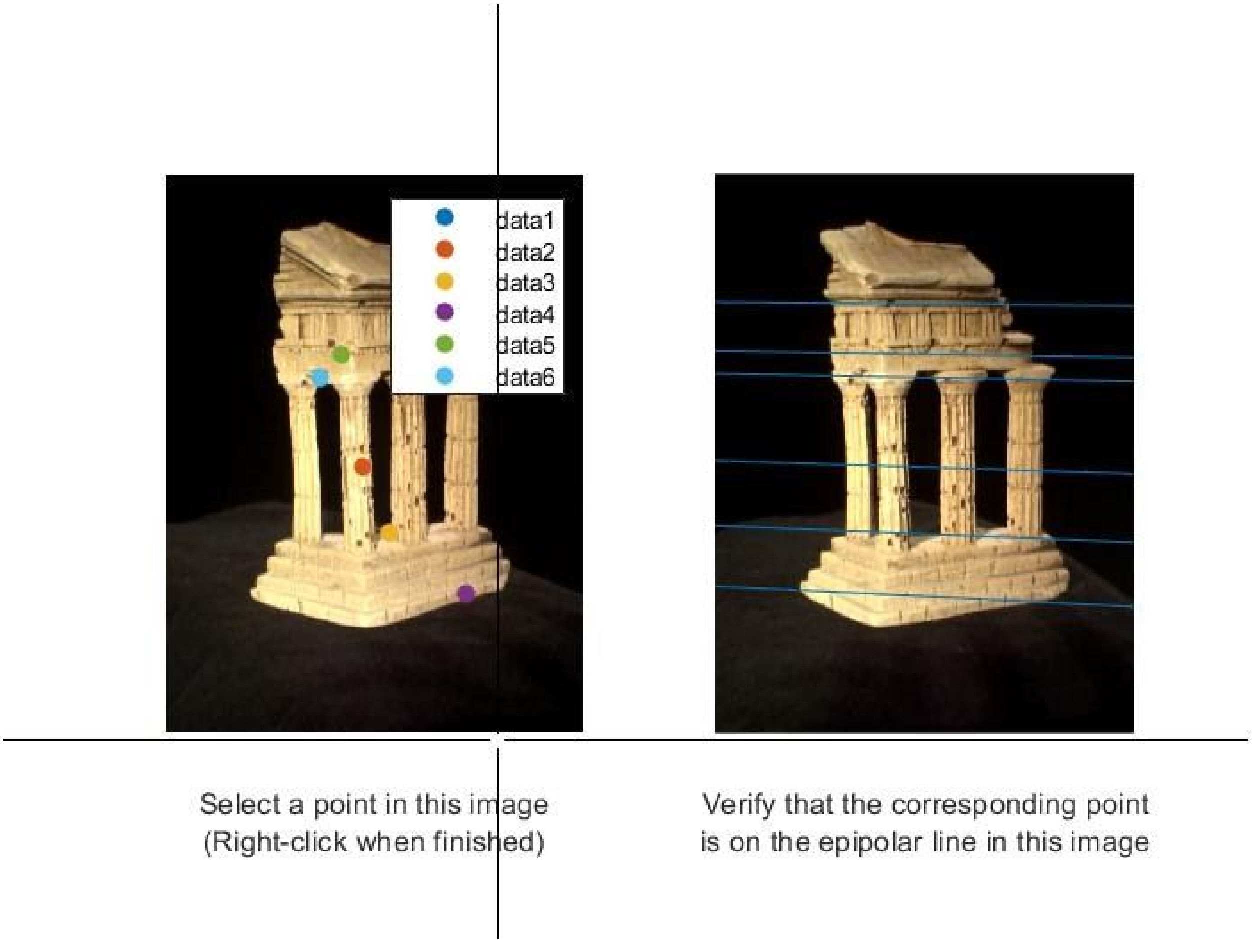
Due date: 23:59 Tuesday 3/3rd (2020)

3. Tasks

3.1 Sparse reconstruction

Here is the fundamental matrix:
F =

```
    0.0000   -0.0000   -0.0000
   -0.0000   -0.0000    0.0007
    0.0000   -0.0007   -0.0025
```



Select a point in this image
(Right-click when finished)

Verify that the corresponding point
is on the epipolar line in this image

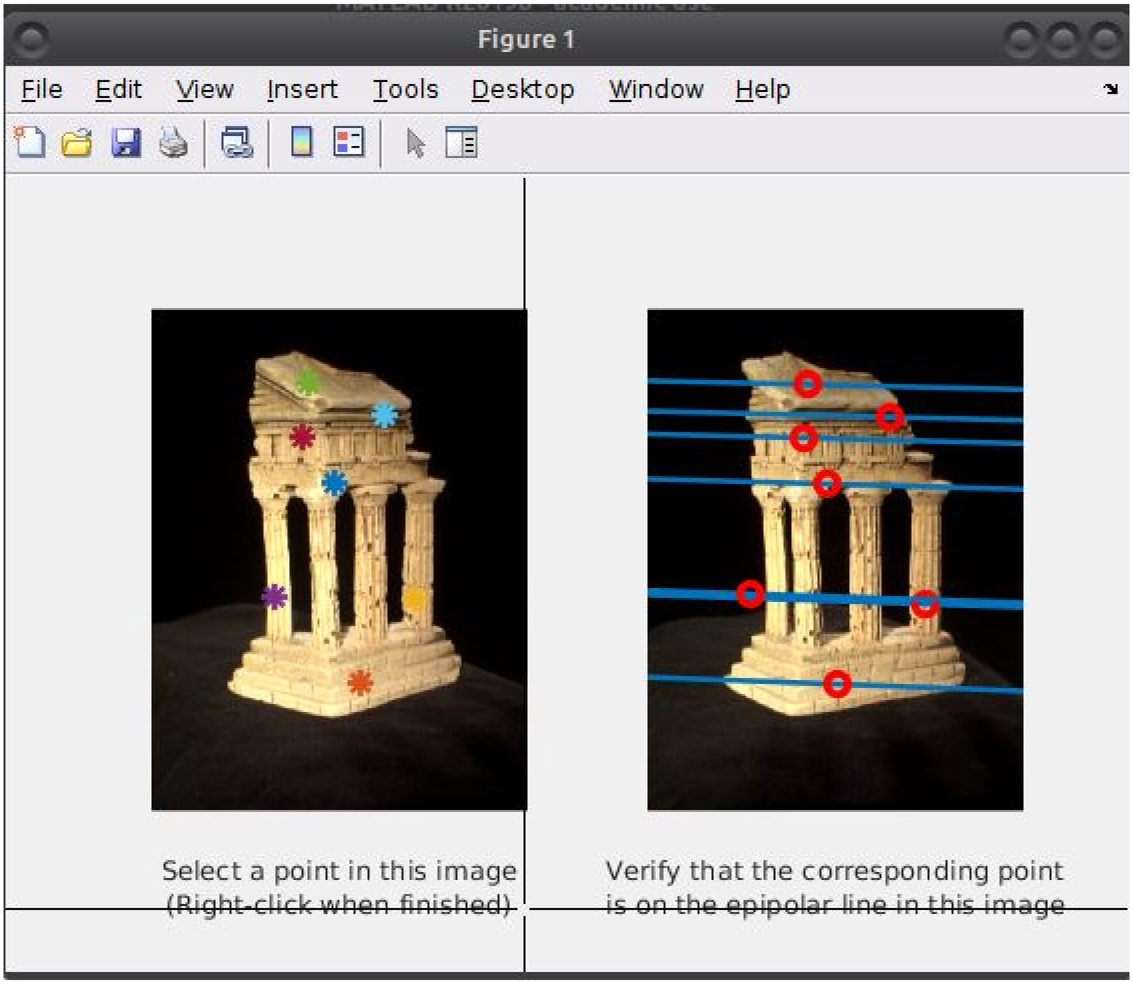
3.1.2 Find epipolar correspondences (2 pts)

In your write-up, include a screenshot of epipolarMatchGui running with your implementation of epipolarCorrespondence. Mention the similarity metric you decided to use. Also comment on any cases where your matching algorithm consistently fails, and why you might think this is.

I used euclidean distance of the two window for checking the similarity:

```
        error= sum(sqrt((toCheck1(:,1)-toCheck2(:,1)).^2 + (toCheck1(:,2)-toCheck2(:,2)).^2));
```

I used a gaussian filter to blur the images so that the result would be more accurate.



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 Write a function to compute the essential matrix (2 pts)

In your write-up, write your estimated E matrix for the temple image pair we provided.

```
E =

    0.0060   -0.0550   -0.0285
   -0.2122   -0.0013    0.9975
   -0.0003   -1.0098   -0.0018
```

3.1.4 Implement triangulation (2 pts)

In your write-up, describe how you determined which extrinsic matrices is correct. Report your re-projection error using pts1, pts2 from someCorresp.mat. If implemented correctly, the re-projection error should be less than 1 pixel.

I knew that the z coordinates of the 3d points should be positive, so I summed over all of these values for the 4 set of 3D points and the one with the maximum value would be the answer.

My final errors were 0.5786 for projection 1 and 1.0559 for projection 2. The second error is a bit high but since I got good result with my implementation I decided to not change my code any further.

3.1.5 Write a test script that uses templeCoords (2 pts)

In your write-up, include 3 images of your final reconstruction of the templeCoords points, from different angles.

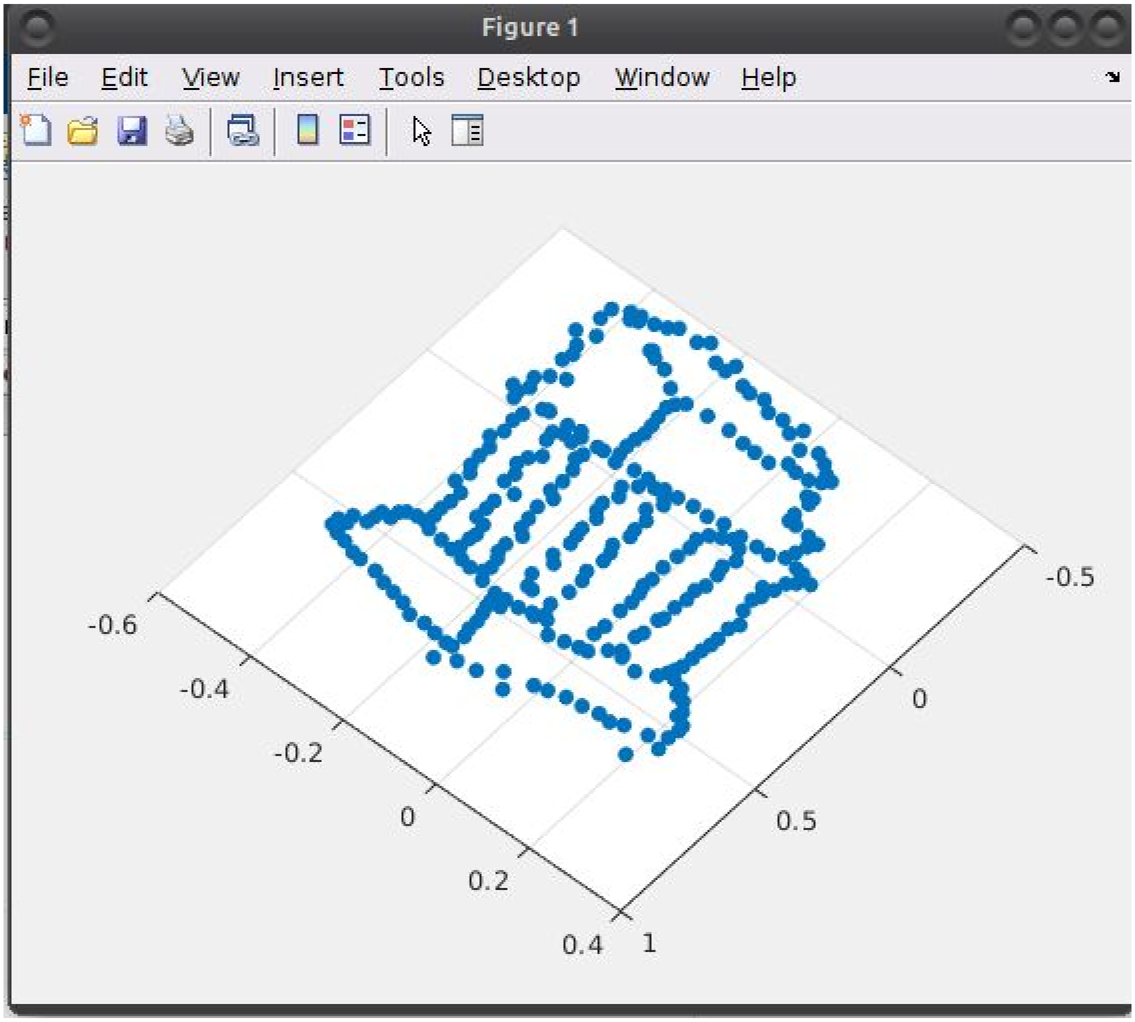


Figure 1
File
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Tools
Desktop
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Help
-0.6
-0.4
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1

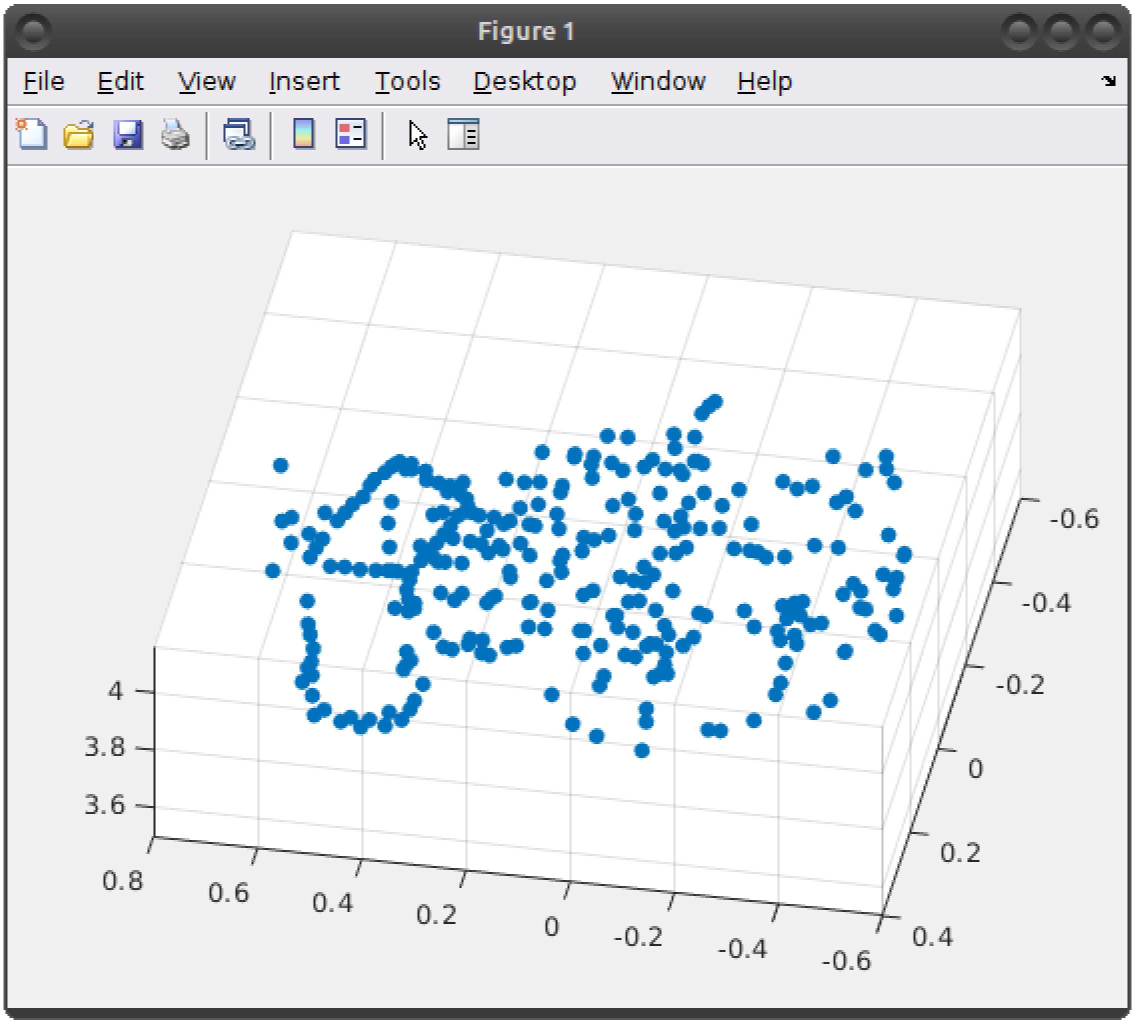
Figure 1
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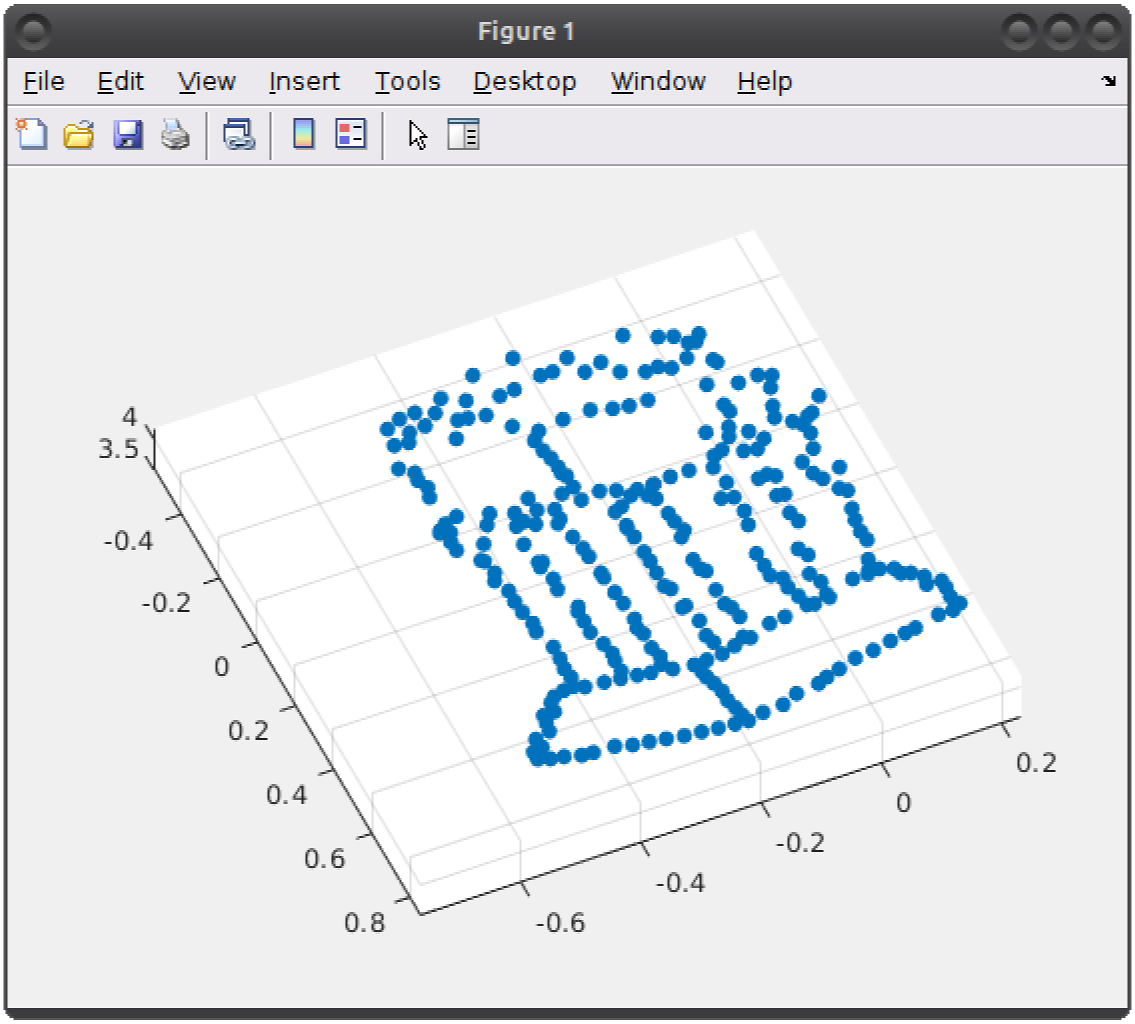
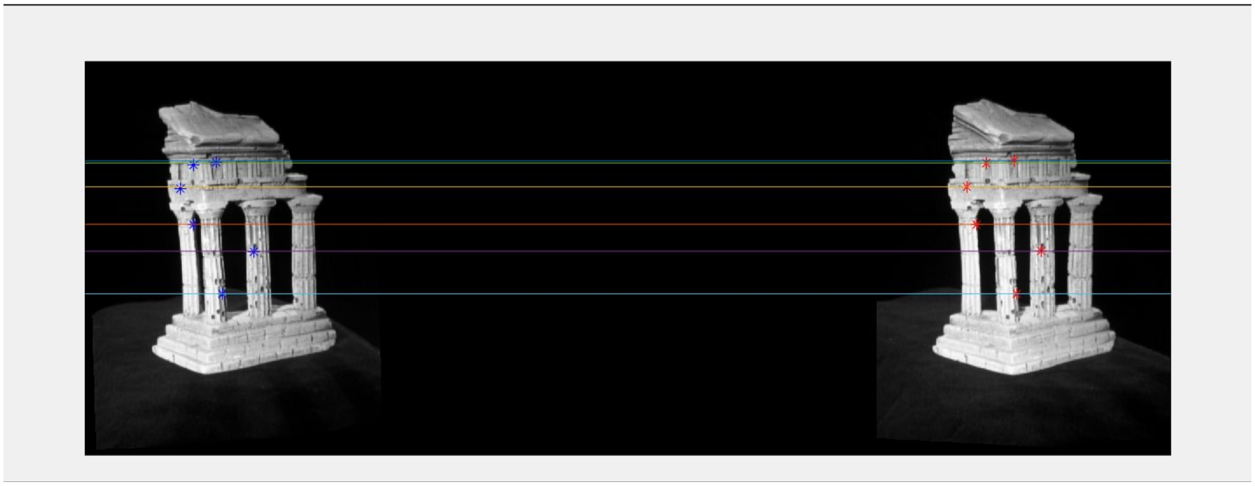


3.2 Dense reconstruction

3.2.1 Image rectification (2 pts)

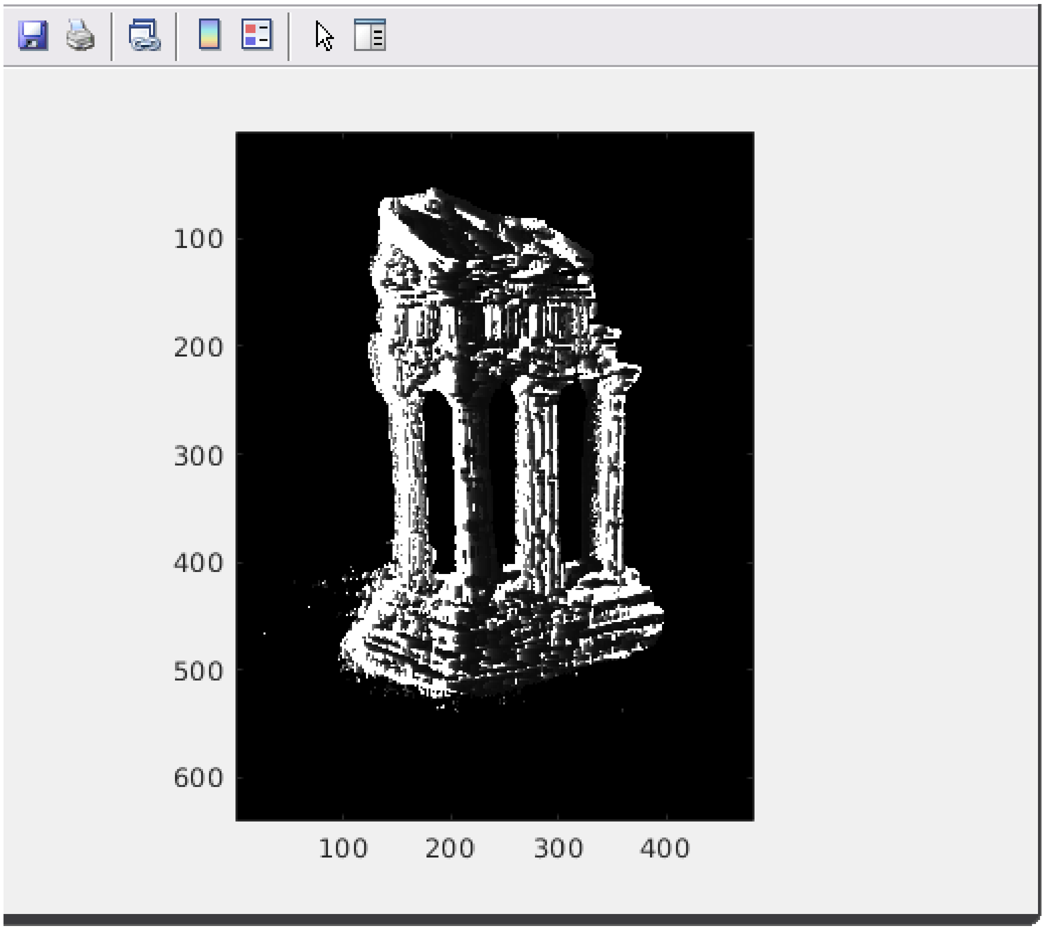
In your write-up, include a screenshot of the result of running testRectify.m on temple images. The results should show some epipolar lines that are perfectly horizontal, with corresponding points in both images lying on the same line.



3.2.2 Dense window matching to find per pixel density (2 pts)

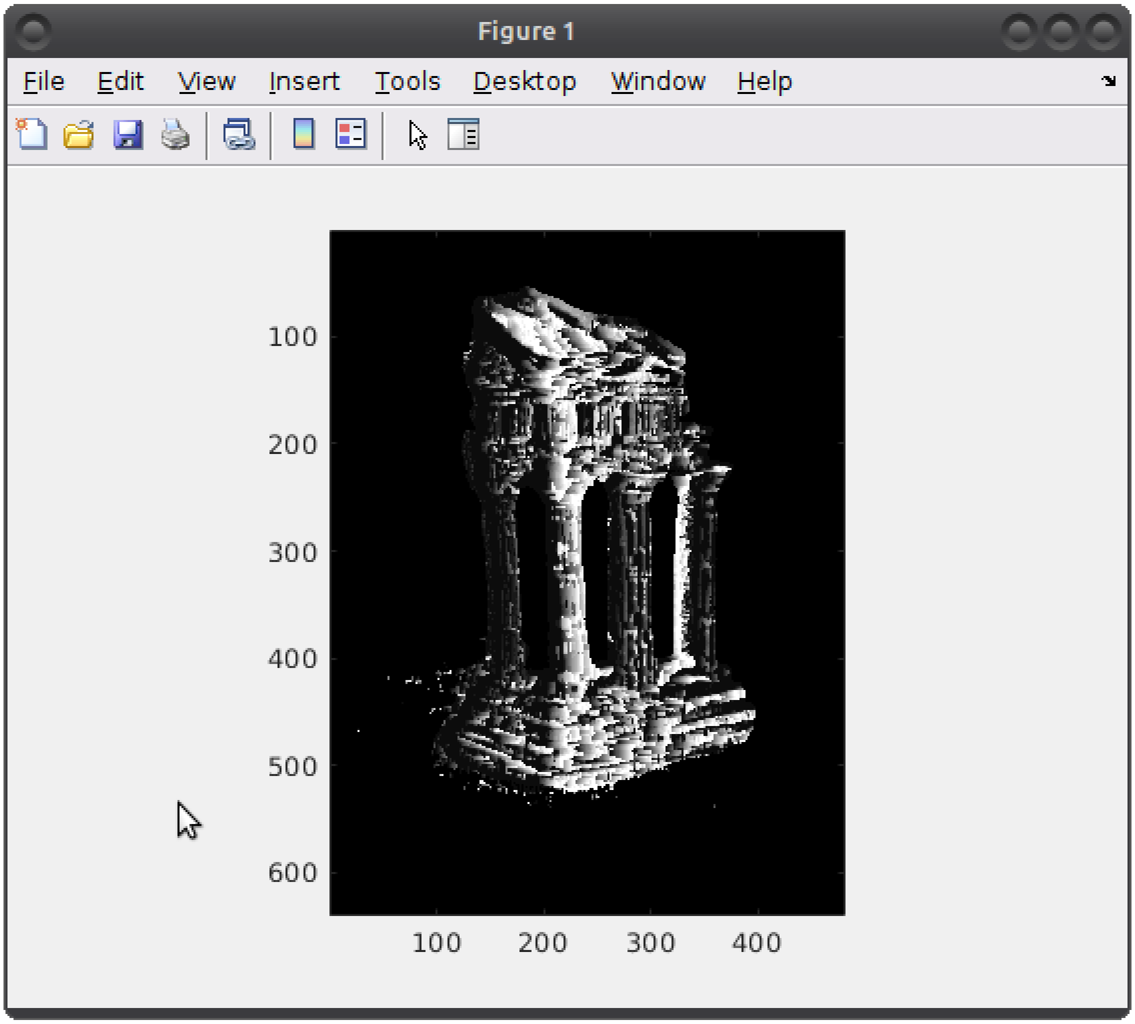
3.2.3 Depth map (2 pts)

In your write-up, include images of your disparity map and your depth map.



Depth map:

Disparity map:



3.3 Pose estimation

3.3.1 Estimate camera matrix P (2 pts)

In your write-up, include the output of the script testPose.

```
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 1.5716
Pose Error with noisy 2D points is 0.0391
```

3.3.2 Estimate intrinsic/extrinsic parameters (2 pts)

```
Intrinsic Error with clean 2D points is 0.0000
Rotation Error with clean 2D points is 2.0000
Translation Error with clean 2D points is 1.1032
------------------------------
Intrinsic Error with clean 2D points is 2.1840
Rotation Error with clean 2D points is 2.0000
Translation Error with clean 2D points is 1.1314
```

In your write-up, include the output of the script testKRt.

3.3.3 Project a CAD model to the image (2 pts)

In your write-up, include the three images similar to the above figure. You have to use different colors from the figure. For example, green circle for given 2D points, black points for projected 3D points, blue CAD model, and red projected CAD model overlapping on the image. You will get NO credit if you use the same color.

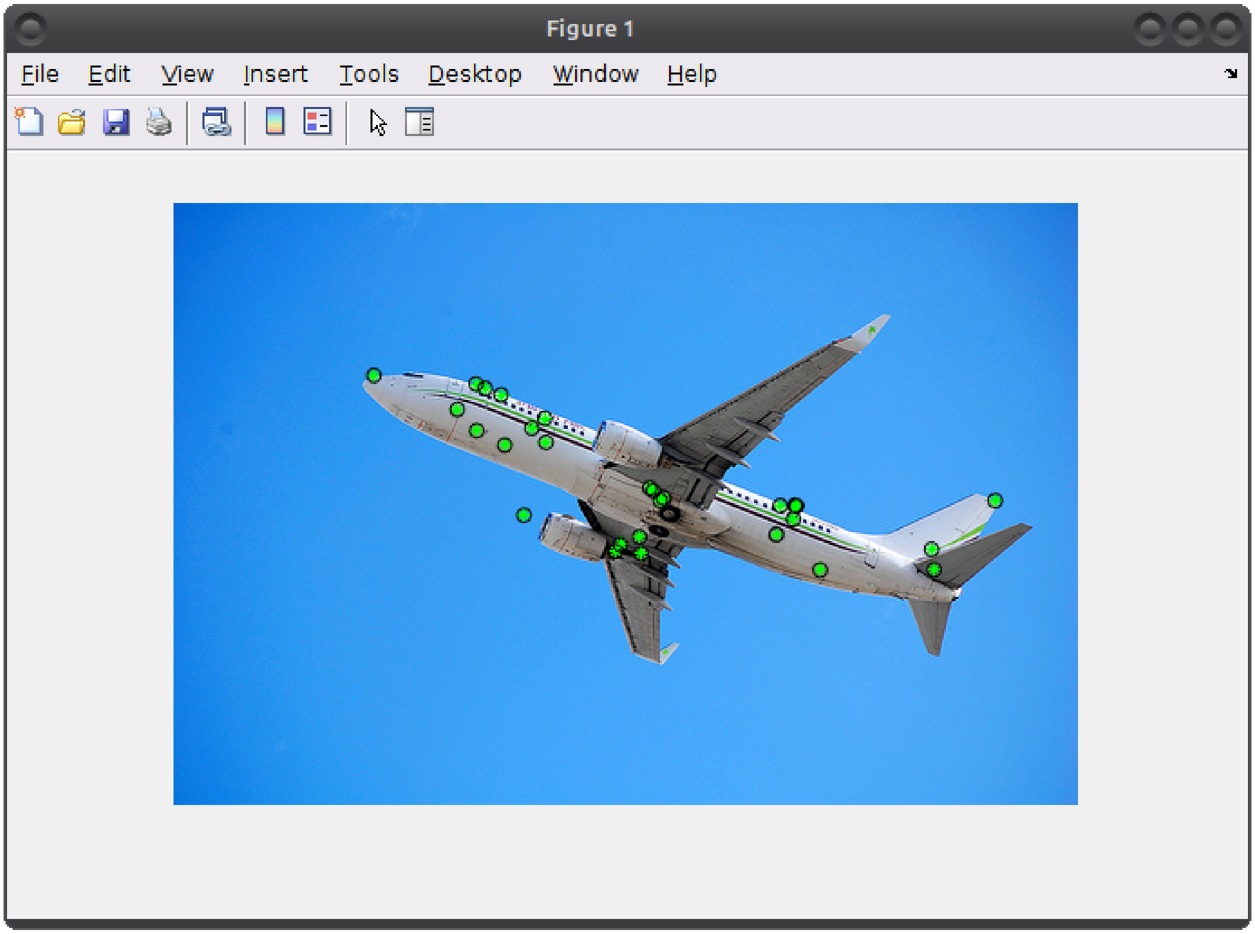


Figure 1
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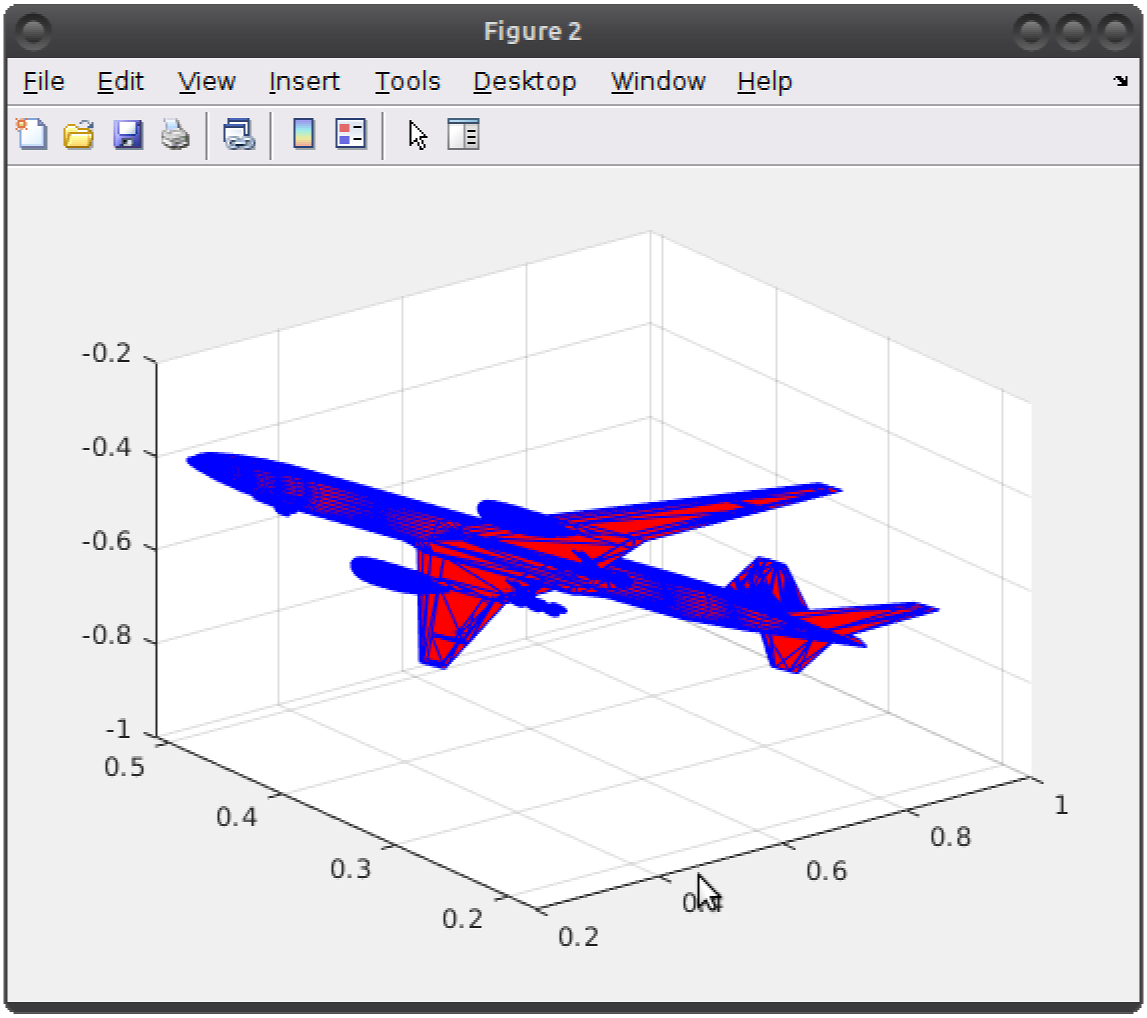
Figure 2
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1

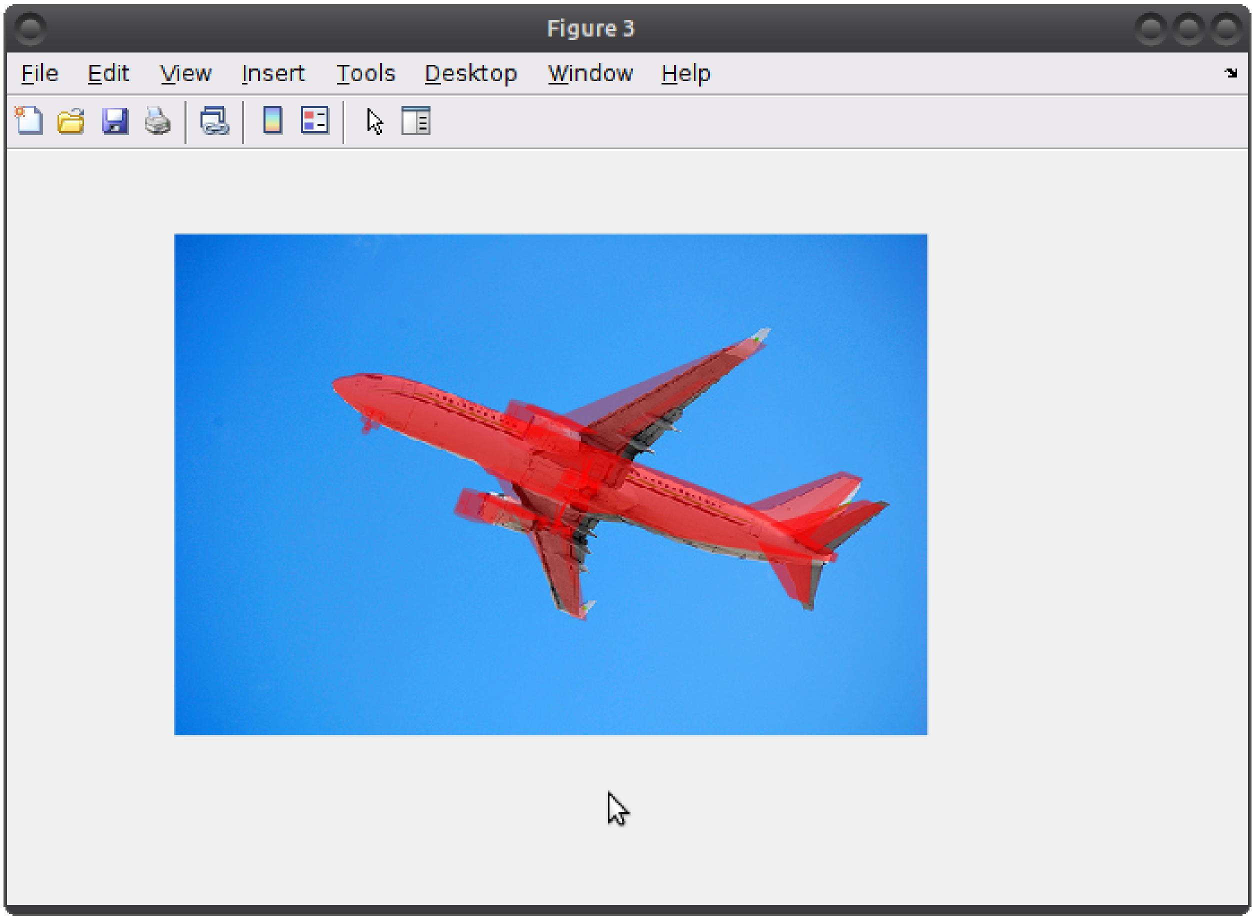
Figure 3
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