

REFERENCE REPORT

Q1

lab 1 camera projection
[[-2.33025839e+00 -1.09883120e-01 3.37076502e-01 7.35937246e+02]
[-2.30819204e-01 -4.79026523e-01 2.08508919e+00 1.53474128e+02]
[-1.26253226e-03 -2.06564146e-03 5.14120597e-04 9.99000000e-01]]

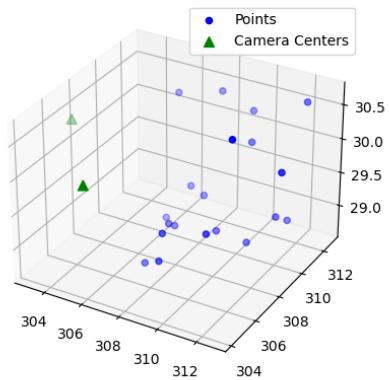
lab 2 camera projection
[[-2.04457869e+00 1.18624309e+00 3.88549262e-01 2.43489252e+02]
[-4.56429836e-01 -3.01715111e-01 2.14507126e+00 1.65766543e+02]
[-2.24454042e-03 -1.09270766e-03 5.57988564e-04 9.99000000e-01]]
residuals between the observed 2D points and the projected 3D points:
residual in lab1: 13.555740448531774
residual in lab2: 15.621732278746734

Q2

lab1 camera center [305.80514791 304.17373601 30.13428556 1.]
lab2 camera center [303.06938509 307.15659022 30.41953527 1.]

Q3

Mean 3D reconstruction error for the lab data: 0.01343
2D reprojection error for the lab 1 data: 6.26719699570243
2D reprojection error for the lab 2 data: 5.909410510746149
(2, 4)



Q5

a)

-With the given camera matrices $M1$ and $M2$ as $M1 = [I|0]$ and $M2 = [A|a]$, we can determine the Fundamental Matrix F using the provided formula:

$$F = [a] \times A$$

-For each point $(u1, v1)$ in the first image, employ the Fundamental Matrix F to compute the corresponding epipolar line in the second image:

$$l2 = F * (u1, v1, 1)^T$$

Similarly, for each point $(u2, v2)$ in the second image, calculate the epipolar line in the first image:

$$l1 = F^T * (u2, v2, 1)^T$$

-Restrict your search to the epipolar lines rather than trying to find equivalent spots all over the second image. By comparing local picture patches surrounding the points with a similarity measure, such as the Sum of Squared Differences (SSD) or Normalized Cross-Correlation (NCC), you may determine which point on the epipolar line in the second image corresponds to each point in the first image.

-After getting the optical flow vectors, weed out false matches by employing an outlier rejection approach like RANSAC. This stage is critical because, especially when working with repeating patterns or occlusions, epipolar limitations may not always ensure the precision of matched points.

-The Lucas-Kanade approach or the Horn-Schunck method are two possible iterative optimization algorithms to use to further the optical flow vectors. These techniques can improve the calculated optical flow's accuracy even more by minimizing an energy function that is specified across the entire picture.

optical flow algorithm's efficiency and robustness can be improved by including epipolar geometry. By limiting the search for similar points to the epipolar lines, this method not only narrows the search space but also more effectively deals with repeating patterns and occlusions.

b)

We know that,

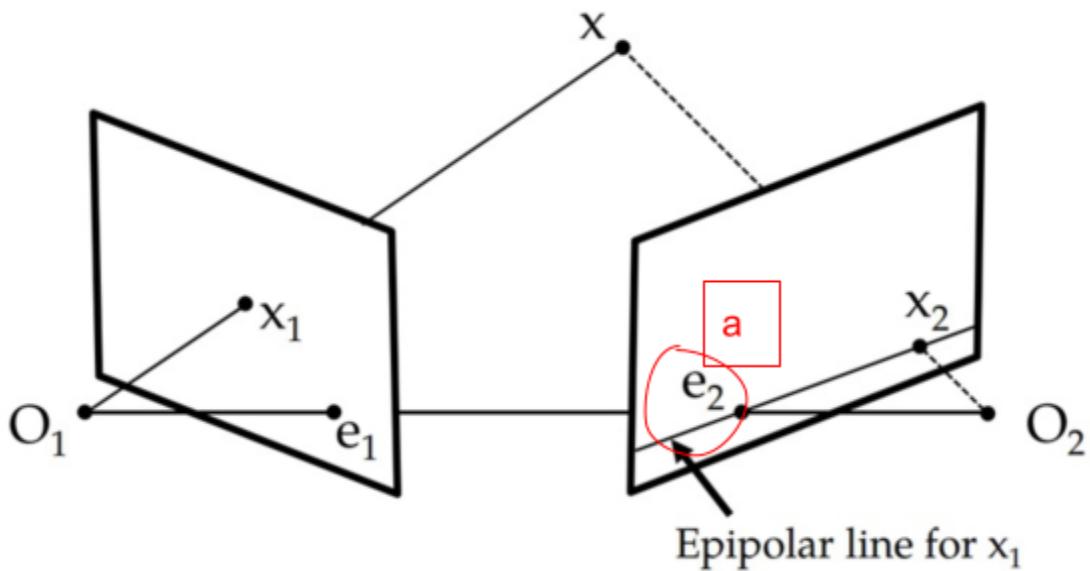
$$Fe' = 0, Fe = 0, F = [a]_X A, F^T = A^T [a]^T X$$

Given that ,

$$[a]_X \text{ is skew-symmetric, } [a]^T X = -[a] X$$

We can use a for e and e' :

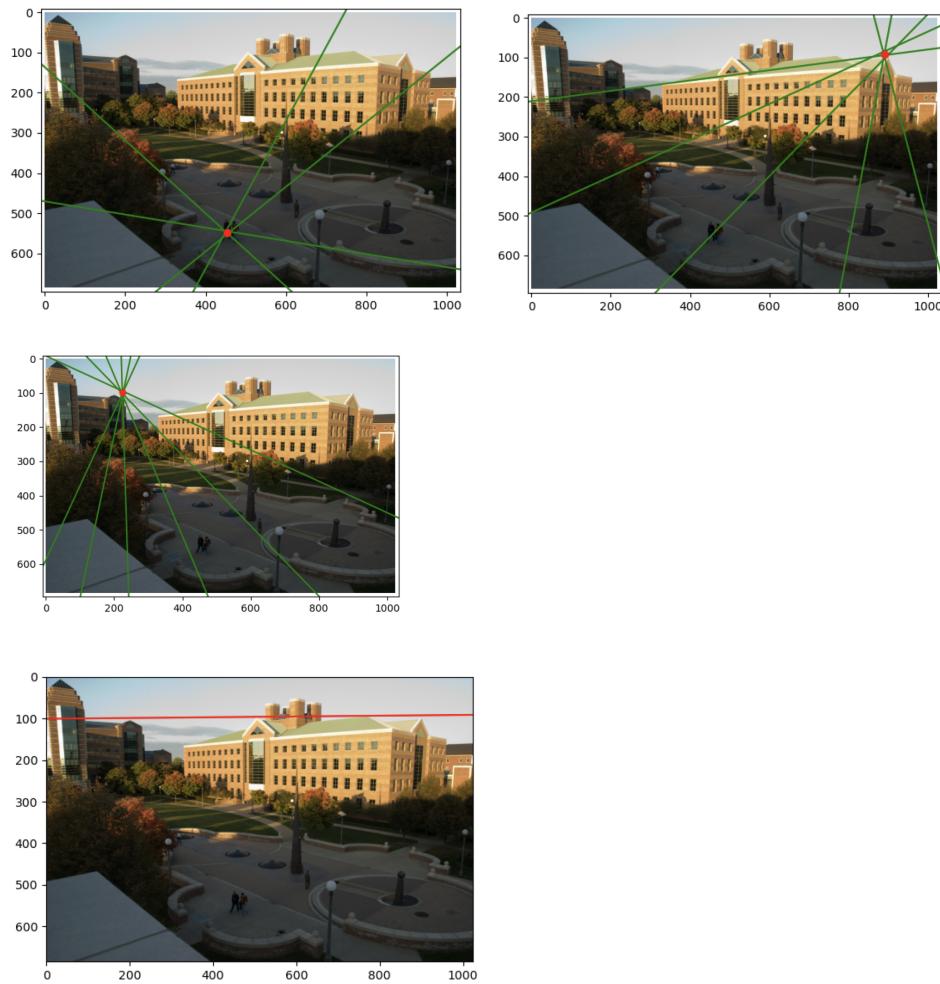
$F^T a = A^T [a]^T X a = -A^T [a] X a = -A0$ (from figure $[a] X a = 0$) it must probably be on the right side as shown below



Q7

7.1

```
[(array([529.17823162, 232.50035999, 2.35644916]), 578.0017458545951),
 (array([-2760.82991111, -286.75200543, -3.09939042]), 2775.6816299221505),
 (array([3472.80296888, 4196.91216576, 7.66800782]), 5447.424362739521)]
```



7.2

```
[-9.71306827e+02 0.00000000e+00 -4.23779921e+03]
[ 0.00000000e+00 -9.71306827e+02 -2.98112910e+03]
[ 0.00000000e+00 0.00000000e+00 1.00000000e+00]]
```

7.3

```
[-0.96380342 0.8492256 -0.35084677]
[ 0.21109449 -0.51760396 -0.73621207]
[-0.16285606 0.10441269 -0.57870401]]
```

7.4

Click on the top coordinate of person
 Click on the bottom coordinate of person
 Click on the top coordinate of Building
 Click on the bottom coordinate of Building

Click on the top coordinate of the spike statue

Click on the bottom coordinate of the spike statue

Click on the top coordinate of the lamp posts

Click on the bottom coordinate of the lamp posts

Estimating height of Building at height 5 ft 6 inches

predicted height: 5 ft 3 inches

Estimating height of the spike statue at height 5 ft 6 inches

predicted height: 5 ft 5 inches

Estimating height of the lamp posts at height 5 ft 6 inches

predicted height: 5 ft 5 inches

Estimating height of Building at height 6 ft 0 inches

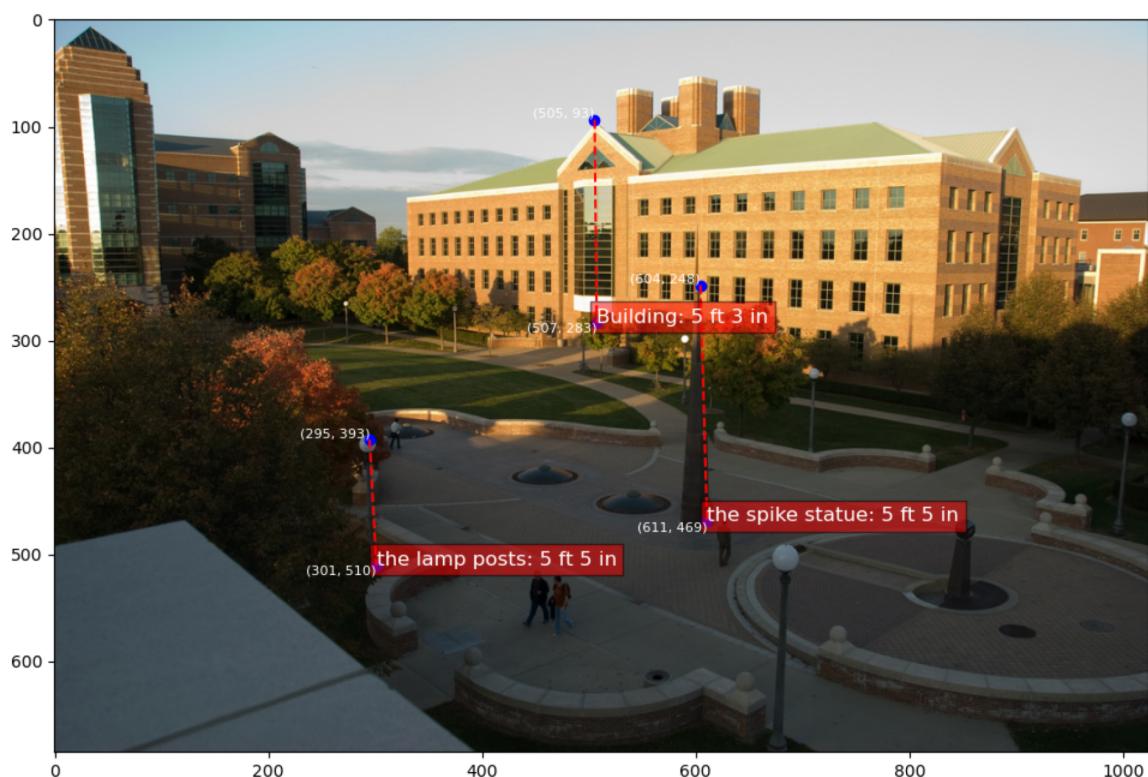
predicted height: 5 ft 8 inches

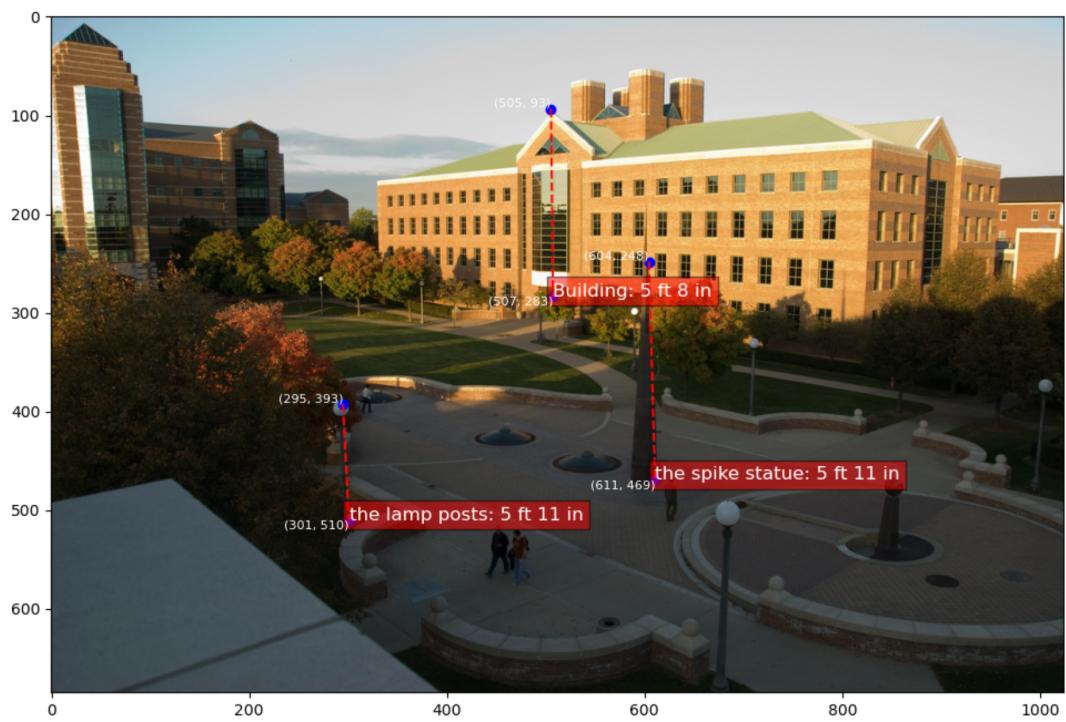
Estimating height of the spike statue at height 6 ft 0 inches

predicted height: 5 ft 11 inches

Estimating height of the lamp posts at height 6 ft 0 inches

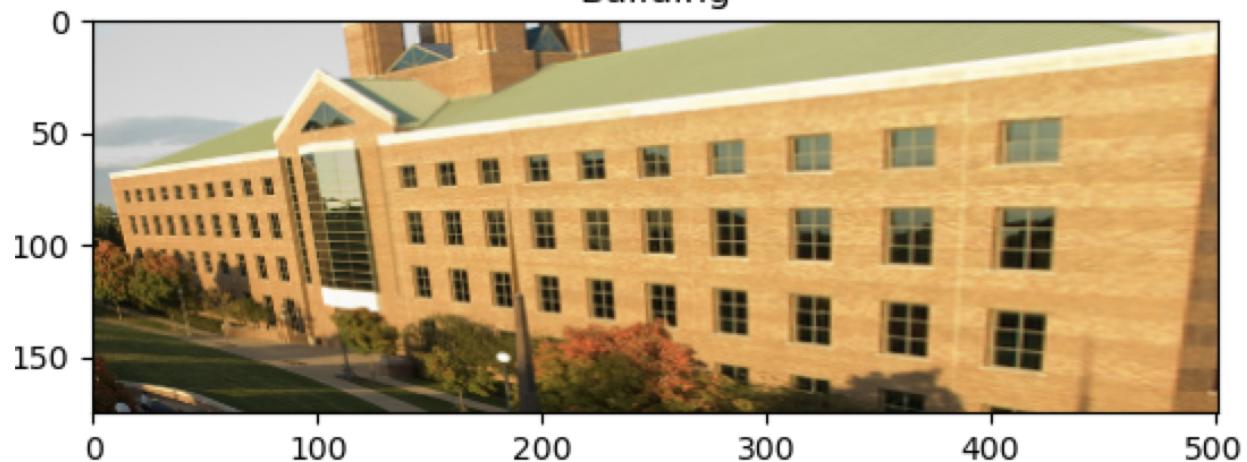
predicted height: 5 ft 11 inches





Q8

Building



Ground Plane

