Assignment 3: Robust estimation and geometric vision

Spring 2018 CS543/ECE549

Zhenye Na (zna2)

University of Illinois at Urbana-Champaign
Department of Industrial and Enterprise Systems Engineering

Part 1: Stitching pairs of images

1. Implementation

1) Feature extraction

For feature extraction I used provided Harris detector code with parameters sigma = 3, thresh = 0.04, radius = 3. Then I filtered those descriptors with computing distance and select the top smallest ones.

2) Putative matching and RANSAC

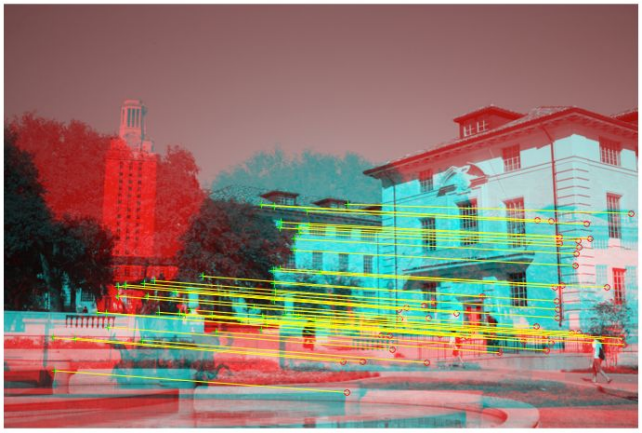
I chose initial number of samples to be 4 and 250 iterations in RANSAC. I have normalized all the descriptors to have zero mean and unit standard deviation. Size of neighborhood I chose to be 9 to get the pleasant result. For putative matching, I also used built-in function detectHarrisFeatures in Matlab to compare the result given my own implementation.

3) Optional filtering

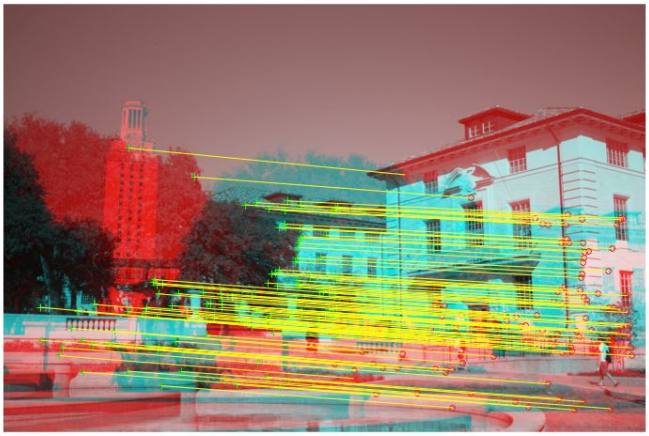
I implemented an optional part which used Gaussian Filter and canny edge detection to detect edge of both side of images. Then use the original images to extract corresponding matching feature points and then stitch the original RGB images together.

2. Inliers, residuals and matches

Normalized all the selected descriptors using zscore function.
num_of_inliers = 87
average_of_residual: 0.619883



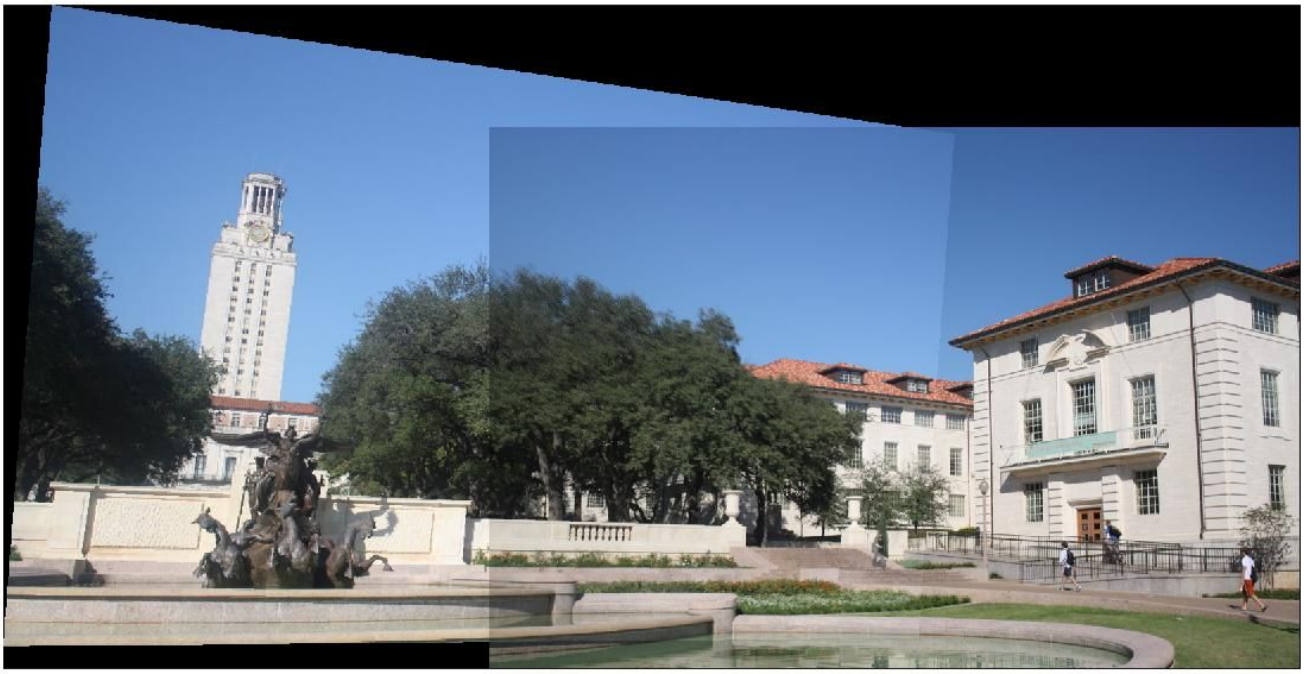
Harris detector code



detectHarrisFeatures (built-in function)

3. Output result

1) Without filtering and edge detection



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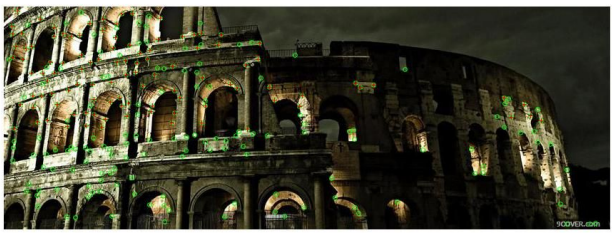
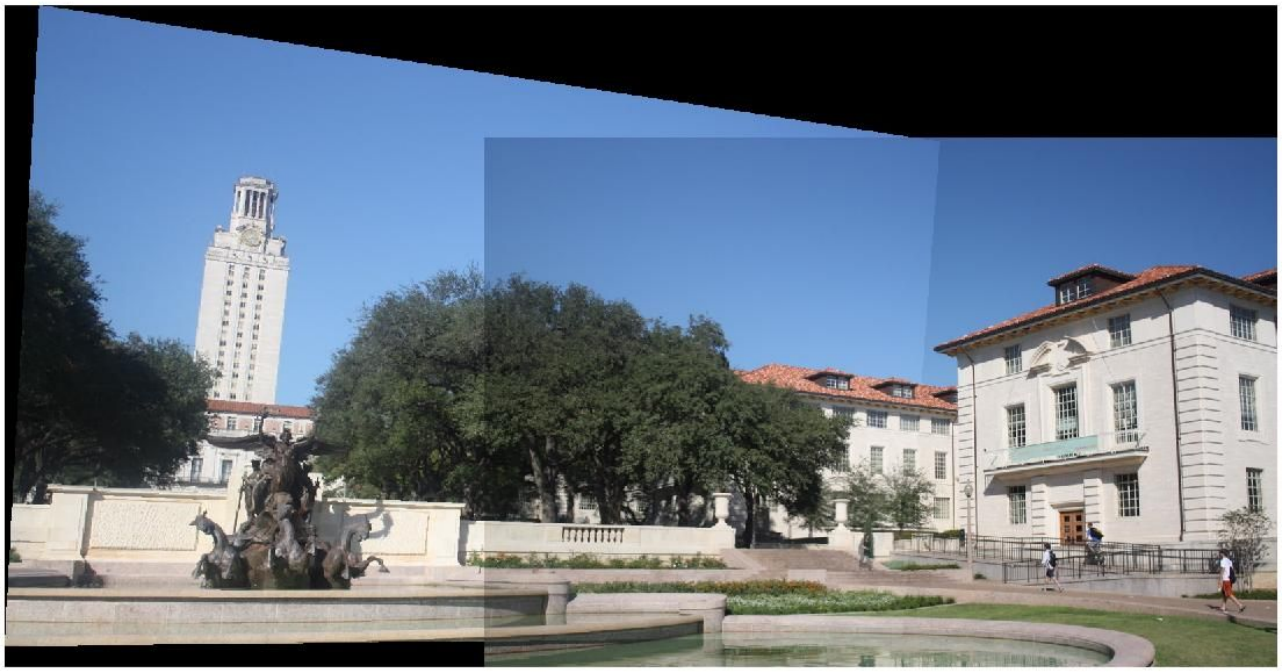


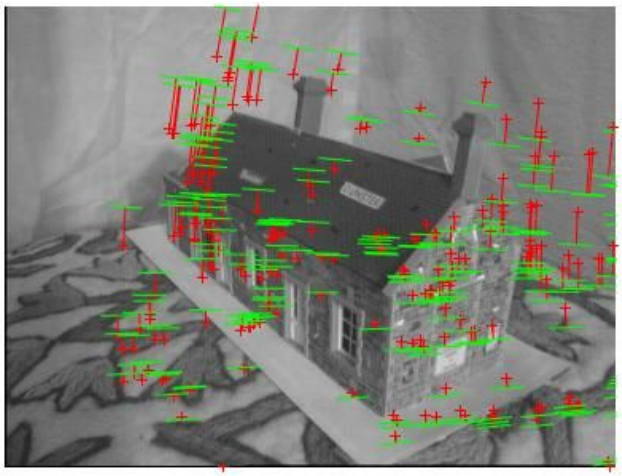
2) With filtering and edge detection



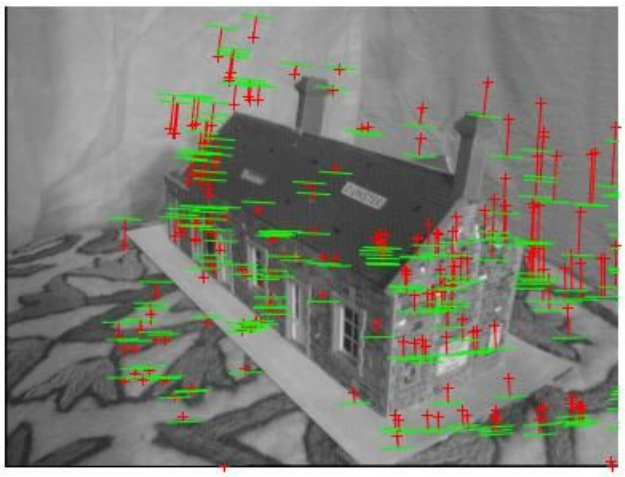
Part 2: Fundamental Matrix Estimation and Triangulation

1. For both image pairs, for both unnormalized and normalized estimation using ground truth matches, display your result and report your residual.

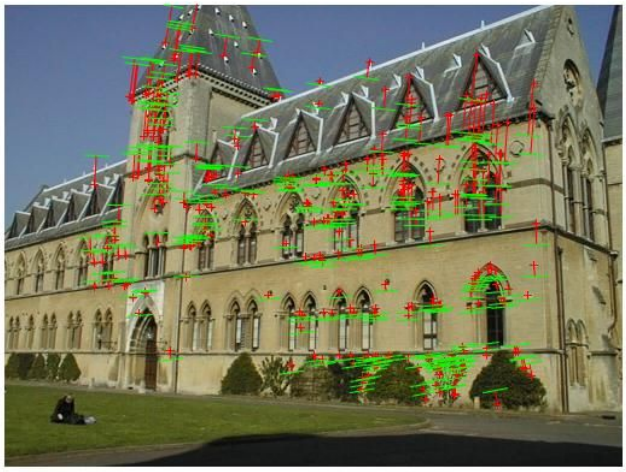
Fit	Normalized	Unnormalized
Library	mean_of_residual: 0.021648 residual_1: 51.532271 residual_2: 81.281321	mean_of_residual: 0.385331 residual_1: 51.532271 residual_2: 81.281321
House	mean_of_residual: 0.021648 residual_1: 51.532271 residual_2: 81.281321	mean_of_residual: 0.385331 residual_1: 51.532271 residual_2: 81.281321



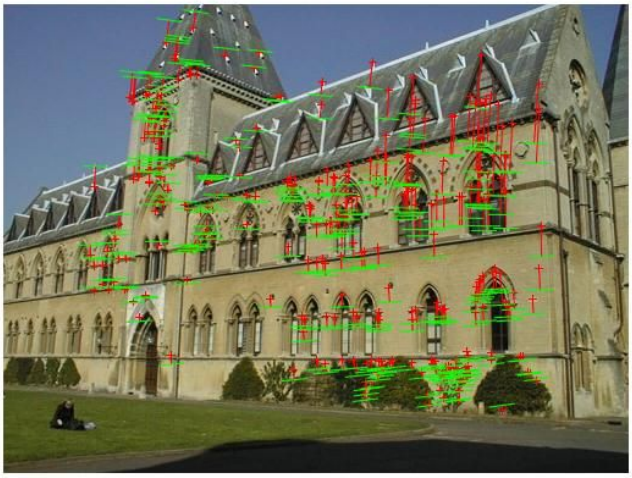
Normalized



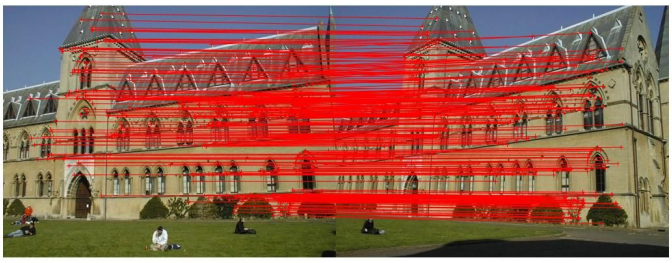
Un-normalized

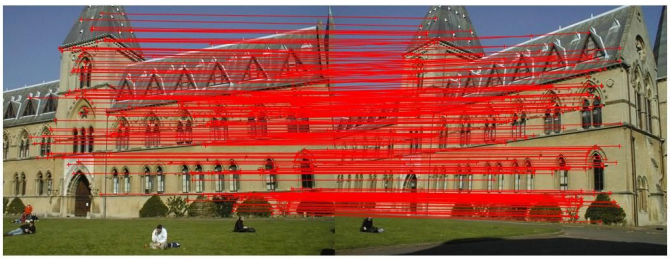


Normalized



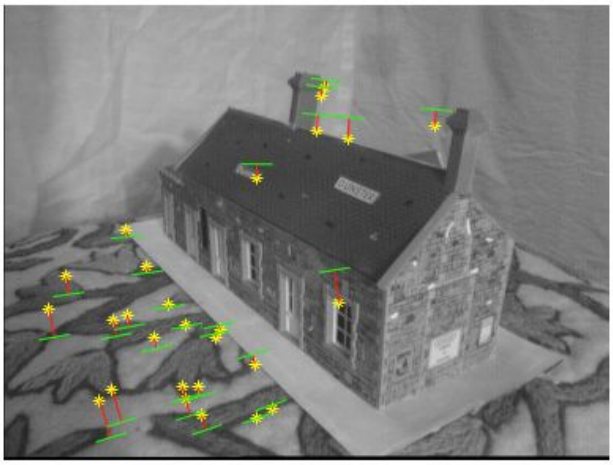
Un-normalized

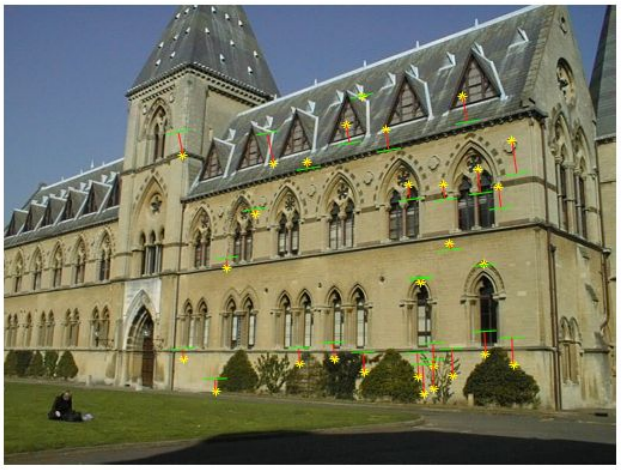




2. For both image pairs, for normalized estimation without ground truth matches, display your result and report your number of inliers and residual for inliers.

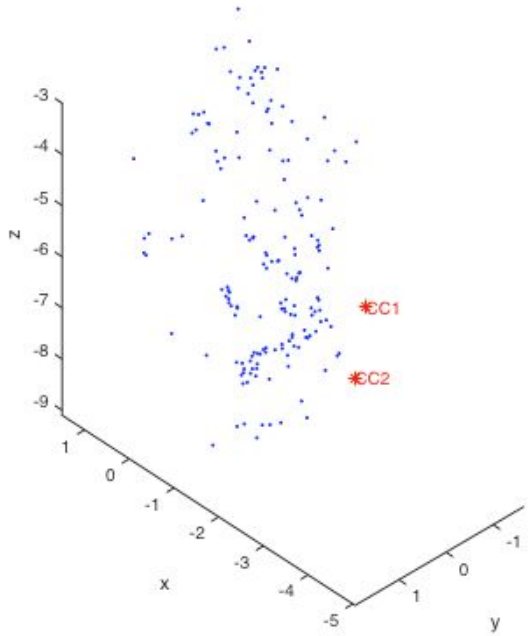
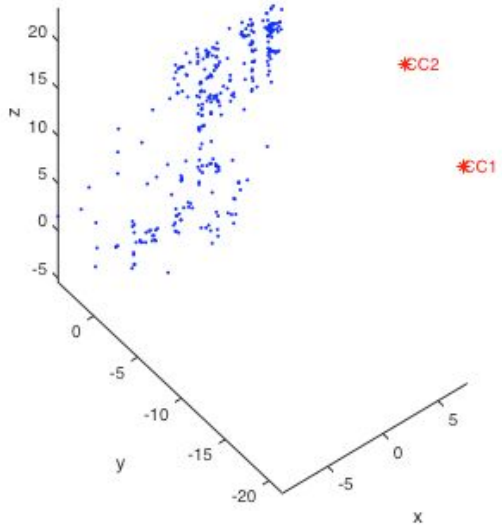
Estimate	Normalization Method
Library	this is mean_of_residual: 14.435947 this is num_of_inliers: 30
House	this is mean_of_residual: 9.187441 this is num_of_inliers: 24

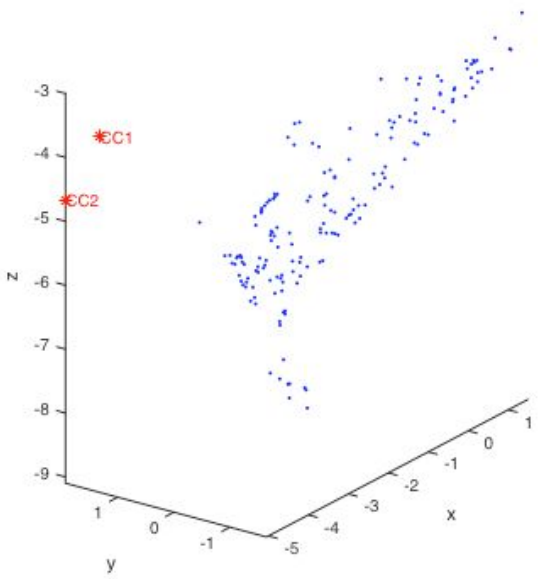
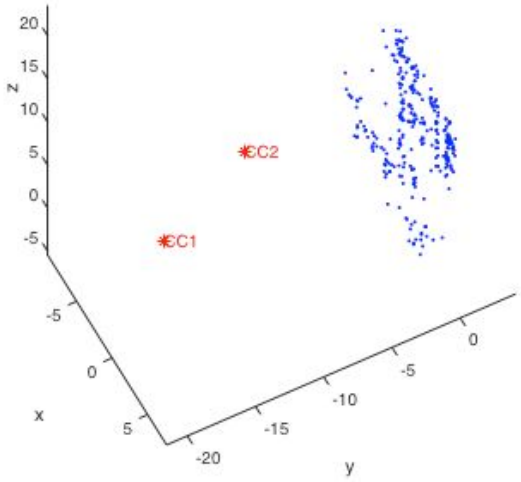




Compared with the result given by ground truth matches, my own implementation find much fewer feature matches than ground truth.

3. For both image pairs, visualize 3D camera centers and triangulated 3D points.

House: residual_1: 6.474154 residual_2: 50.409235	**Library:** residual_1: 51.532271 residual_2: 81.281321
	

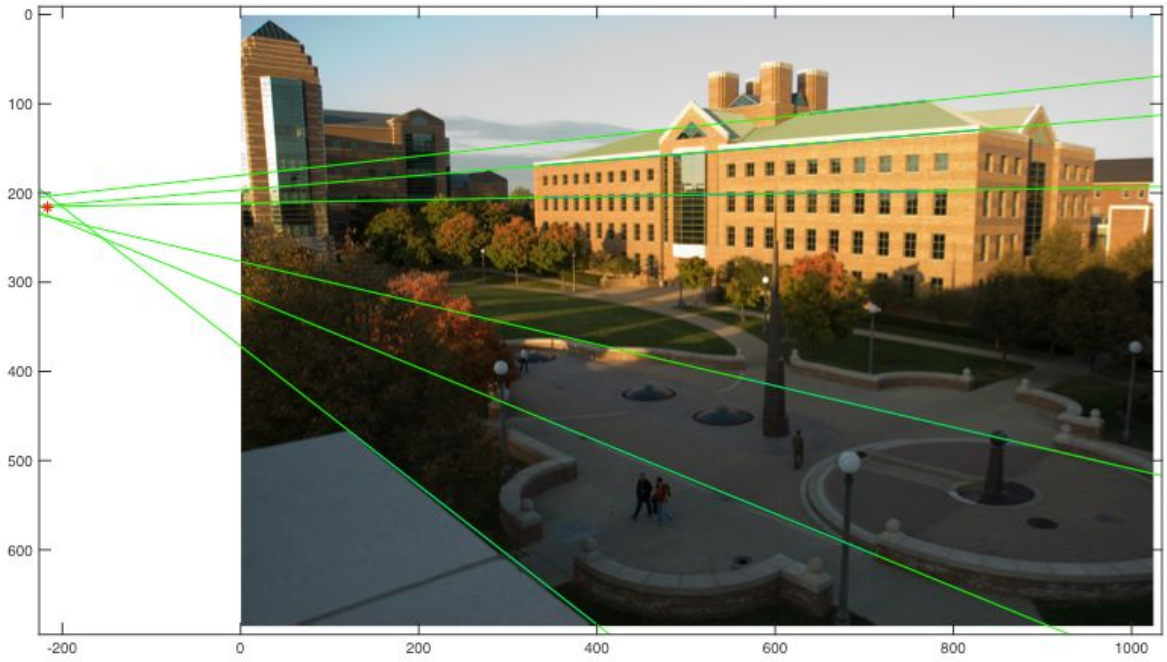
	

Gif is available. Please click the links for more information:

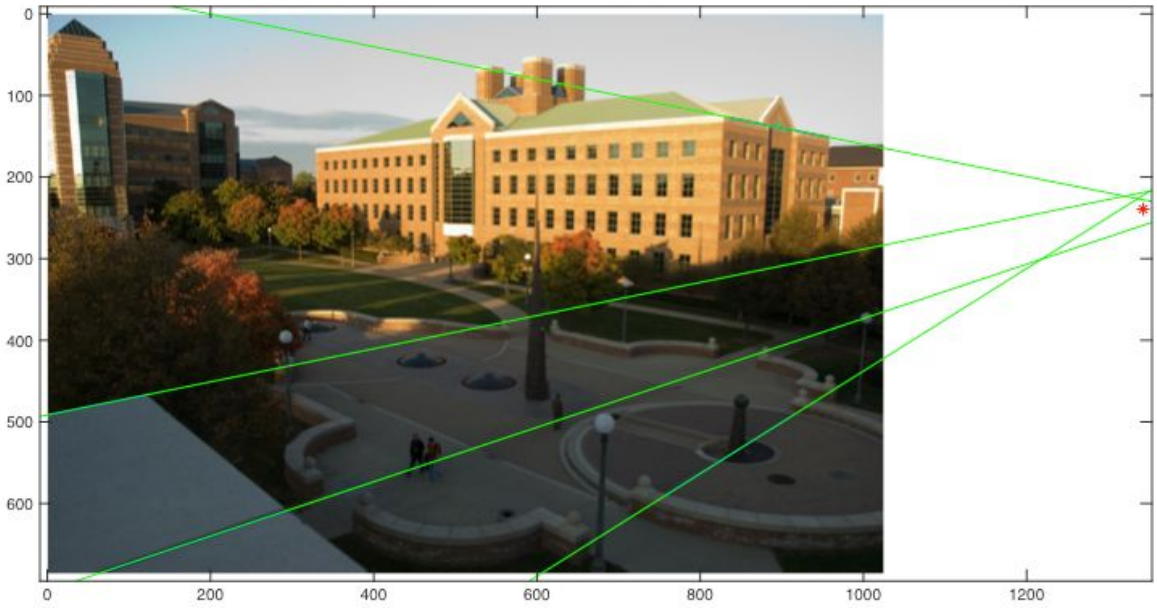
House	House.gif
Library	Library.gif

Part 3: Single-View Geometry

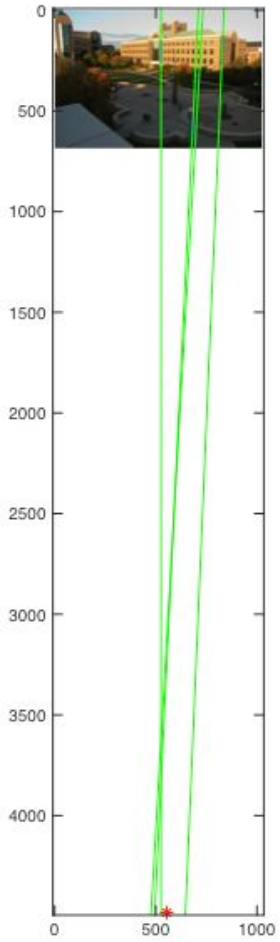
1. Vanishing points and vanishing line



vp1 coordinate = -202.3586 215.3724



vp2 coordinate = 1.0e+03 * (1.3715 0.2306)



vp3 coordinate = 1.0e+03 * (0.5031 4.8670)

Plot vanishing point line. more info see plotVP.m

Parameters for vanighing line: -0.0095 x + 1.0000 y -216.9164 = 0

2. Focal Length and principle points

K =

-774.3358	0	546.0258
0	-774.3358	355.0230
0	0	1.0000

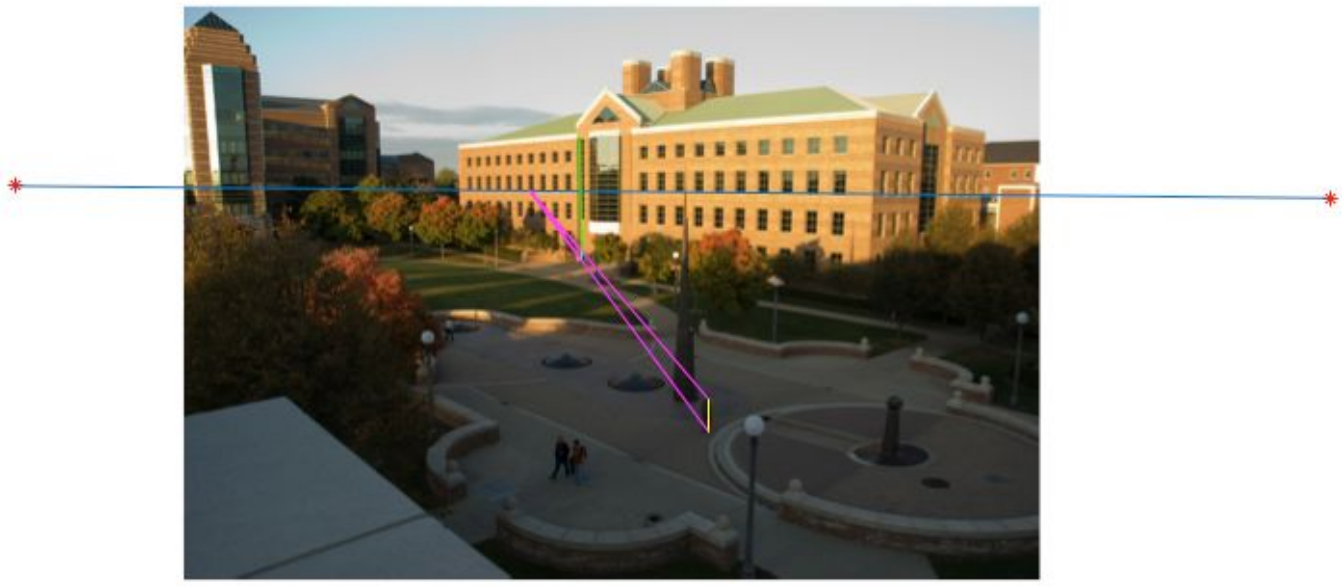
3. Rotation Matrix

R =

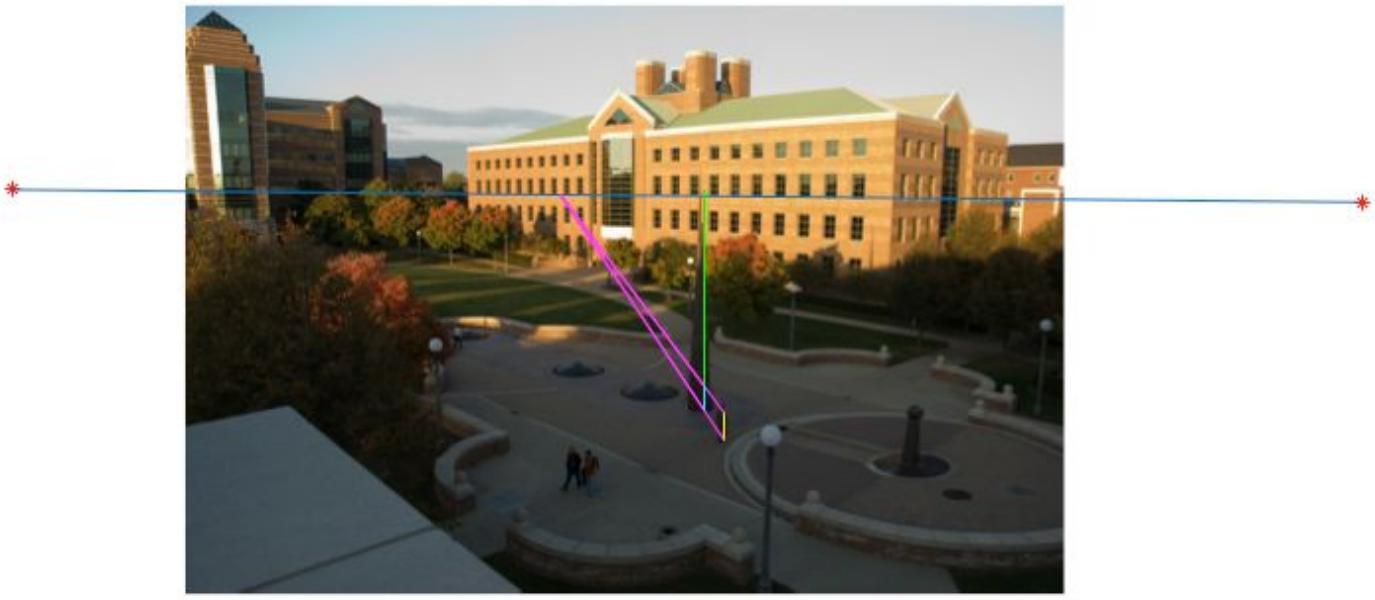
-0.7247	0.0094	0.6890
0.1098	-0.9855	0.1290
0.6802	0.1691	0.7132

4. Estimate heights

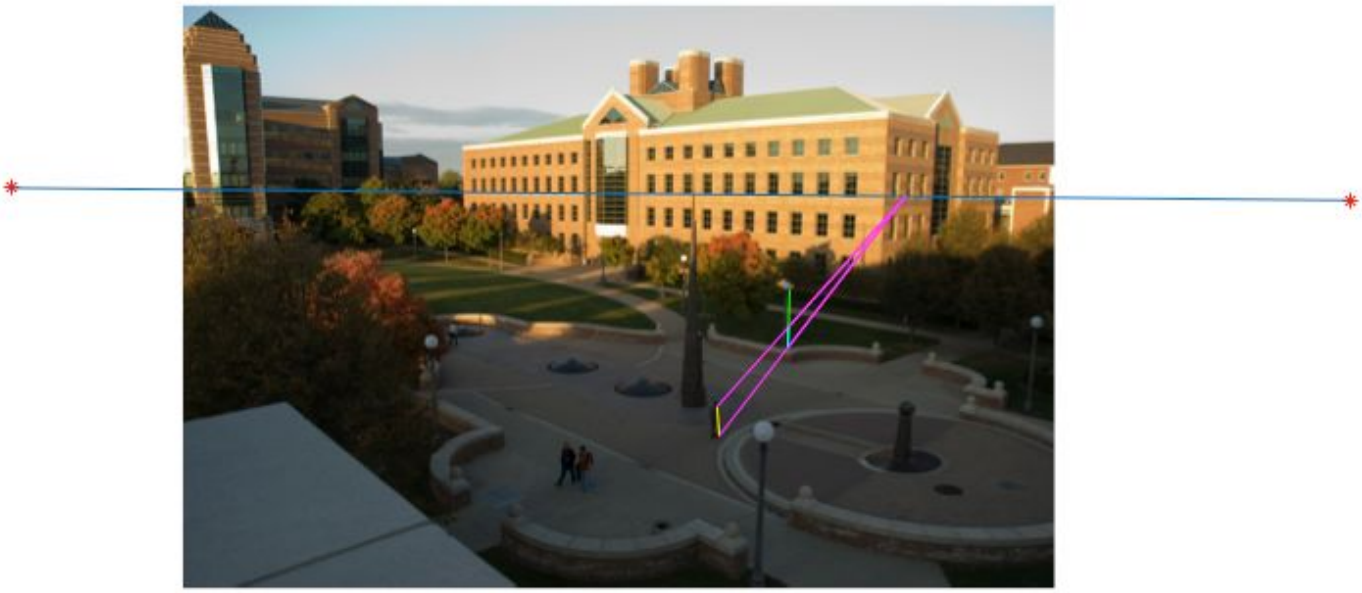
(a) the CSL building
height = 2.0884e+03 cm (reference 5ft 6in)
height = 2.4440e+03 cm (reference 6ft)



(b) the spike statue
height = 1.4383e+03 cm (reference 5ft 6in)
height = 2.0716e+03cm (reference 6ft)



(c) the lamp posts
height = 470.8359cm (reference 5ft 6in)
height = 512.3950cm (reference 6ft)



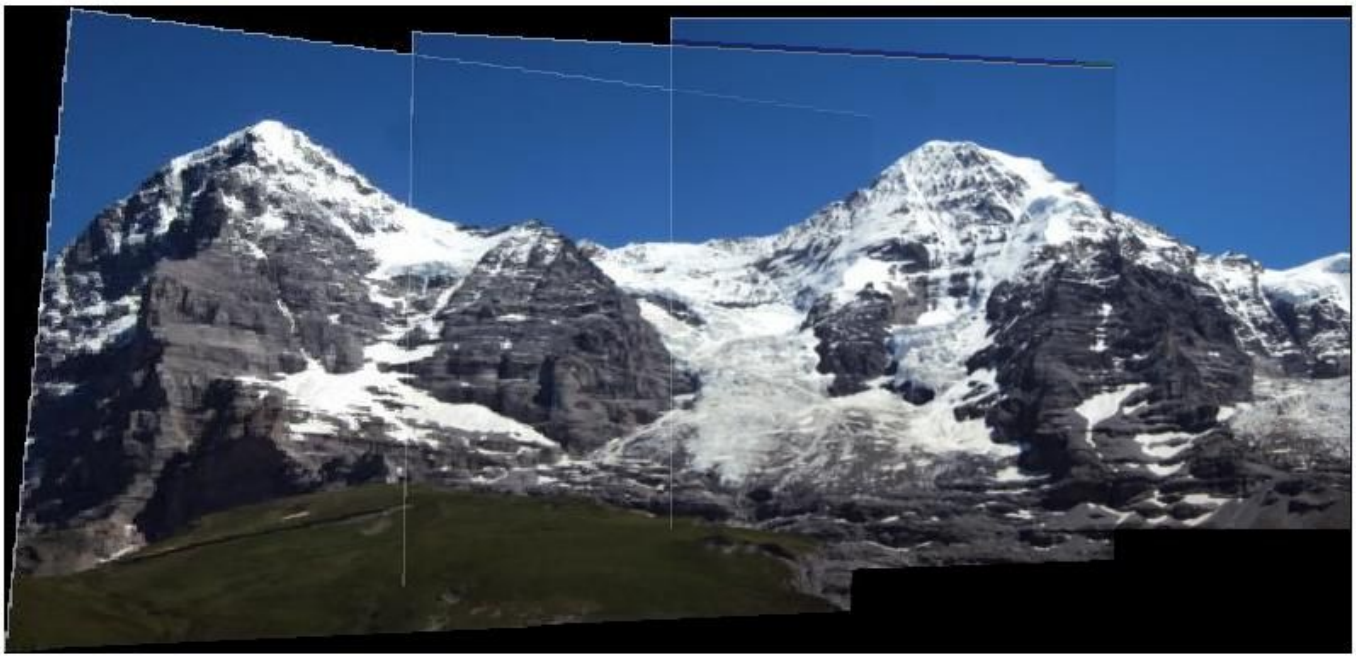
Extra Credit

Part1

Multiple image stitching

Hill:

Match of first two image of hill: num_of_inliers = 78 mean_of_residual: 0.471676
Match with the 3rd image of hill: num_of_inliers = 80 mean_of_residual: 0.424192



Pier:

Match of first two image of pier: num_of_inliers = 65 mean_of_residual: 0.378784
Match with the 3rd image of pier: num_of_inliers = 59 mean_of_residual: 0.342921

Ledge:

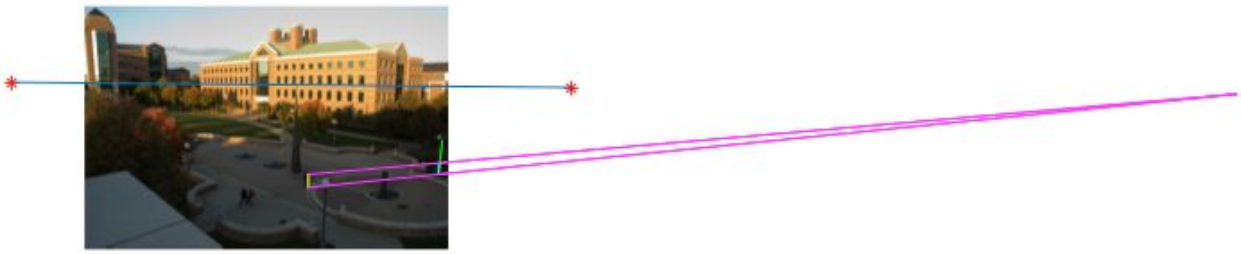
Match of first two image of ledge: num_of_inliers = 21 mean_of_residual: 0.356153
Match with the 3rd image of ledge: num_of_inliers = 50 mean_of_residual: 0.710728

The result for this image is not pleasant. I think this is because it is hard to tell that which image is the image in the middle. So I try both way. This is given by the order from left to right (1 -> 3 -> 2). If I changed to (1 -> 2 -> 3). It is even worse. It does not give result even after running for 1 min.

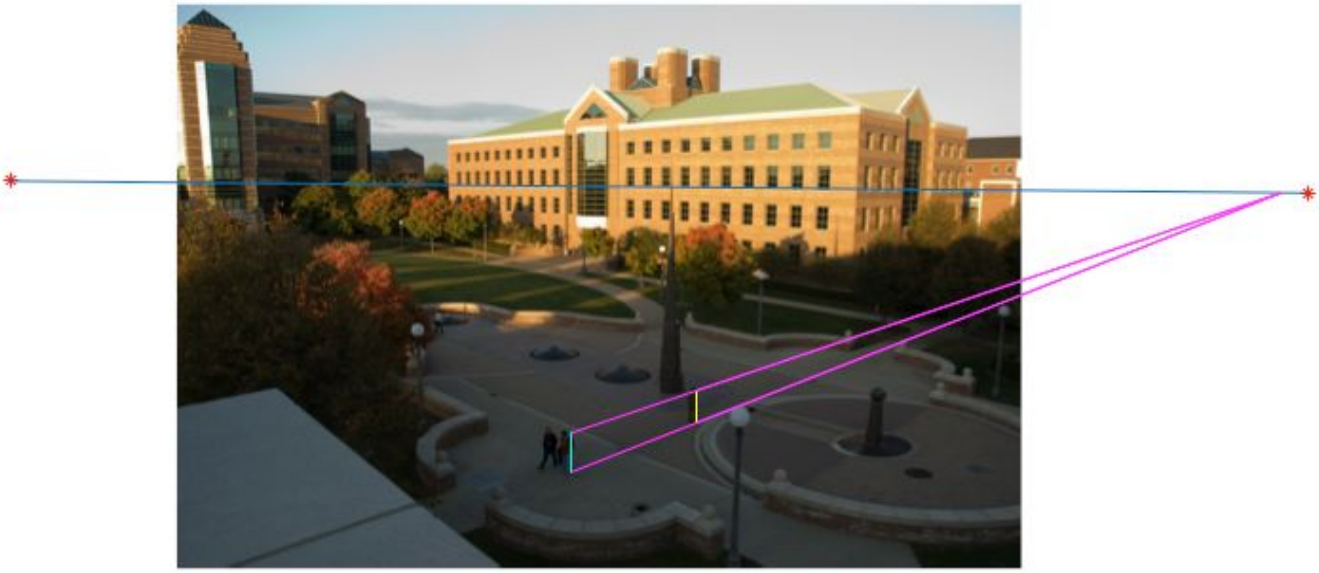
Part3

1. Additional measurements

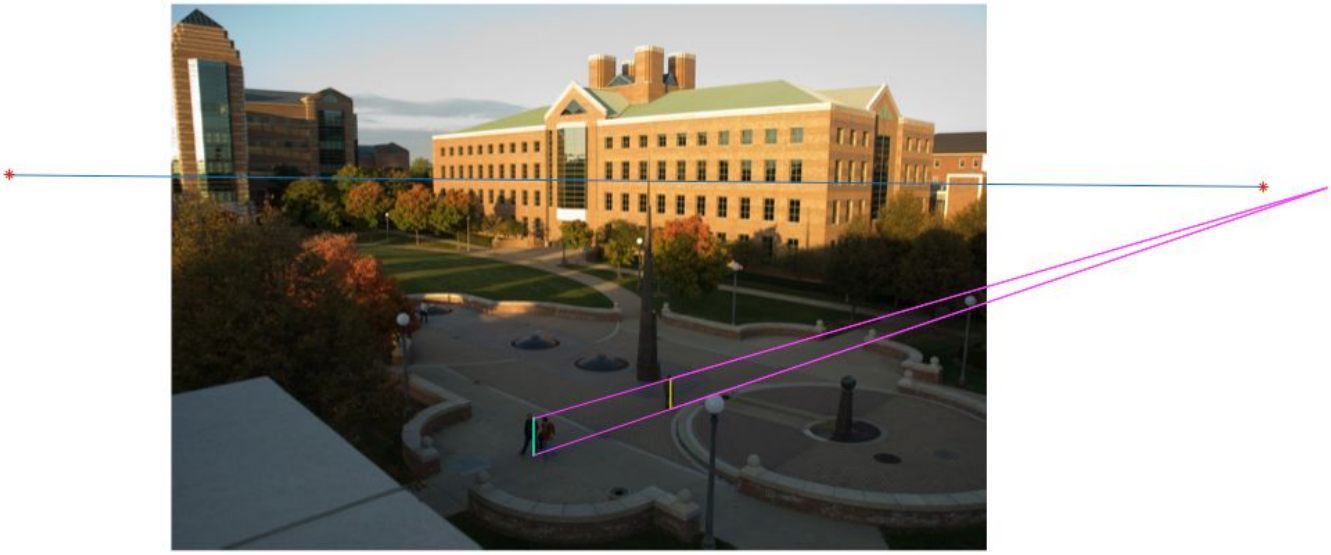
height = 499.1059cm (reference 5ft 6in tall) another lamp post



height = 162.4428 cm (reference 5ft 6in tall) for man on the right



height = 174.8212 cm (reference 5ft 6in tall) for man on the left



2. Compute and display rectified views of the ground plane and the facades of the CSL building.

I found this available code for Automated Rectification of Image on Github. Link to it : https://github.com/chsasank/Image-Rectification