CS543 Assignment 4

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Part 1 Single-View Geometry:

Plot the VPs and the lines used to estimate them on the image plane using the provided code.

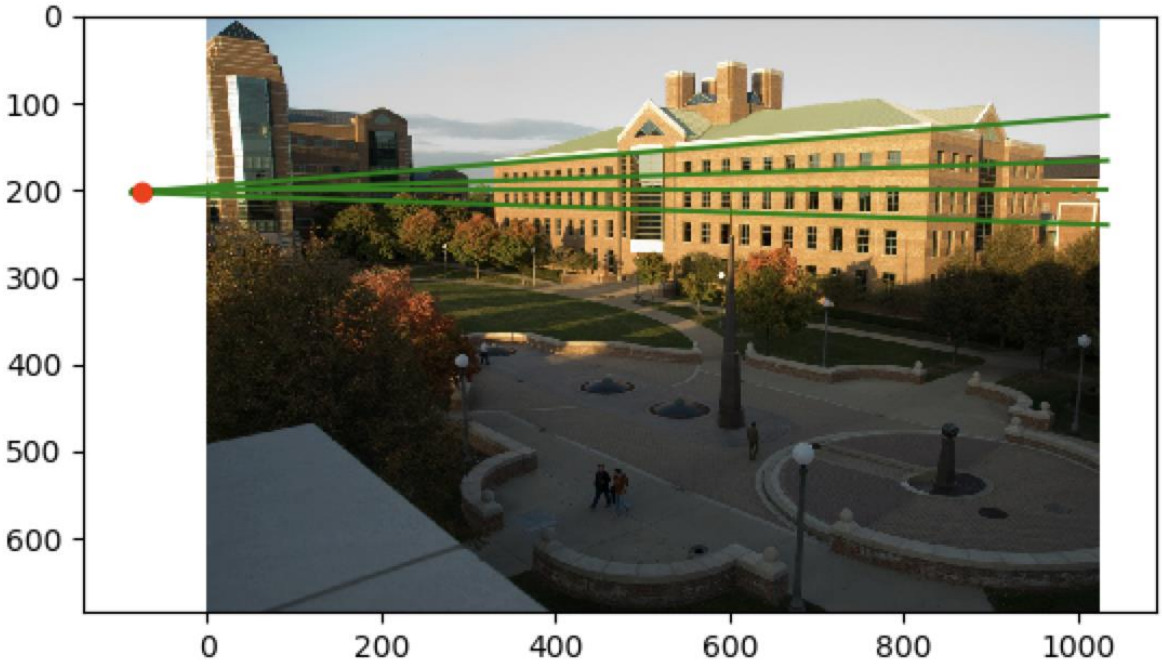


Figure 1.1 *Vanish Point* 1

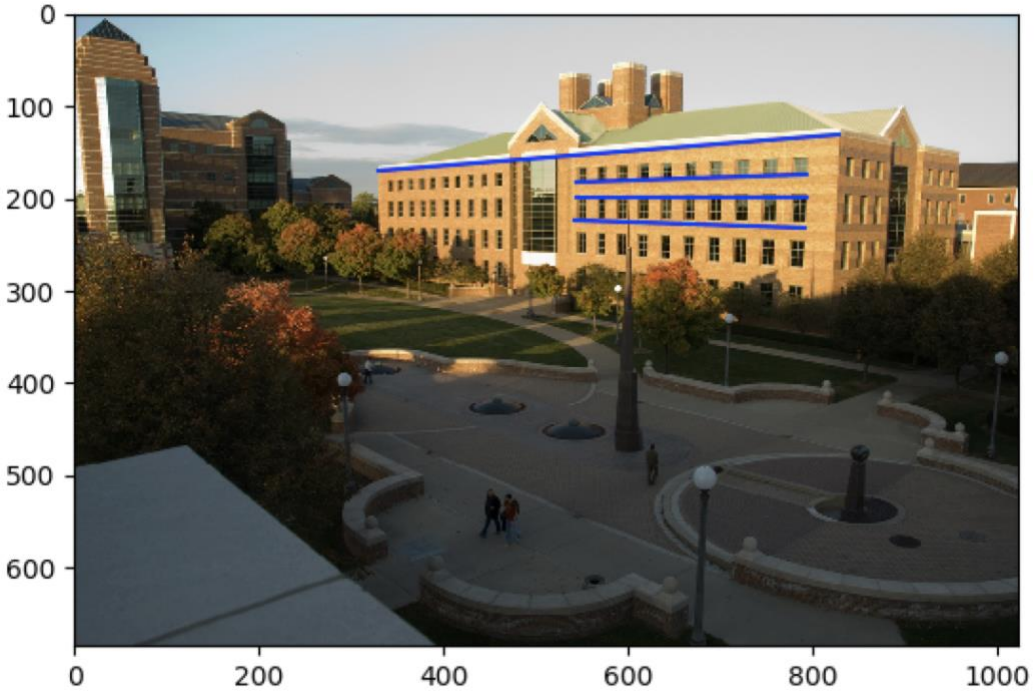


Figure 1.2 *Vanish Point* 1 *lines*

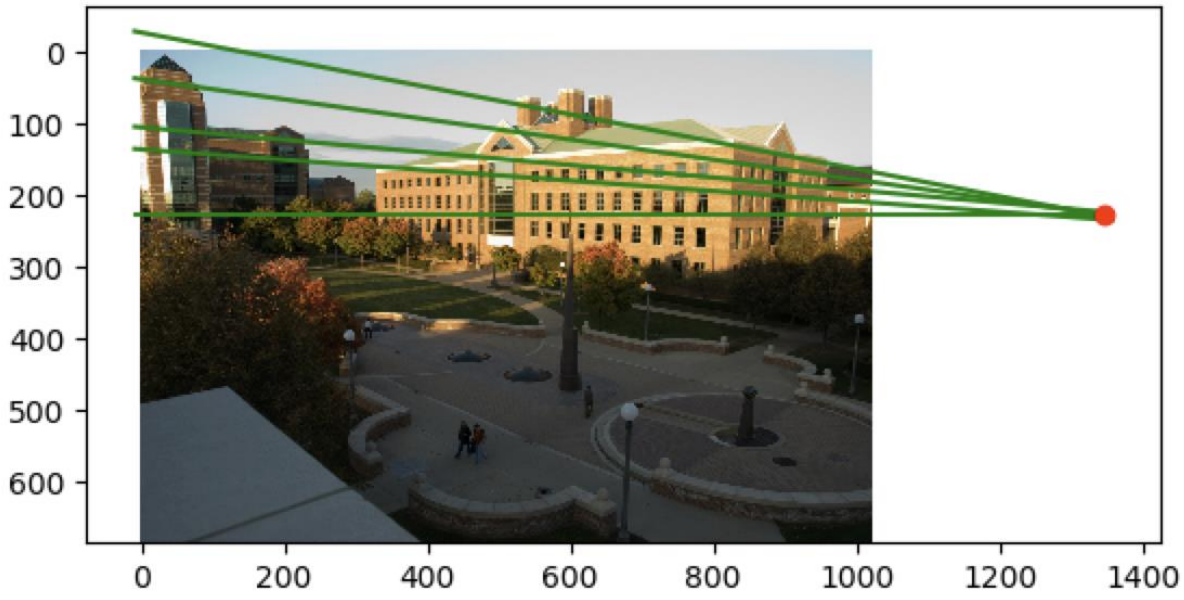


Figure 1.3 *Vanish Point* 2

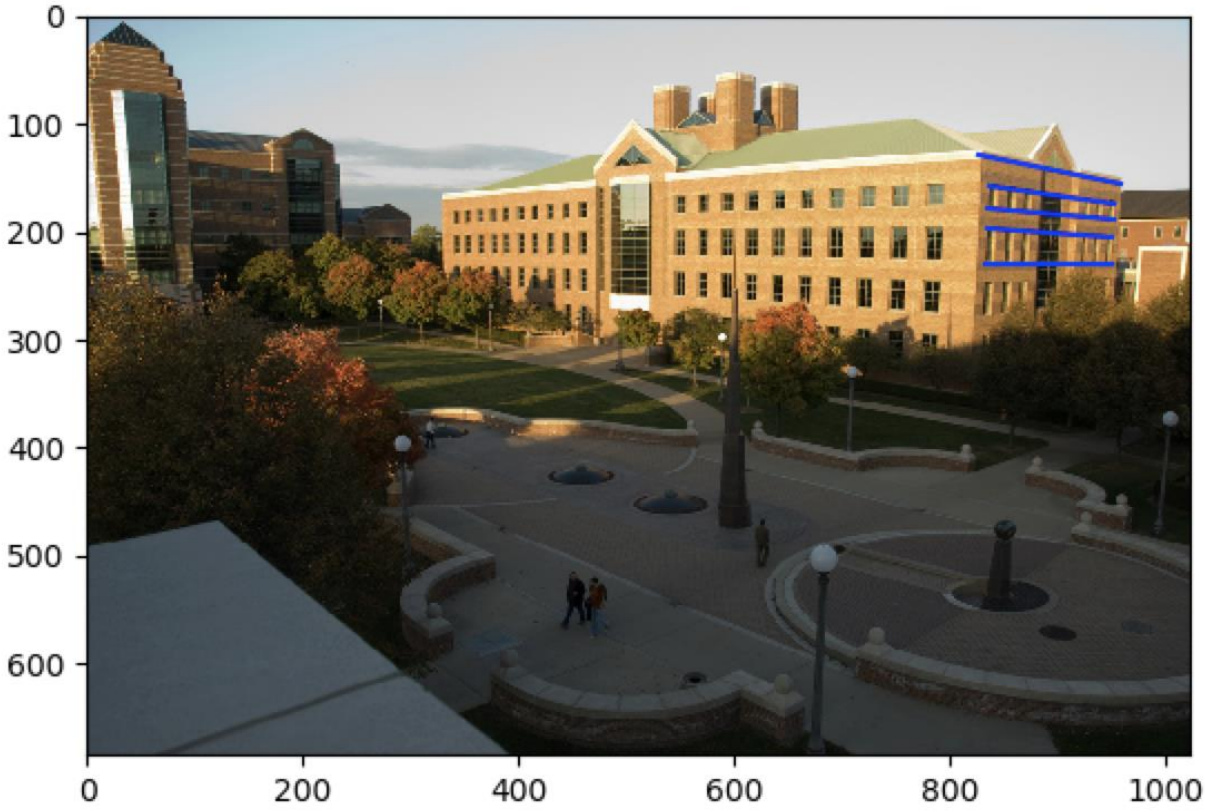


Figure 1.4 *Vanish Point* 2 *lines*

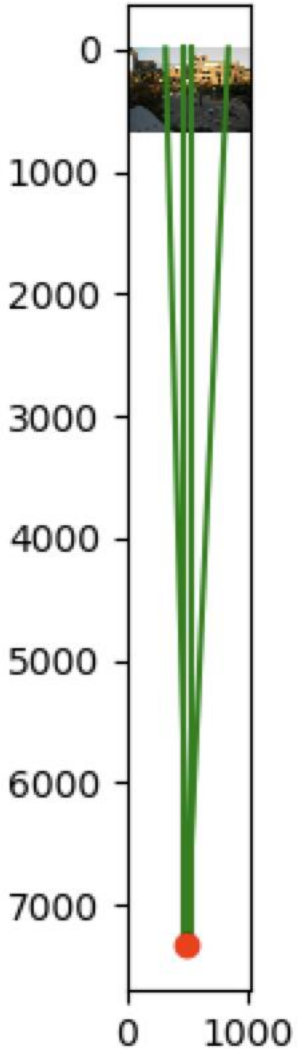


Figure 1.5 *Vanish Point* 3

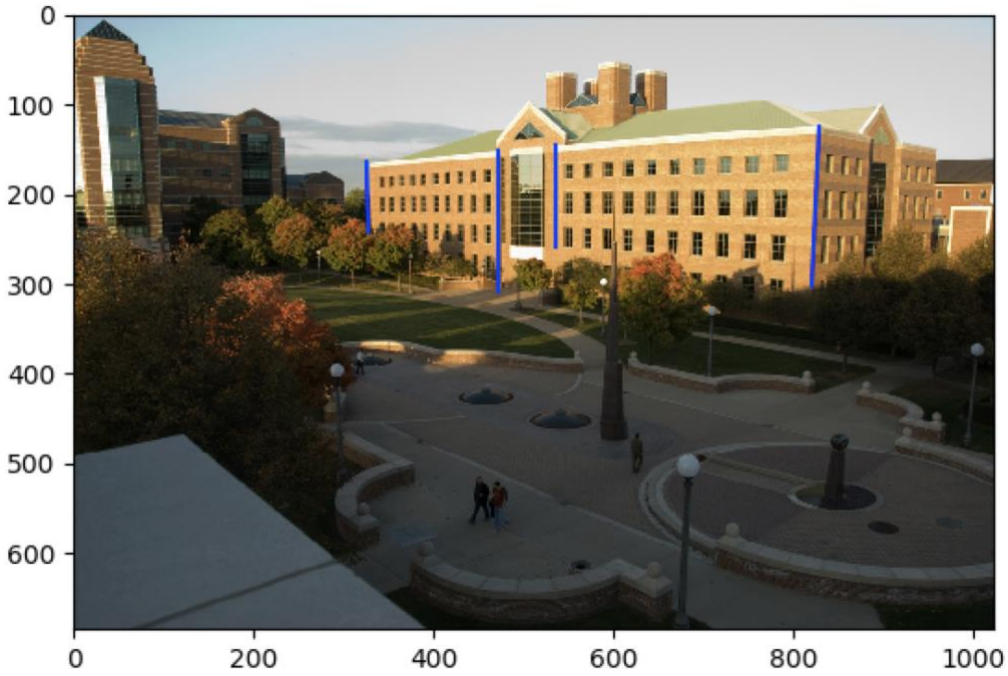


Figure 1.6 Vanish Point 3 lines

Specify the VP pixel coordinates.

Coordiantes of vanishing points:

[[-2.40634116e+02 1.48697782e+03 5.04727562e+02]

[2.07980414e+02 2.38364049e+02 7.98492603e+03]

[1.00000000e+00 1.00000000e+00 1.00000000e+00]]

Plot the ground horizon line and specify its parameters in the form a * x + b * y + c = 0. Normalize the parameters so that: a^2 + b^2 = 1.

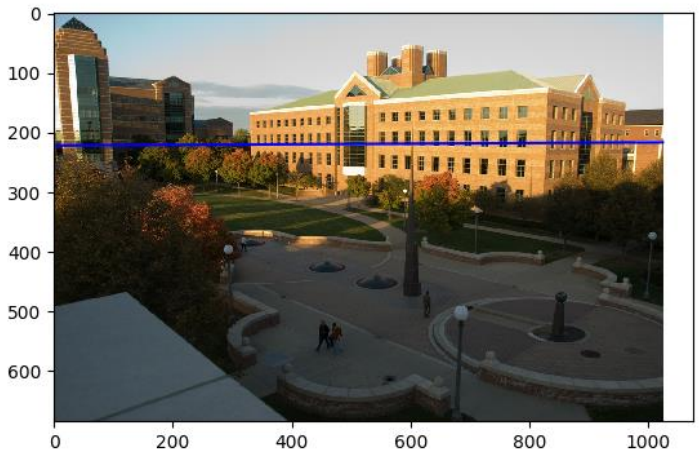


Figure 1.7 *Ground horizon line*

Horizon parameters: [-1.75843520e-02 9.99845383e-01 -2.12179652e+02]

Using the fact that the vanishing directions are orthogonal, solve for the focal length and optical center (principal point) of the camera. Show all your work.

Focal length: 858.387039286772, Optical center: (639.538466012930,319.584730160366). My works: Implement get_camera_parameters(vpts) function, and use solve([m1[0], m2[0], m3[0]], (f, px, py))[0] to compute the focal length and optical center.

Compute the rotation matrix for the camera.

Rotation matrix:

[[0.70096696 -0.01747516 -0.71297962]

[-0.0671824 0.99363652 -0.09040455]

[0.71002243 0.11127029 0.69533235]]

Estimate the heights of (a) the CSL building, (b) the spike statue, and (c) the lamp posts assuming that the person nearest to the spike is 5ft 6in tall. In the report, show all the lines and measurements used to perform the calculation.

(a) Height of CSL building is 27.823072050153215 meters

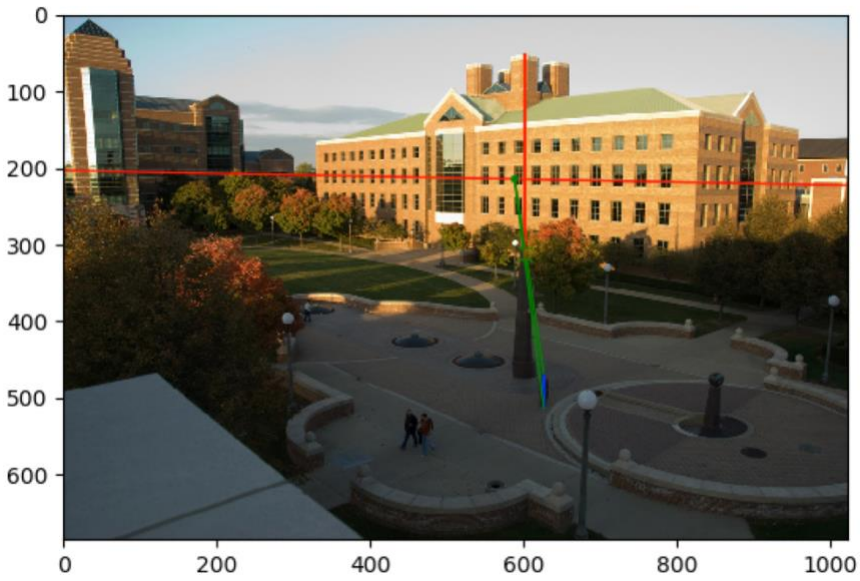


Figure 1.8 *Estimate height of CSL building*

(b) Height of the spike statue is 9.250992828270343 meters

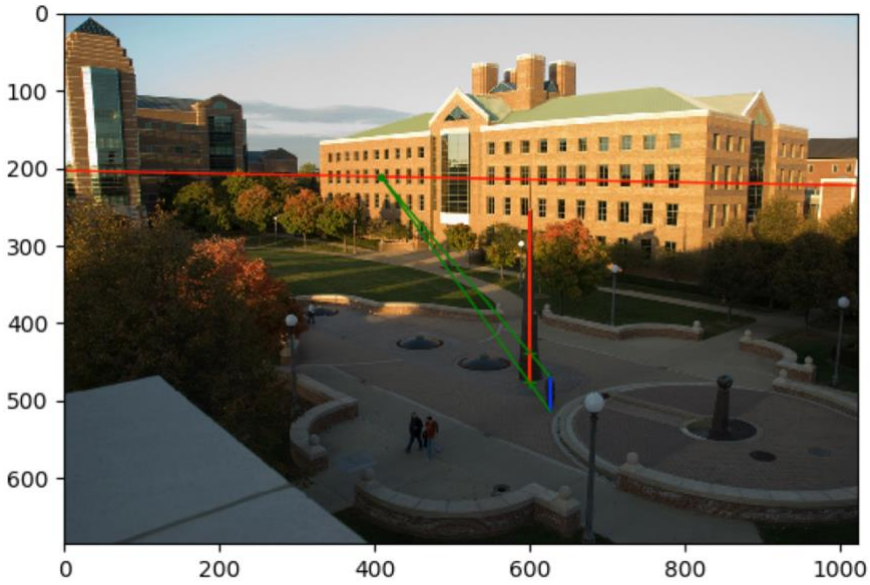


Figure 1.9 *Estimate height of spike statue*

(c)

(1) First height of the lamp post is 4.618452824075178 meters

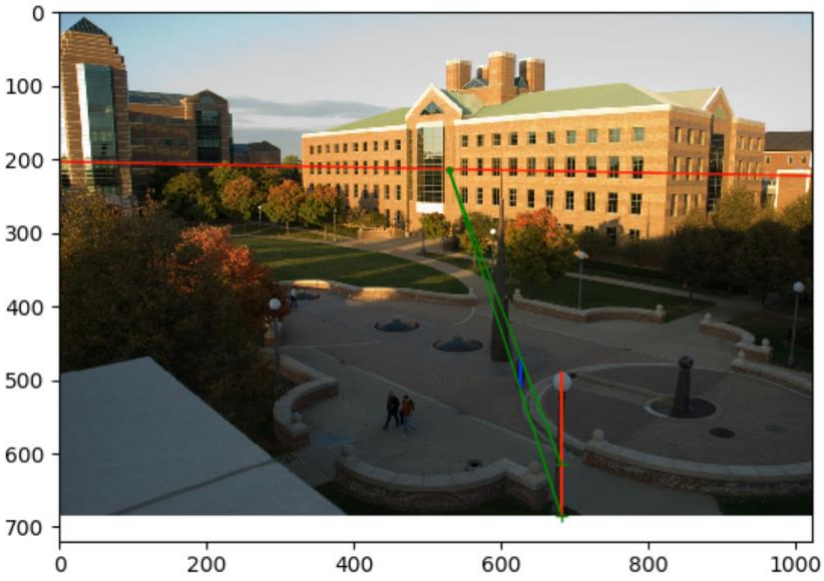


Figure 1.10 *Estimate height of Lamp post* 1

(2) Second height of the lamp post is 5.30974128870862 meters

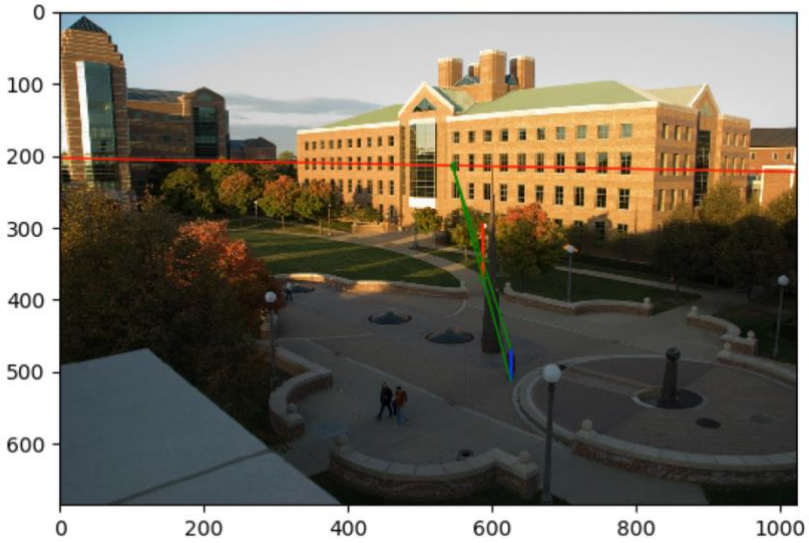


Figure 1.11 *Estimate height of Lamp post* 2

(3) Third height of the lamp post is 4.698483945609883 meters

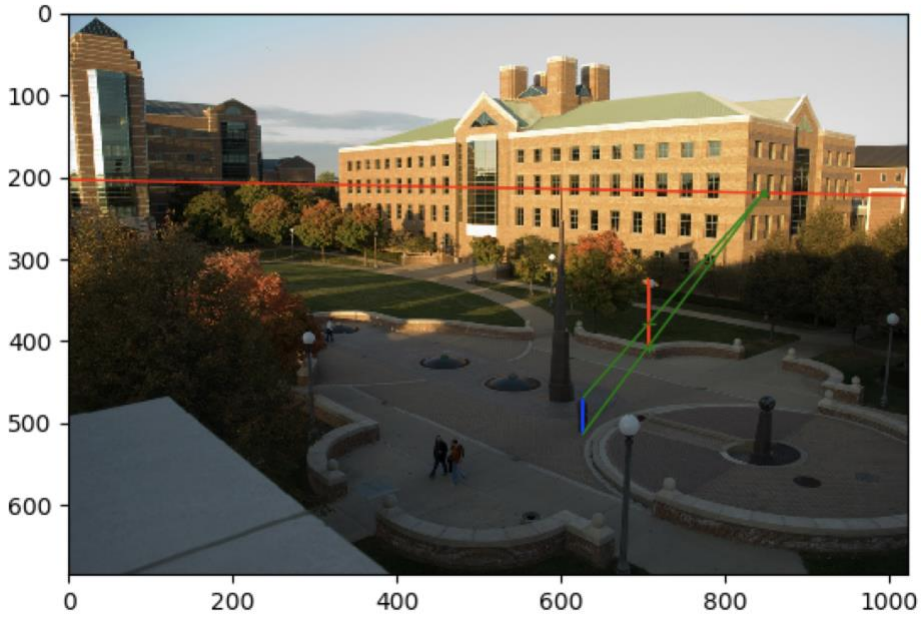


Figure 1.12 *Estimate height of Lamp post* 3

How do the answers change if you assume the person is 6ft tall?

The height of CSL building will be estimated as 30.35244223653078 meters, the height of the spike statue will be estimated as 10.09199217629492 meters, the height of the lamp post 1 will be estimated as 5.038312171718377 meters, the height of the lamp post 2 will be estimated as 5.792445042227586 meters, the height of the lamp post 3 will be estimated as 5.125618849756237 meters.

Part 2 Fundamental Matrix Estimation, Camera Calibration, Triangulation:

For the lab and library image pairs, display your result (points and epipolar lines) and report your residual for both unnormalized and normalized fundamental matrix estimation.

Figure 2.1 *Lab unnormalized result*

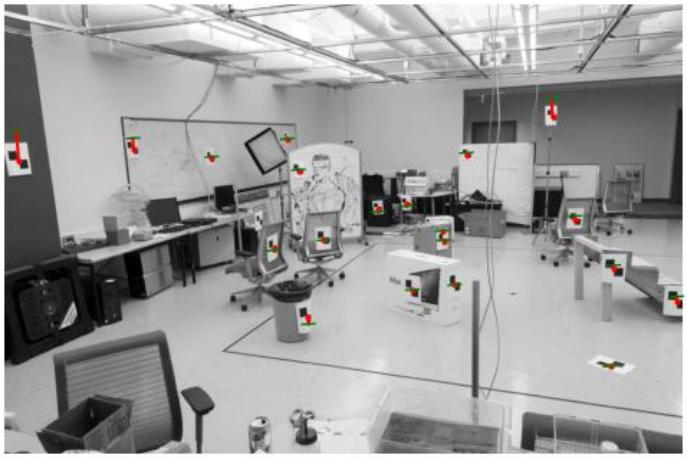


Figure 2.2 *Lab normalized result*

Figure 2.3 *Library unnormalized result*

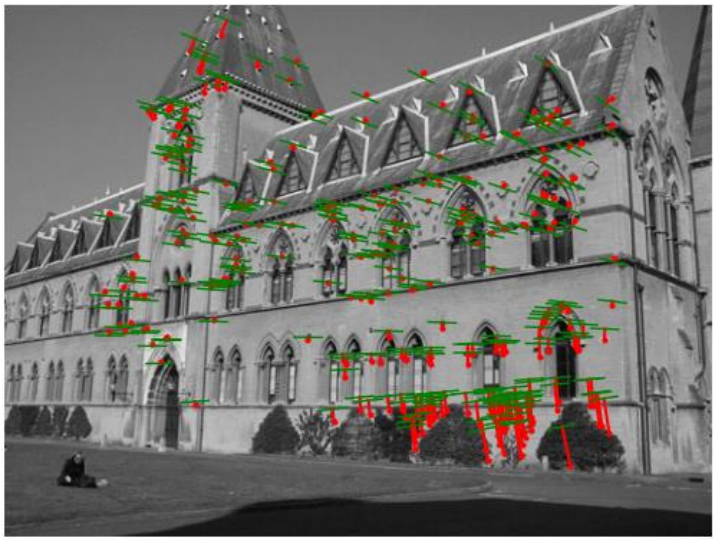


Figure 2.4 Library normalized result

Unnormalized residual for lab: 0.08656000816636474
Normalized residual for lab: 0.06676997447204941
Unnormalized residual for library: 0.03049145968156545
Normalized residual for library: 0.024947711698872718

For the lab image pair, show your estimated 3x4 camera projection matrices. Report the residual between the projected and observed 2D points.

Projection matrice 1:
[[-3.09963956e-03 -1.46205031e-04 4.48498448e-04 9.78930676e-01]
[-3.07018197e-04 -6.37193726e-04 2.77356160e-03 2.04144414e-01]
[-1.67933507e-06 -2.74767711e-06 6.83965776e-07 1.32882926e-03]]

Residual 1: 13.545770830239727

Projection matrice 2:
[[-6.93154844e-03 4.01684642e-03 1.32602798e-03 8.26700542e-01]
[-1.54768761e-03 -1.02452749e-03 7.27440828e-03 5.62523274e-01]
[-7.60946222e-06 -3.70953978e-06 1.90203092e-06 3.38807765e-03]]

Residual 2: 15.544963799332589

For the lab and library image pairs, visualize 3D camera centers and triangulated 3D points.
For Lab:
Residuals: 10.017098289856898, 4.069147222724494

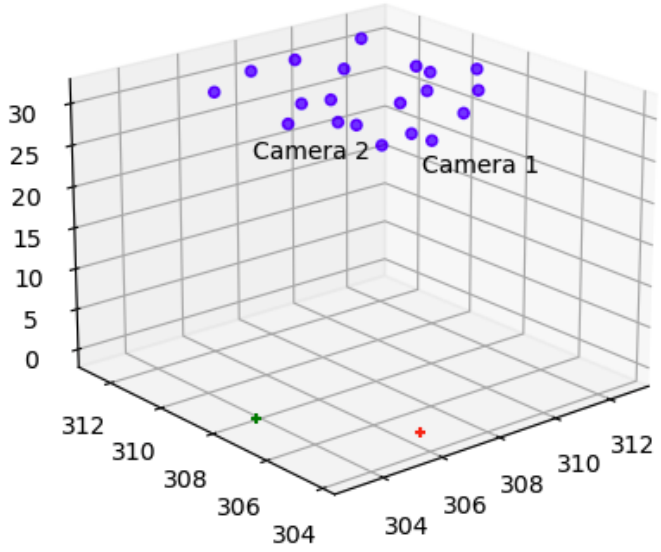


Figure 3.1 visualize 3D camera centers and triangulated 3D points for lab

For library:
Residuals: 7.532180317017734, 10.339121174852957

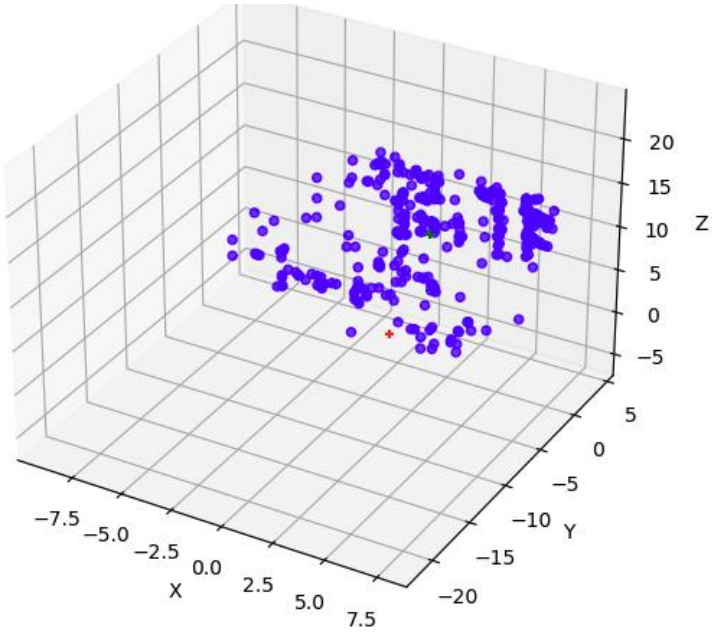
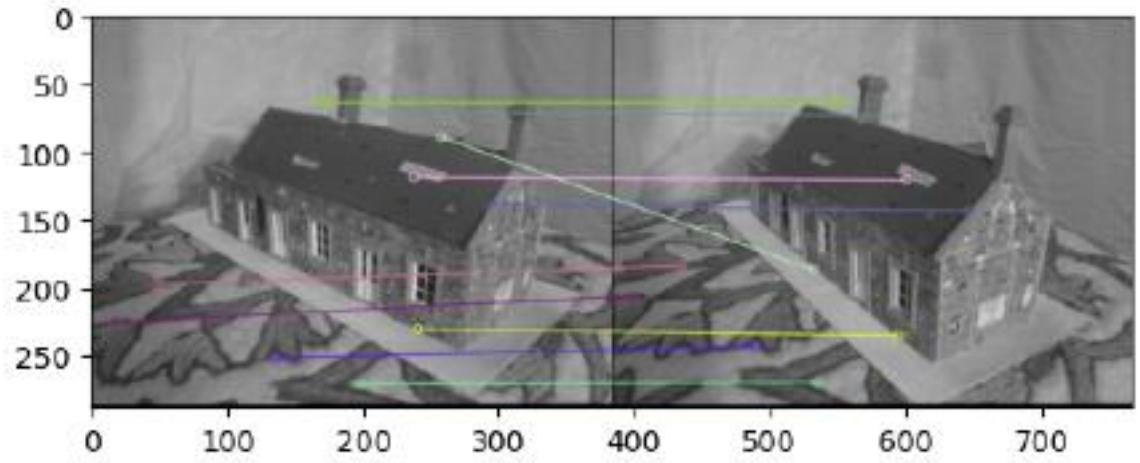
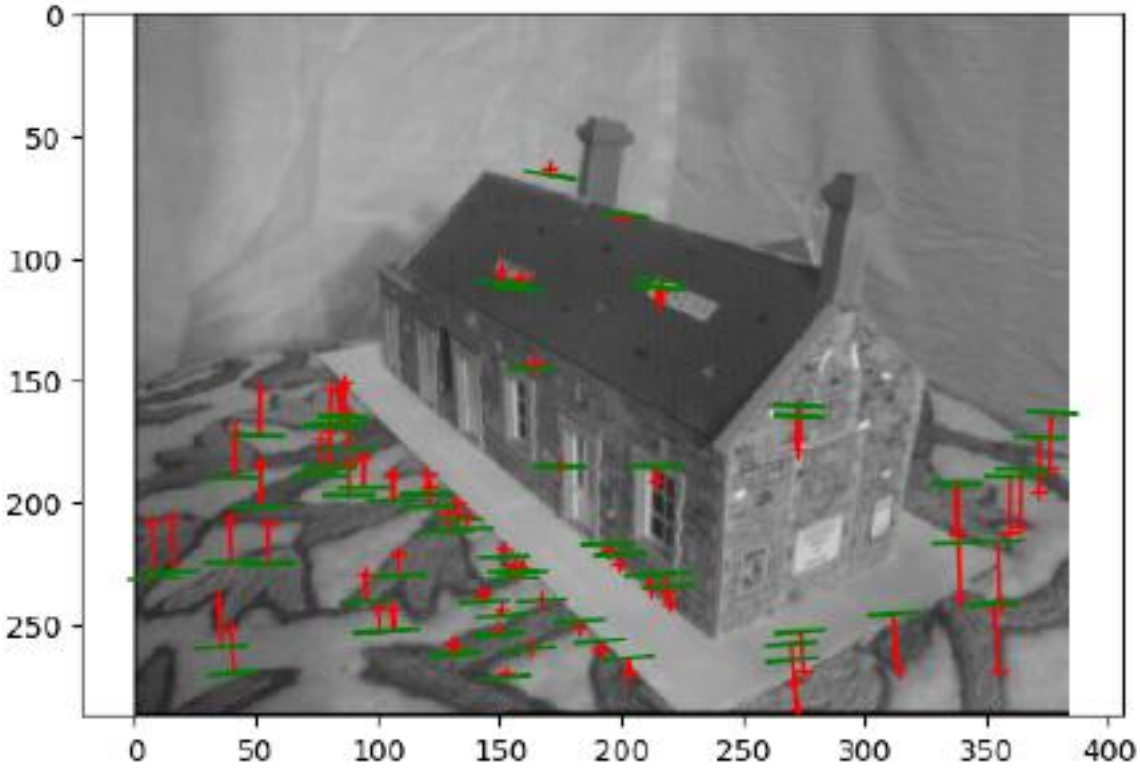


Figure 3.2 visualize 3D camera centers and triangulated 3D points for library

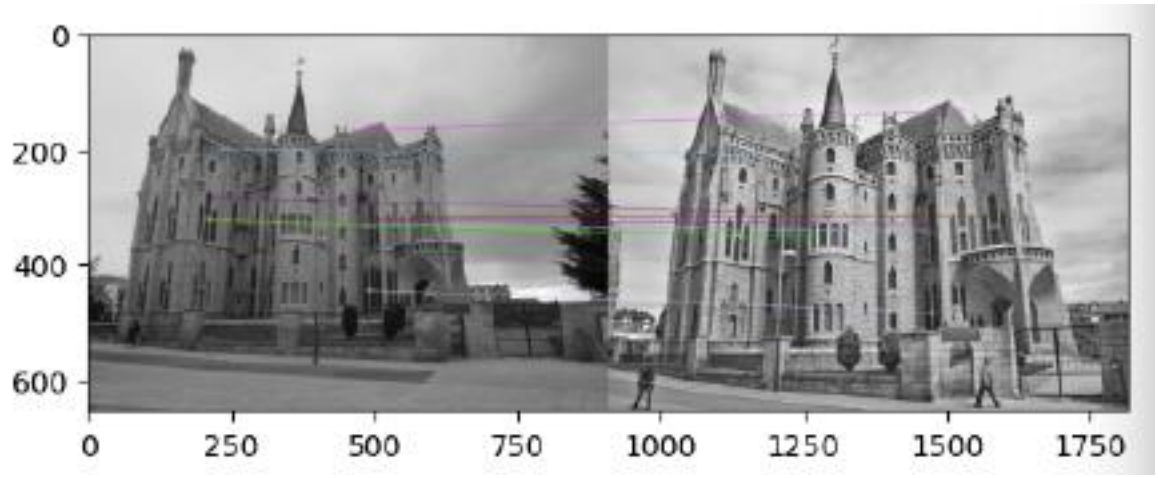
For the house and gaudi image pairs, display your result and report your number of inliers and average inlier residual for normalized estimation without ground truth matches.

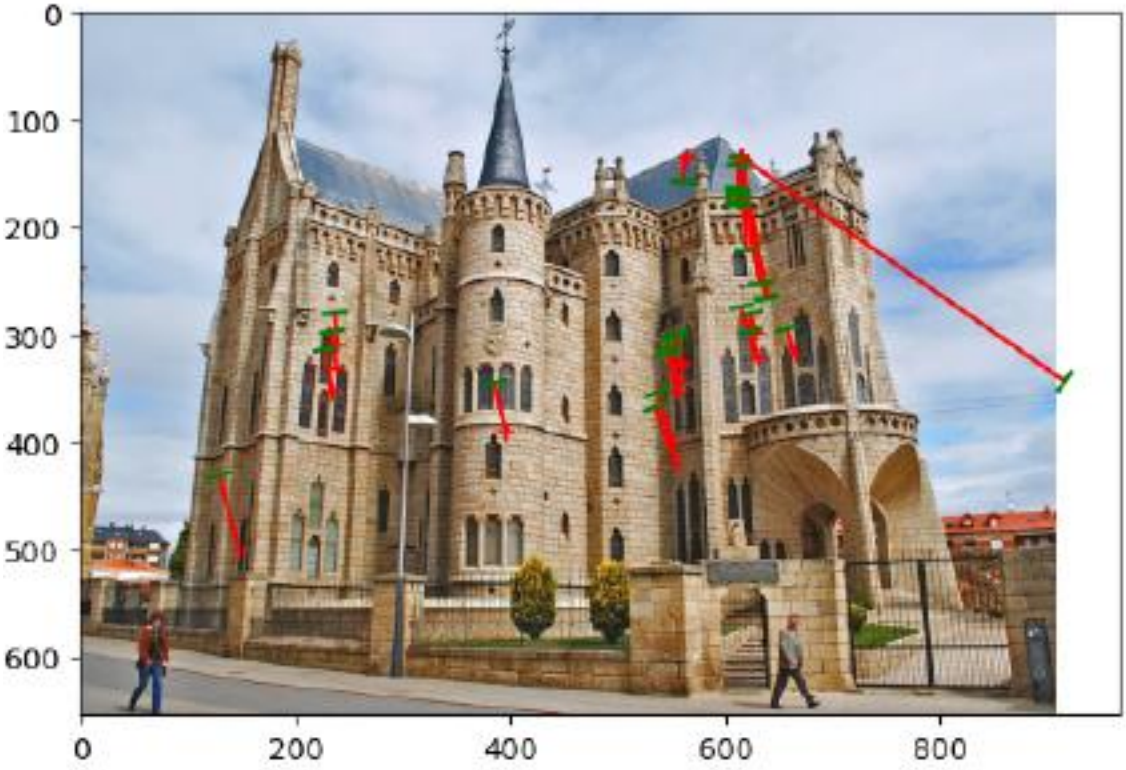
For house:
Number of inliners: 76
Average inlier residual: 10.870797521195911





For gaudi:
Number of inliers: 35
Average inlier residual: 53.92941391472252


0
200
400
600
0
250
500
750
1000
1250
1500
1750


0
100
200
300
400
500
600
0
200
400
600
800

Extra Credit:

Don’t forget to include references, an explanation, and outputs to receive credit. Refer to the assignment for suggested outputs.

Part 1

Estimate height of person 1 is 1.6214426338772134 meters

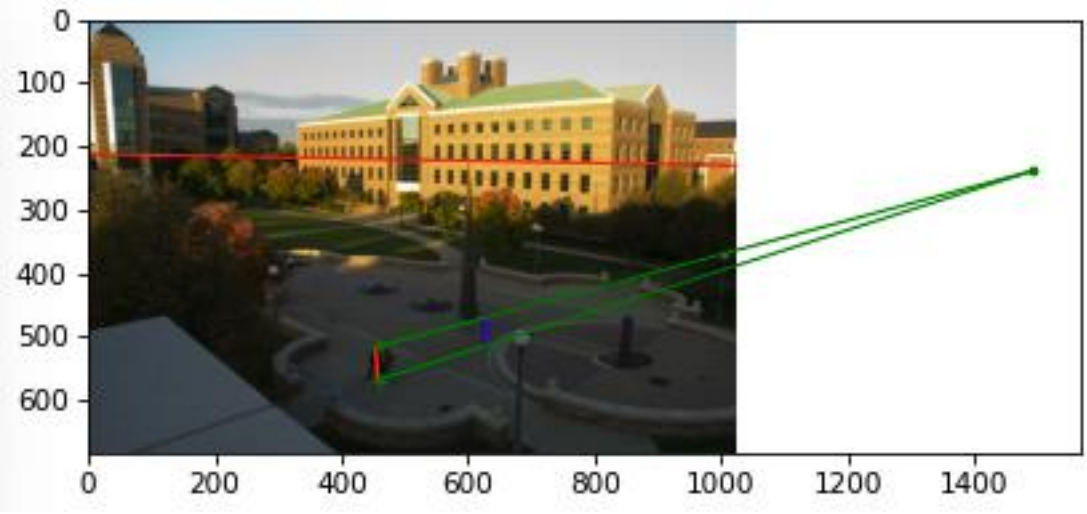


Figure 3.1 Estimate height of person 1

Estimate height of person 2 is 1.7342718532356907 meters

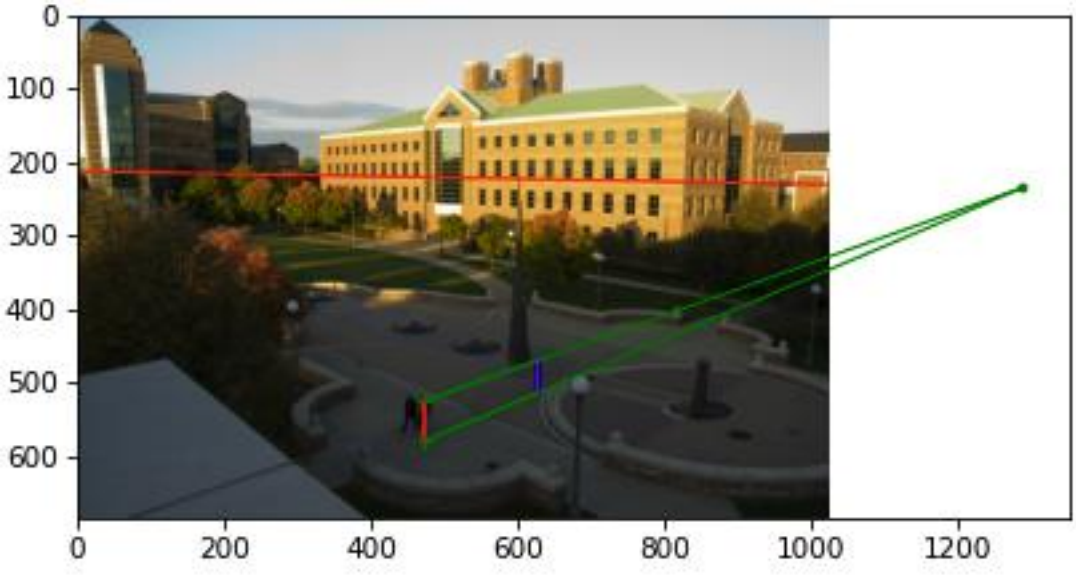


Figure 3.2 Estimate height of person 2

Estimate height of person 2 is 1.5163864840352395 meters

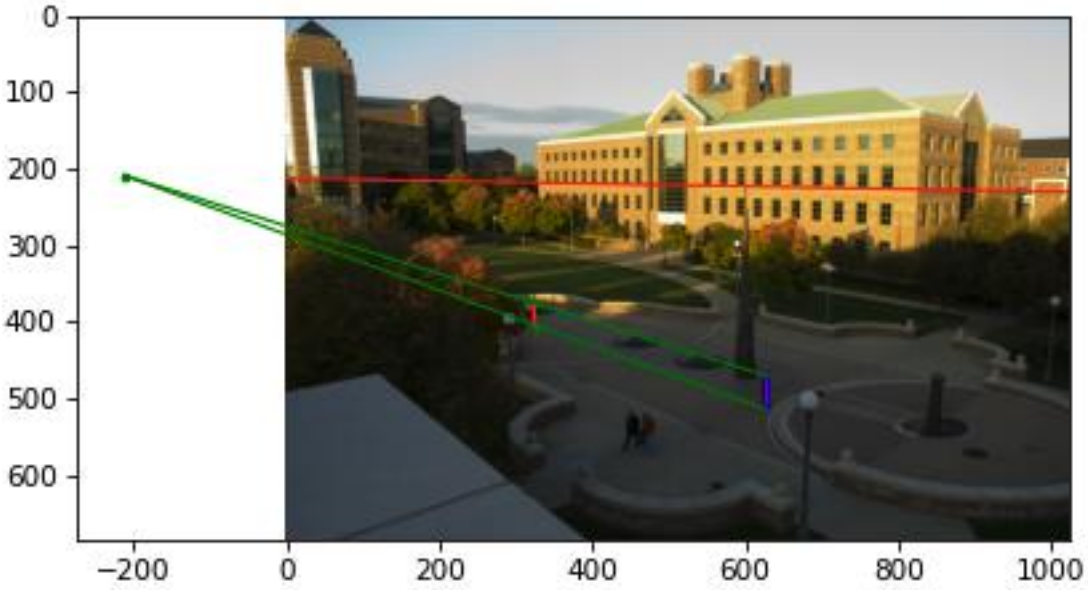


Figure 3.3 Estimate height of person 3

Part 2