

# Project Report

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## *Stitching pairs of images*

Usage: `>> stitch_pair`

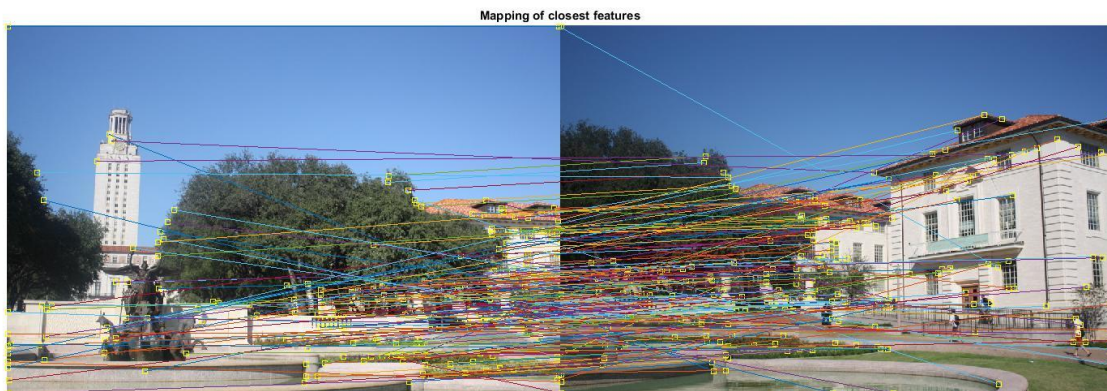
For Harris detector, the radius was chosen to be 2 so that the size of mask is 5. This was done based on the knowledge from previous project.

Different neighbor sizes were selected and tested, they are displayed below

Neighbor size = 3



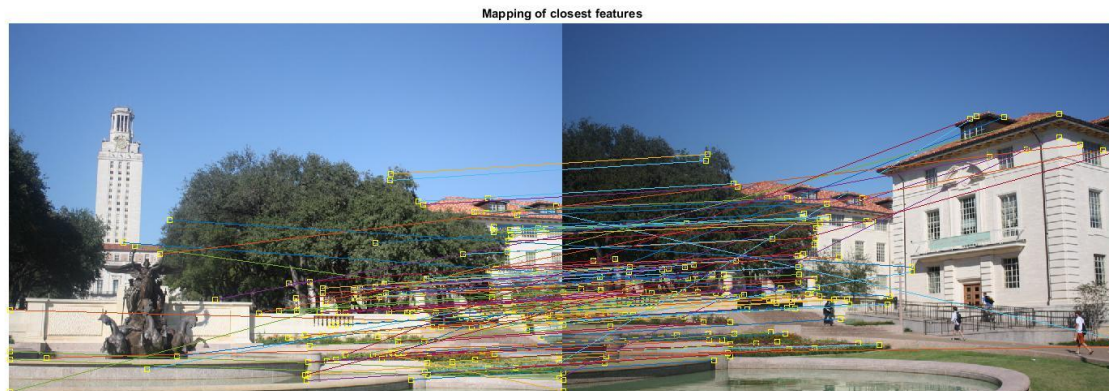
Neighbor size = 5



Neighbor size = 7



Neighbor size = 9



Neighbor size = 10



To get descriptors, top 200 points with minimum distance were selected.

RANSAC was applied on these feature points to get the inliers and residual error

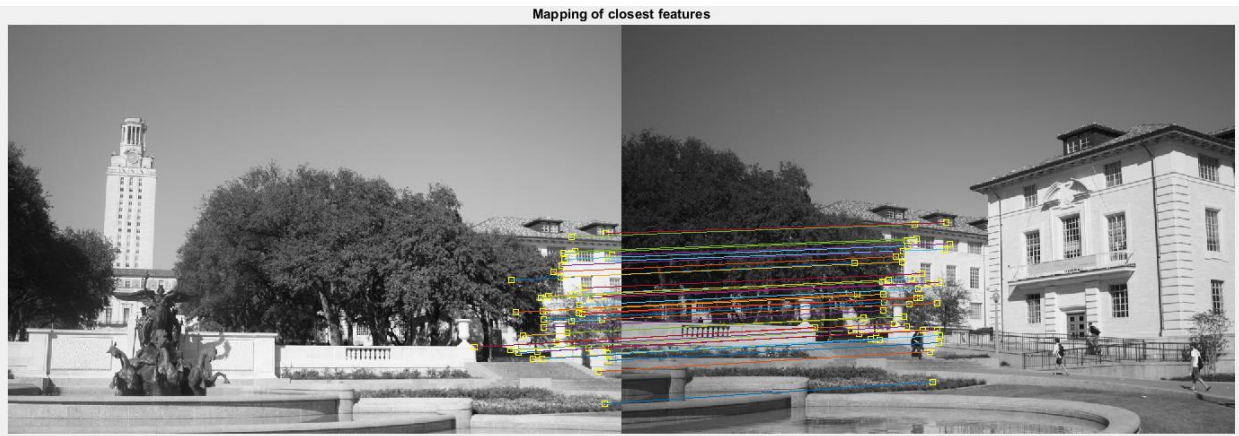


Number of Iterations = 200

Number of Inliers: 42

Mean Residual Error: 0.7743

With these inliers found the optimal features, see below

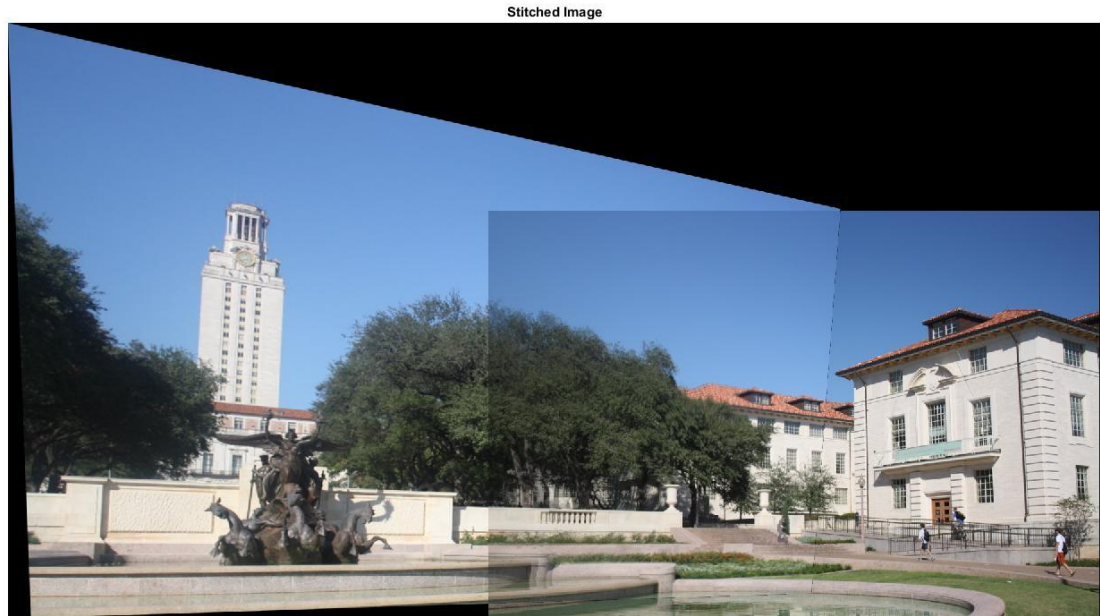


Homography transformed image was created. Instead of using maketform and imtransform, I used **projective2d** and **imwarp**.

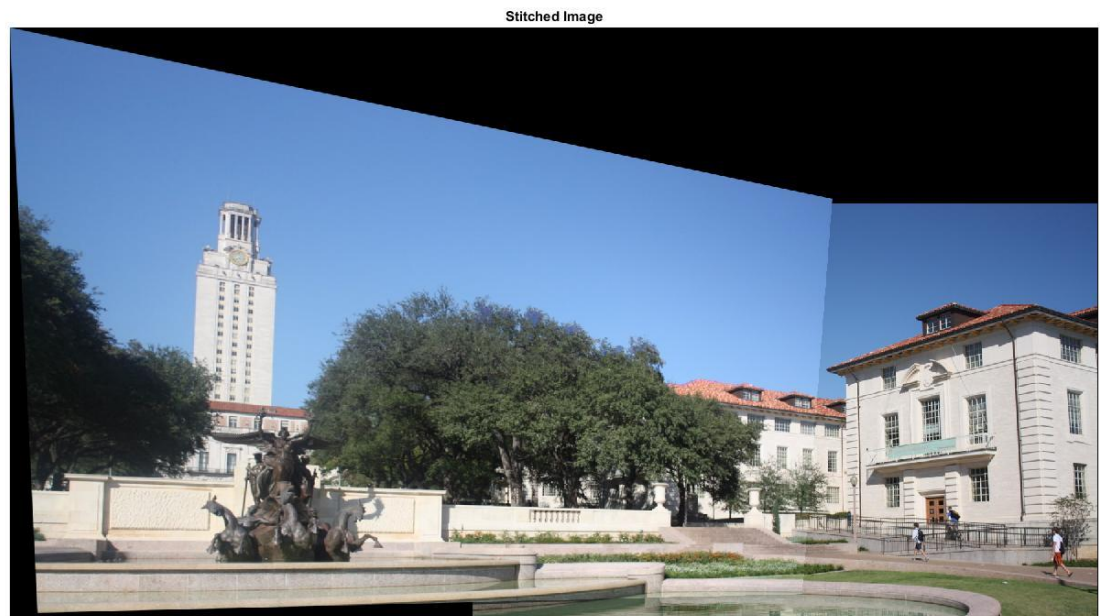


Finally the image was stitched. The following two approaches were taken to stitch the image

1.  $\text{stitched\_img} = \text{left\_img}/2 + \text{right\_img}/2$



2.  $\text{stitched\_img} = \max(\text{left\_img}, \text{right\_img})$   
The idea for trying this method was adopted from a reference link.



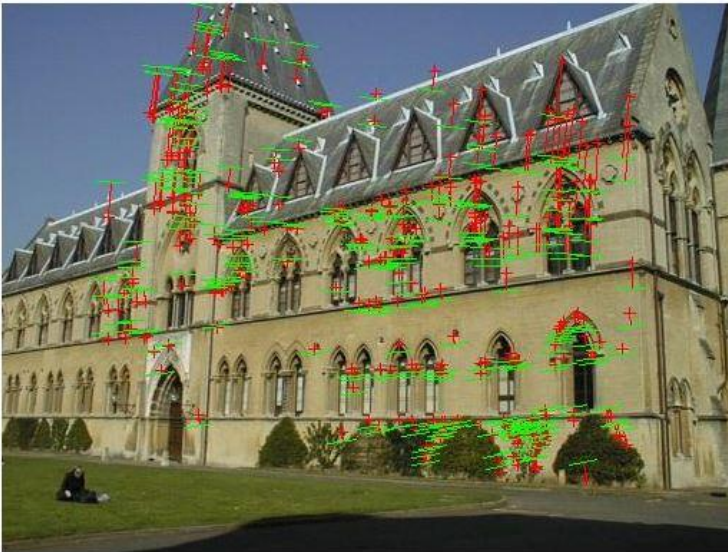
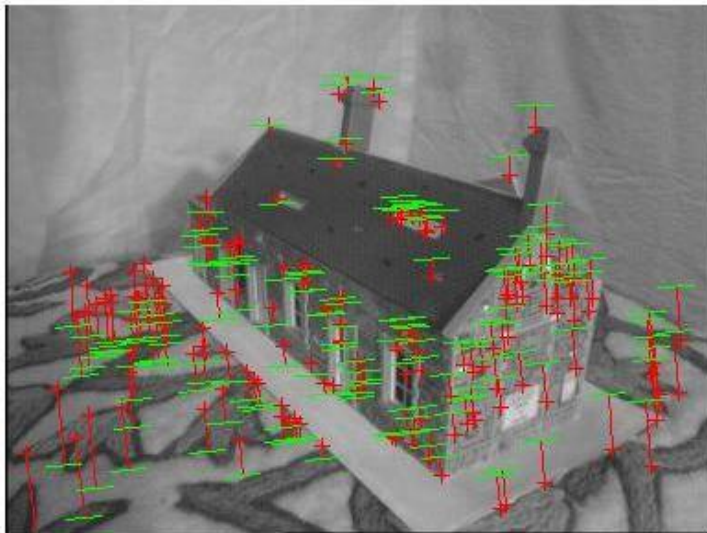
## *Fundamental Matrix Estimation and Triangulation*

Usage: >> sample\_code

The residual errors, mean squared distance between points in the 2 images and their corresponding epipolar lines, for normalized and un-normalized 8 point algorithm are given below

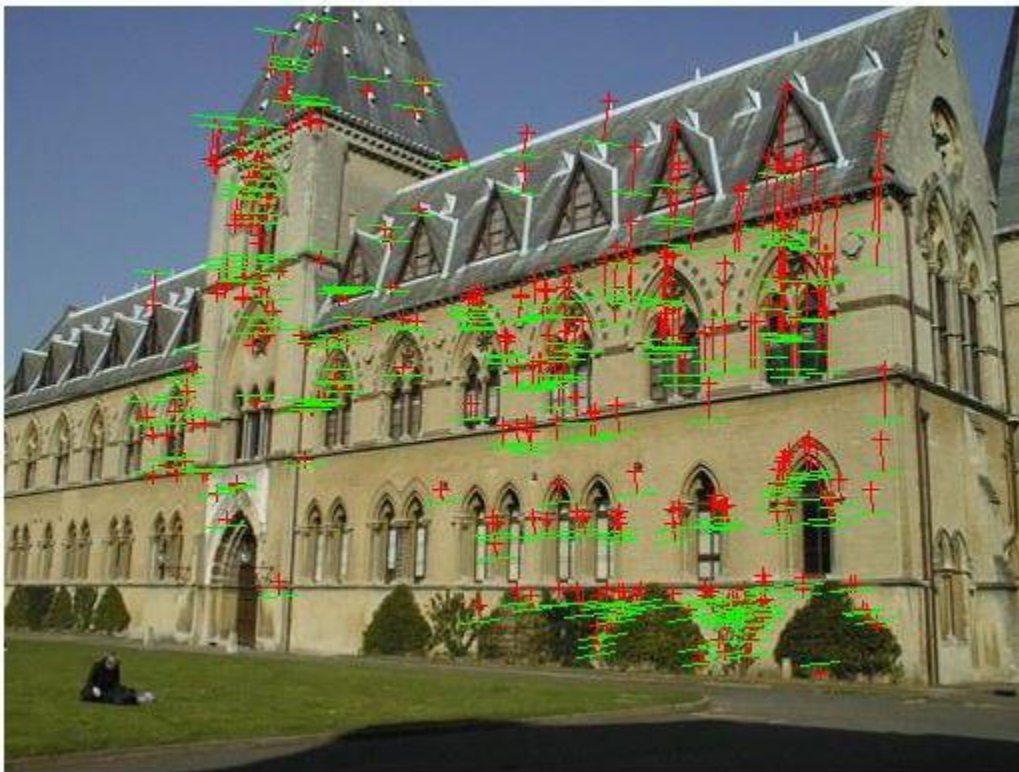
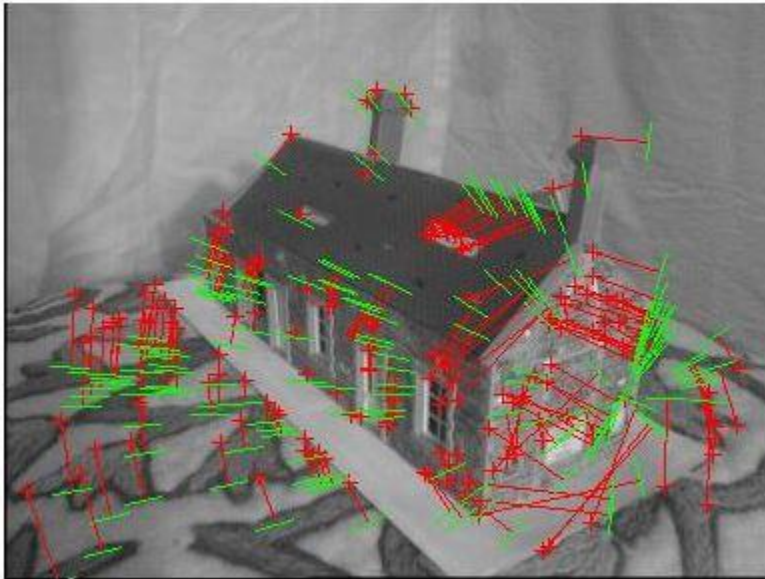
Image \ Algorithm	Normalized	Un-normalized
House	15.4492	26.7532
Library	20.8026	11.8459

Normalized Algorithm:





Un-normalized Algorithm:



For Fundamental matrix using RANSAC and normalized algorithm, the following results were obtained based on different threshold values

Image	Num of Iterations	Threshold	RANSAC num of points		Num of Inliers	Mean Residual Error
House	200		10	4	67	15.0827
			7		36	17.3419
			15		114	12.713
Library	200		15	4	182	13.9331
			12		114	16.253
			10		112	13.8316

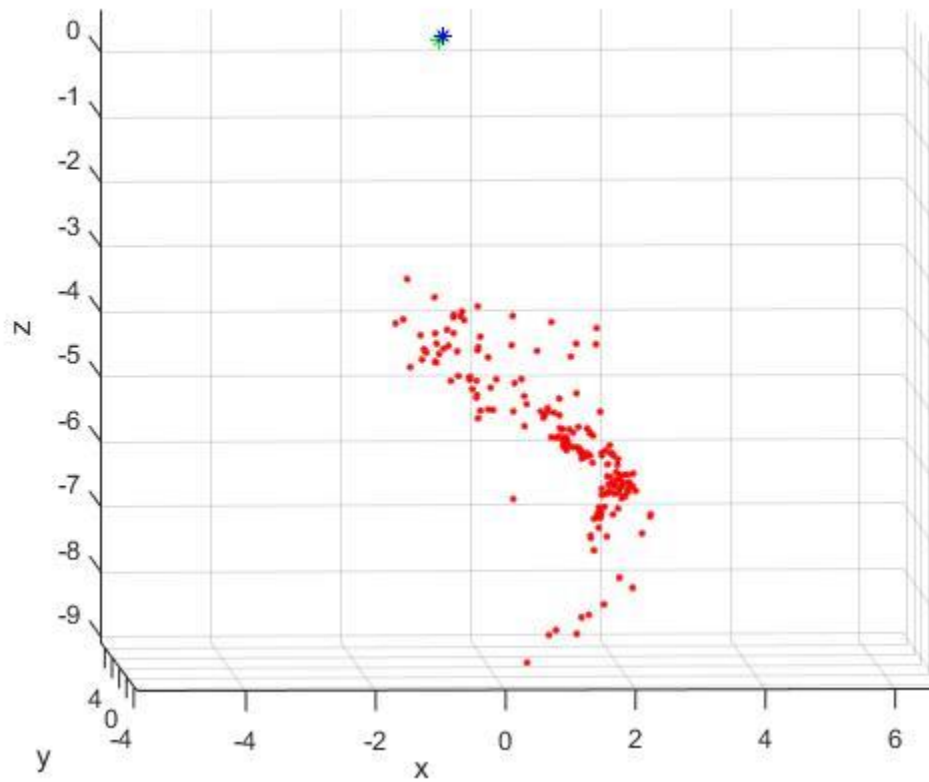
Mean residual error between 2D and 3D points for both images are given below,

Image	House 1 image	House 2 image	Library 1 image	Library 2 image
Mean between 2D and 3D points	0.0025	0.1566	0.0731	0.2677

The 3D plot of the images are attached below,

House Image:

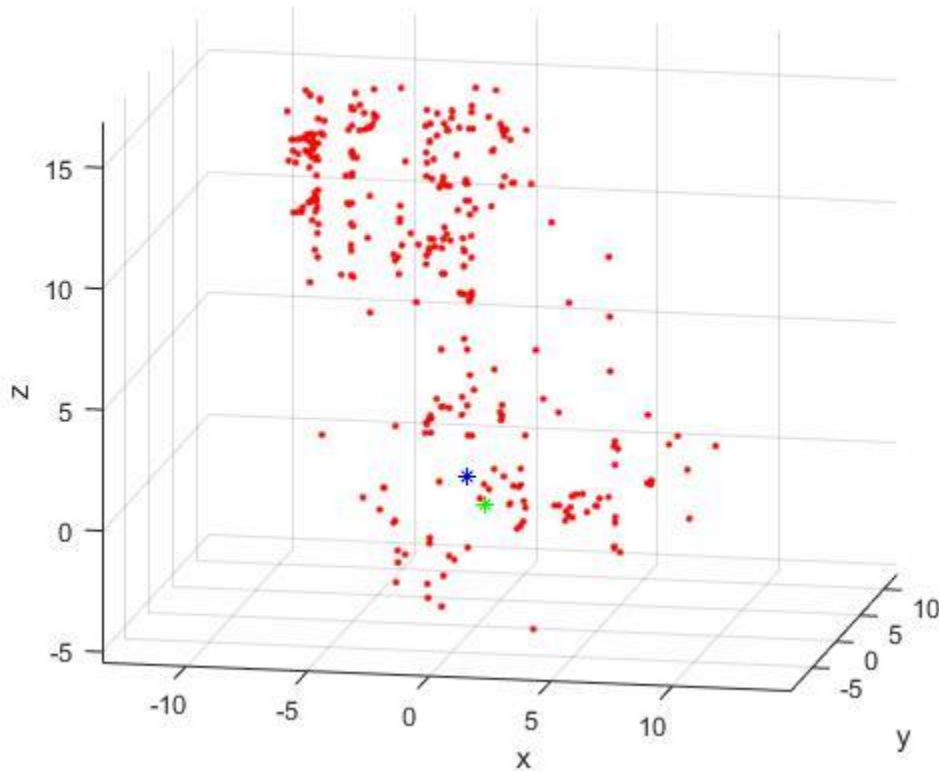
Front facing angle.





Library Image:

Front facing angle.



#### References:

1. Lecture slides
2. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.186.5926&rep=rep1&type=pdf>
3. <http://home.deib.polimi.it/boracchi/teaching/IAS/Stitching/stitch.html>
4. [https://en.wikipedia.org/wiki/Eight-point\\_algorithm](https://en.wikipedia.org/wiki/Eight-point_algorithm)
5. [https://en.wikipedia.org/wiki/Triangulation\\_\(computer\\_vision\)](https://en.wikipedia.org/wiki/Triangulation_(computer_vision))
6. <https://mliu.physics.ucsd.edu/estimation-fundamental-matrix.pdf>
7. <https://www.coursera.org/learn/robotics-perception/lecture/Bwk0d/epipolar-geometry-i>