CSE573 - HW3

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Stitching Pairs of Images

The solution technique I have implemented is as follows (the numbered description correspond to the steps we were required to follow) :

1) The two images were loaded and converted to grayscale (rgb2gray) and then double (im2double).

2) For feature detection, I have used the blob detection script I made as a part of HW2. I made a small change in the script - instead of returning individually the row and column coordinates and the radius of the blobs, I changed it to return a single matrix ' 'blobs' consisting of the rows of the corners detected in the first column, the column of the corners detected in the second column, and it's radius in the third column.

3) I have used the provided 'find_sift' function to create SIFT descriptors for each image. The SIFT descriptors provide a feature description by considering pixels around the radius of a corner location.

4) I have computed general matches between the two images using the descriptors of the images, by calculating the distance between the descriptors in one image and that in the other image. I have implemented Eucledian distance computation using the given 'dist2' function. I have implemented a putative threshold value and have only considered distances that fall within that threshold.

5) I have implemented a RANSAC model that estimates a homography between the matched points. In the RANSAC implementation, I have considered random points from the sample set (which is the set of all the matched points) and calculated the homography matrix as H = points for image left / points for image right. With a different random sample for each iteration, I have chosen the H value for the one that returns the highest number of inliers.

6) For warping one image onto the other, I have calculated the projected pixel coordinates for the right image using the homography matrix and the corresponding matched coordinates of the left image. Based on that I have calculated the dimensions of the right image and also the dimensions of the final image.

Values chosen for parameters:

For blob detection:

a) Initial sigma = 2
b) Number of scales = 12
c) K = 1.5

For SIFT descriptor:

a) Enlarge factor = 1.5

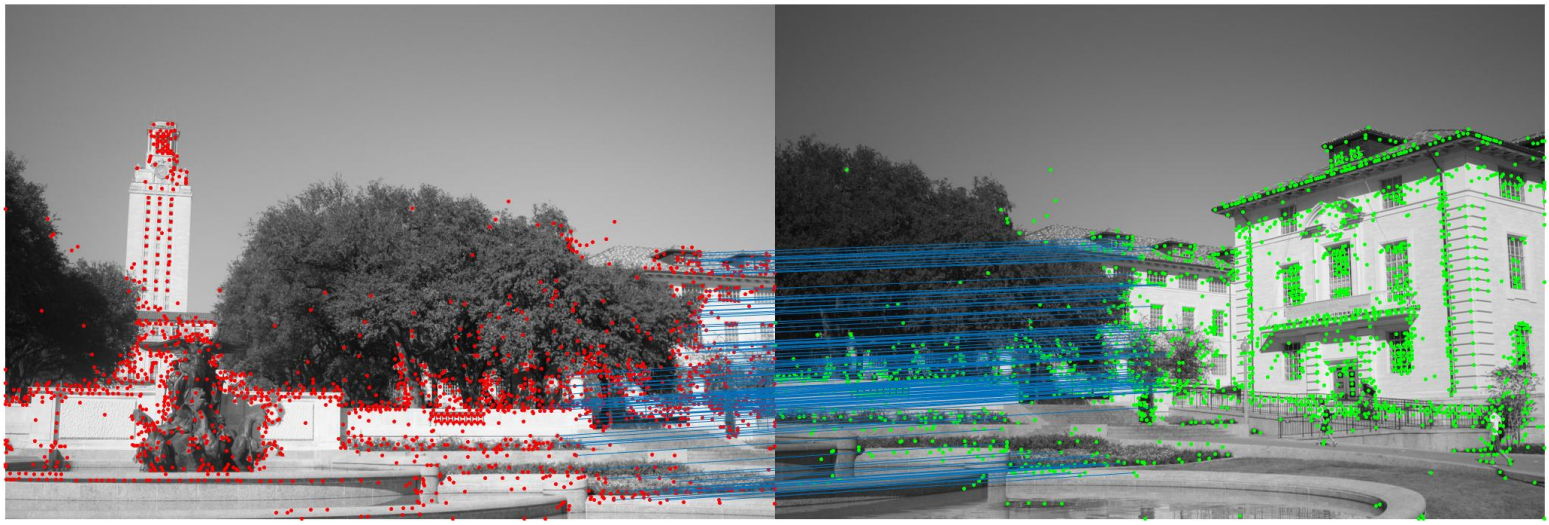
For RANSAC:

a) Iteration = 100
b) Threshold = 3

Putative Threshold = 0.8

Results:

Number of inliers = 89
Residual = 1.4928



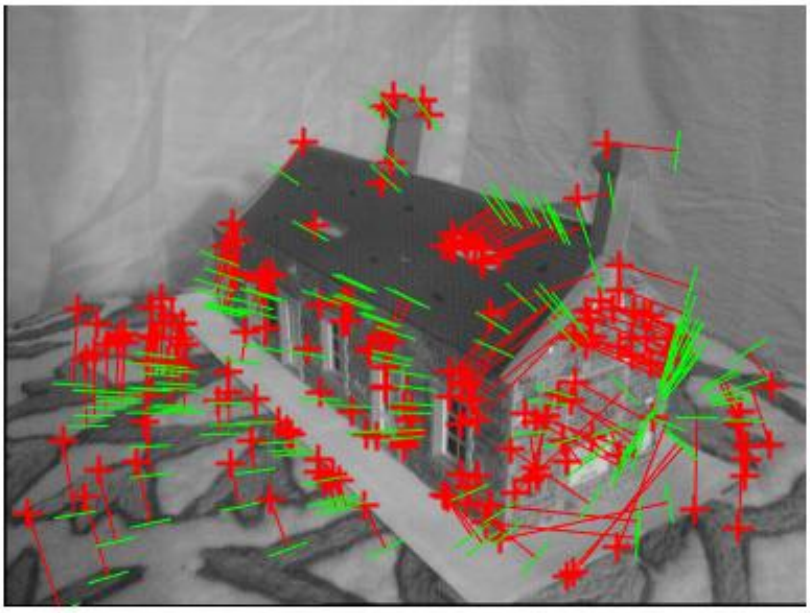
Matched Points

Stitched Image

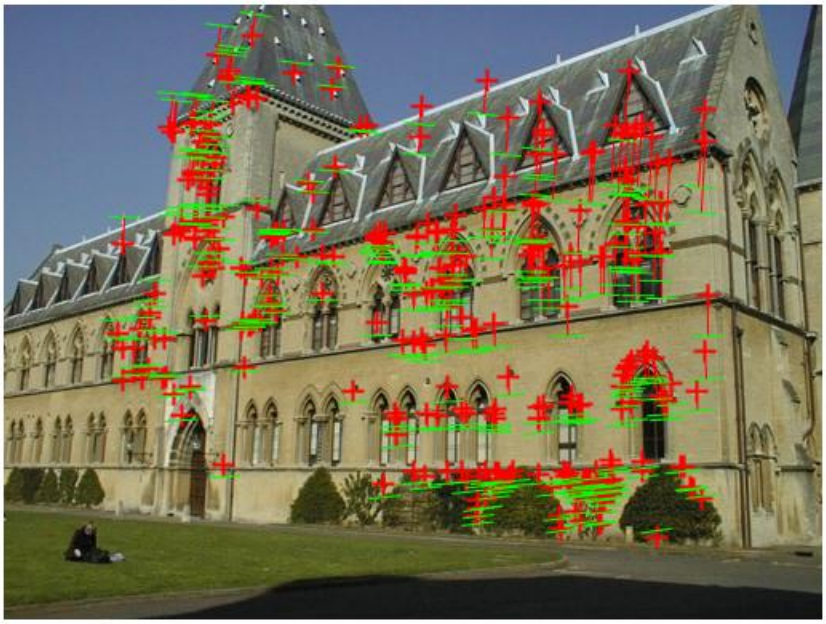
Fundamental Matrix Estimation and Triangulation

For unnormalized estimation:

Residual for the ‘house’ image = 14.5839

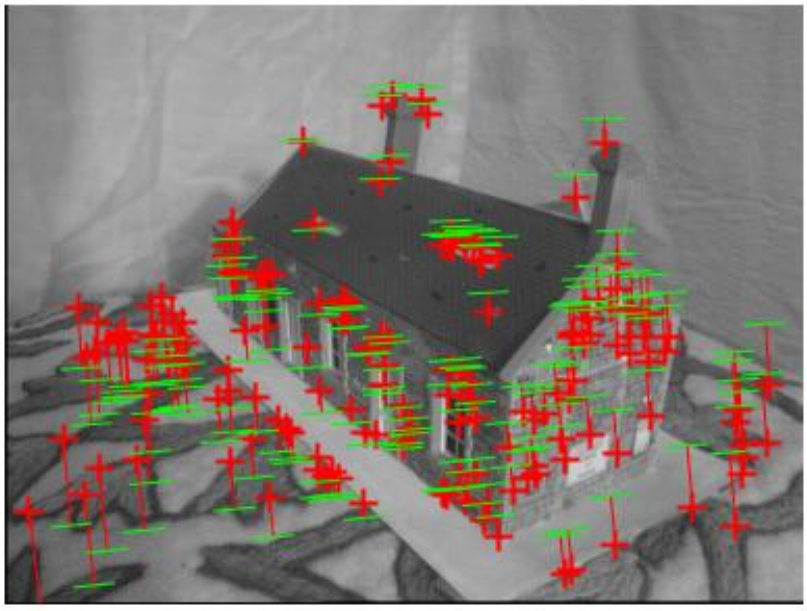


Residual for the ‘library’ image = 10.8974

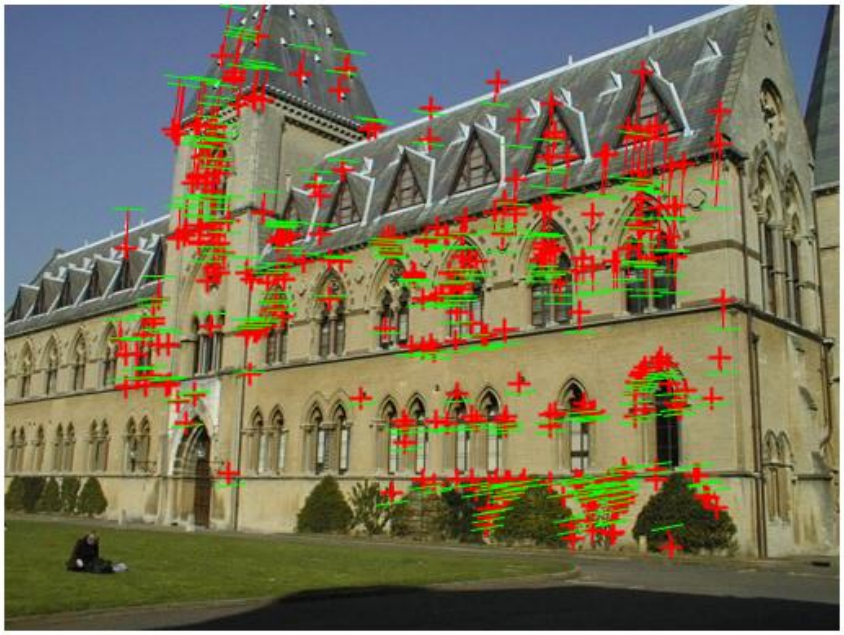


For normalized estimation:

Residual for the ‘house’ image = 26.7532



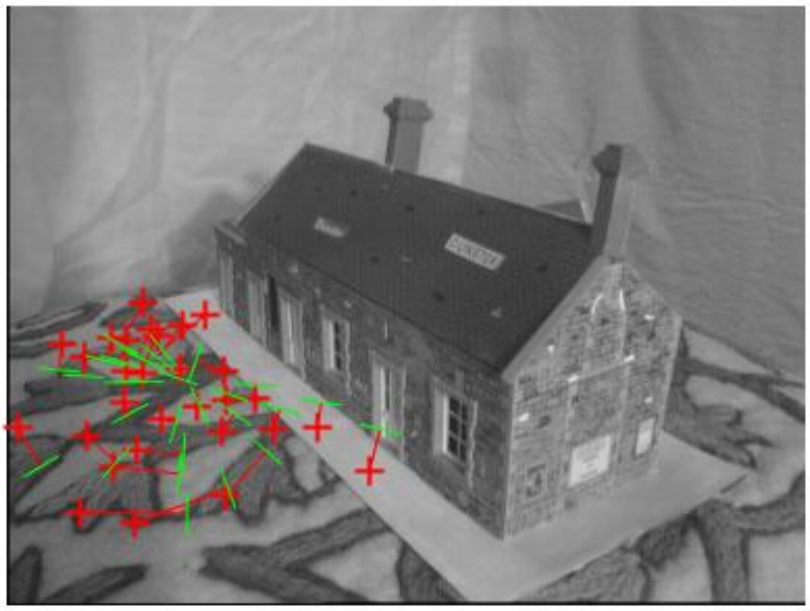
Residual for the ‘library’ image = 11.8459



For normalized estimation without ground truth matches:

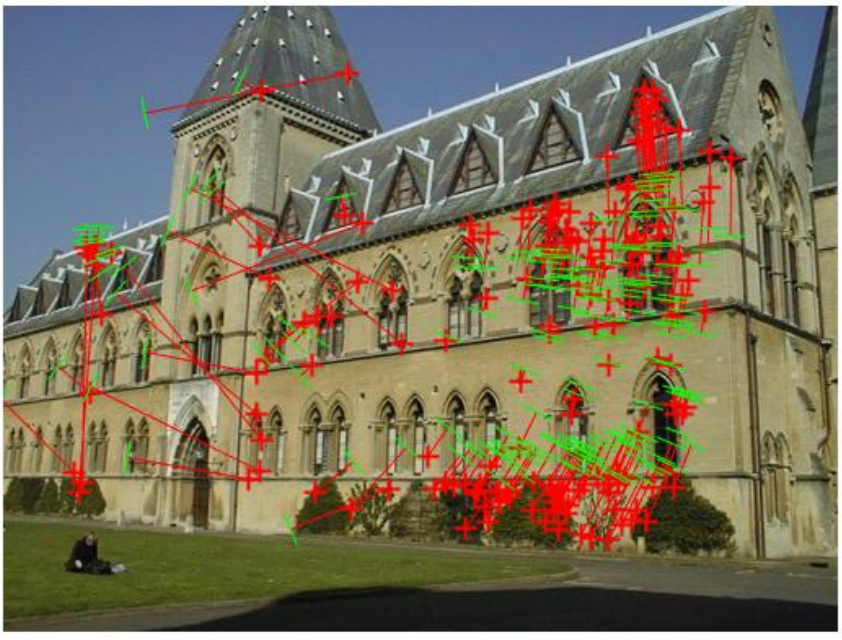
For the ‘house’ image:

Inliers = 29
Residual = 16.7781



For the ‘library’ image:

Inliers = 89
Residual = 31.0836



Quality Comparison

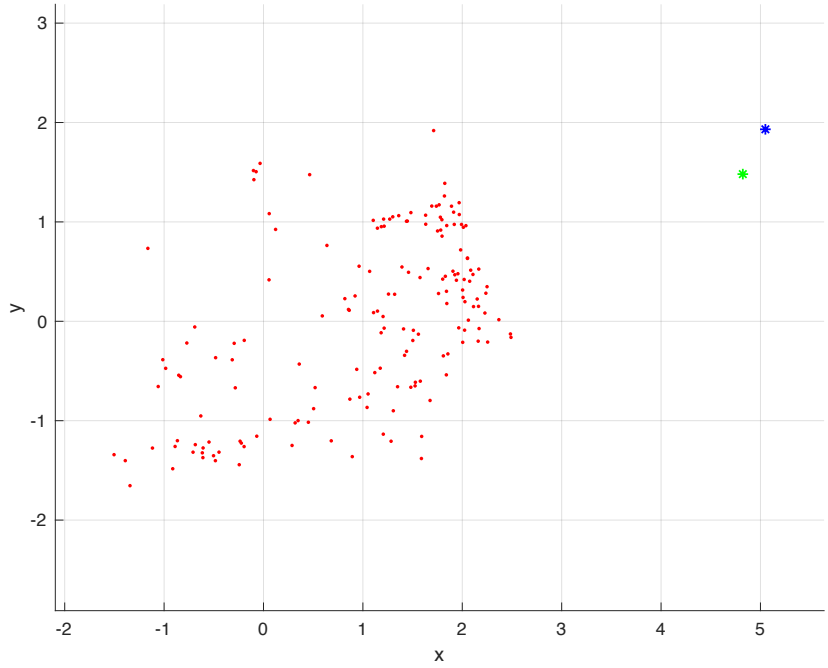
The method without the ground truth matches, in case of the ‘house’ image was unable to determine the matches in the side view and top view of the house maybe because poor corner detection due to the texture or matching error due to poor feature description. The RANSAC implementation might not be perfectly accurate because of which the best homography is obtained from imperfect matches (as indicated by the high residual value).
The ground truth results seemed to deliver a better quality result (which might be because of a poor implementation of the putative matches and RANSAC on my part).

Resources: https://www.mathworks.com/help/vision/examples/feature-based-panoramic-image-stitching.html?prodcode=VP&language=en

3D Camera Centers and Triangulated 3D Points:

- Green is camera center for image 1.
- Blue is camera center for image 2.
- Red are triangulated 3D points.

For the ‘house’ image:



For the ‘library’ image: