CS 6476 Project 4

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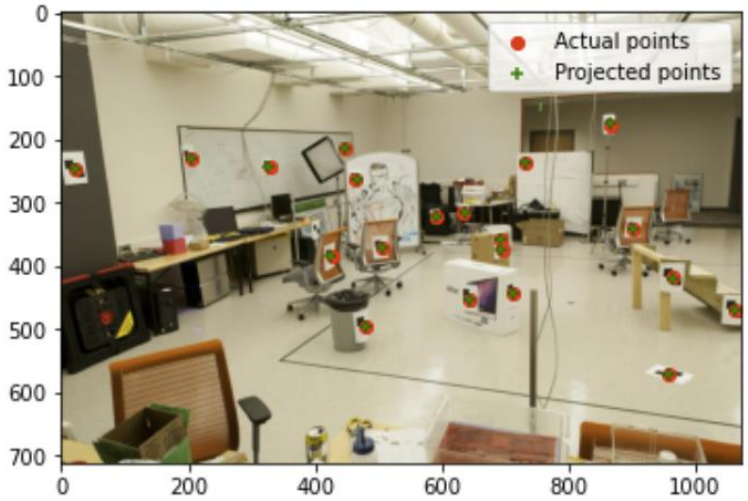
Part 1: Projection Matrix

```
Time since optimization start 0.027949094772338867
The projection matrix is
 [[-2.04554518e+00  1.18126398e+00  4.05587442e-01  2.44822721e+02
 [-4.55828614e-01 -3.04147909e-01  2.14988388e+00  1.66188160e+02]
 [-2.24222878e-03 -1.09957014e-03  5.71551337e-04  1.00000000e+00]
The total residual is 14.711498
```

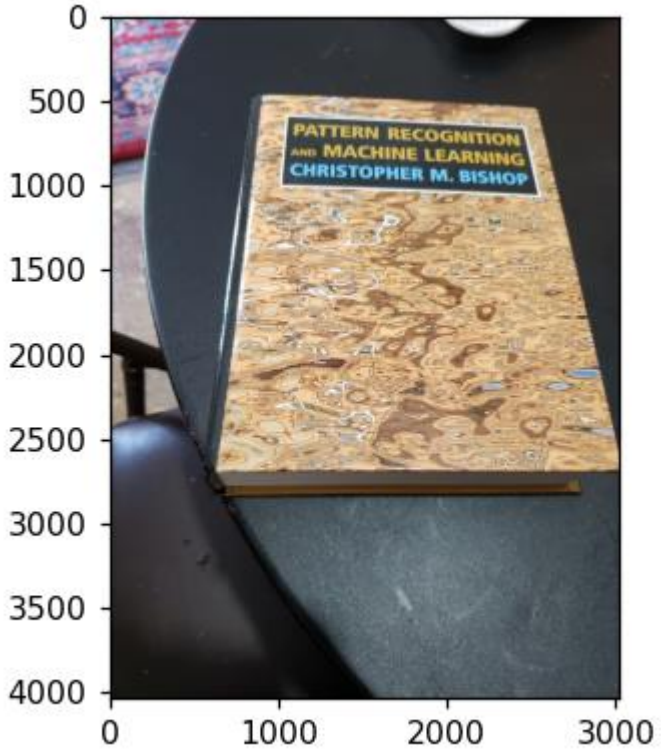


Part 1: Projection Matrix

At least how many 3D-2D point correspondences do you need to estimate the projection matrix? Why?

Roughly around 8 point, since that number reduced the residual the most. Each point corresponded to edges.

Part 2: Estimation with Your Own Images



Part 2: Estimation with Your Own Images

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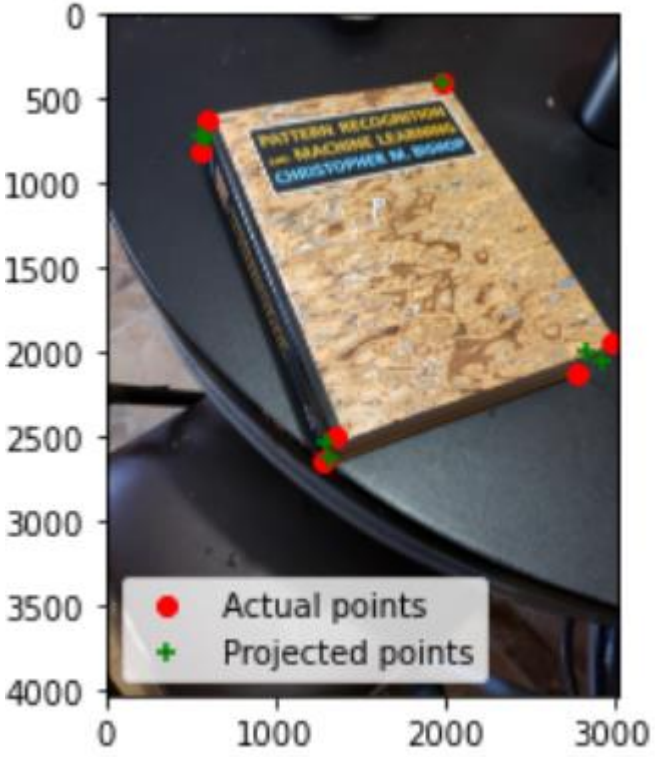
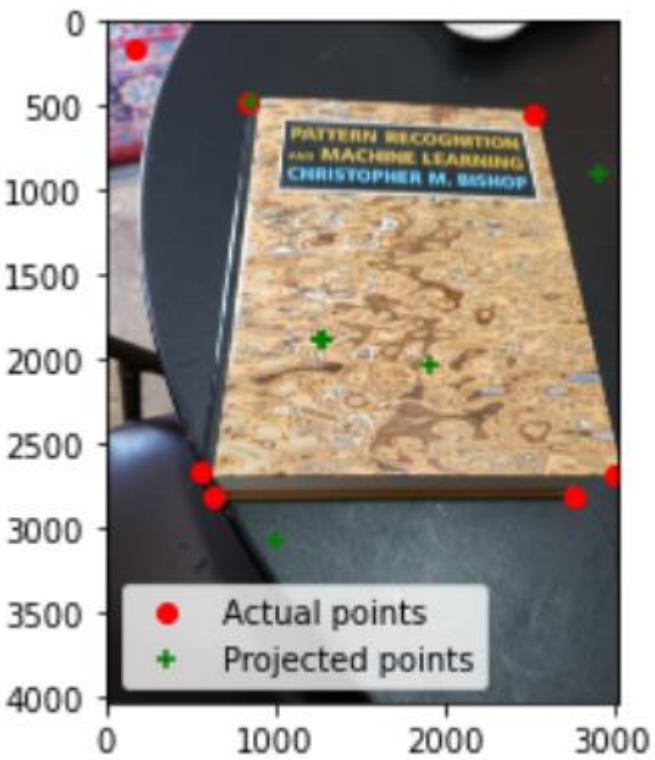
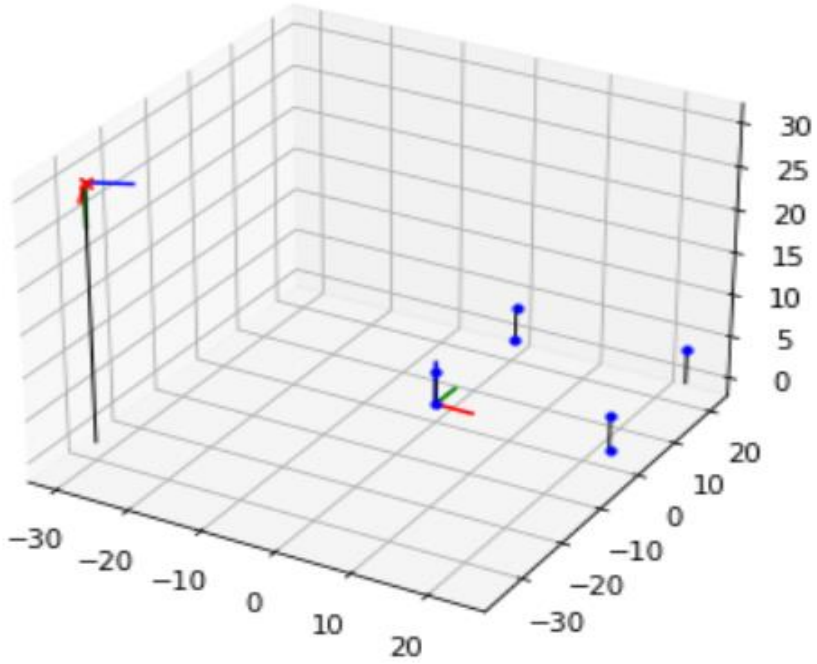
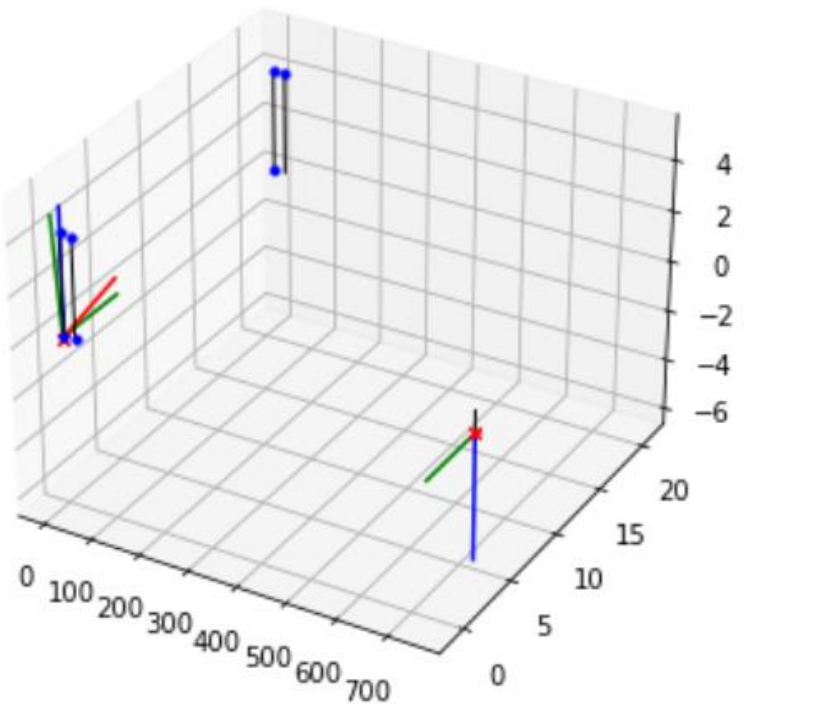




Part 2: Estimation with Your Own Images

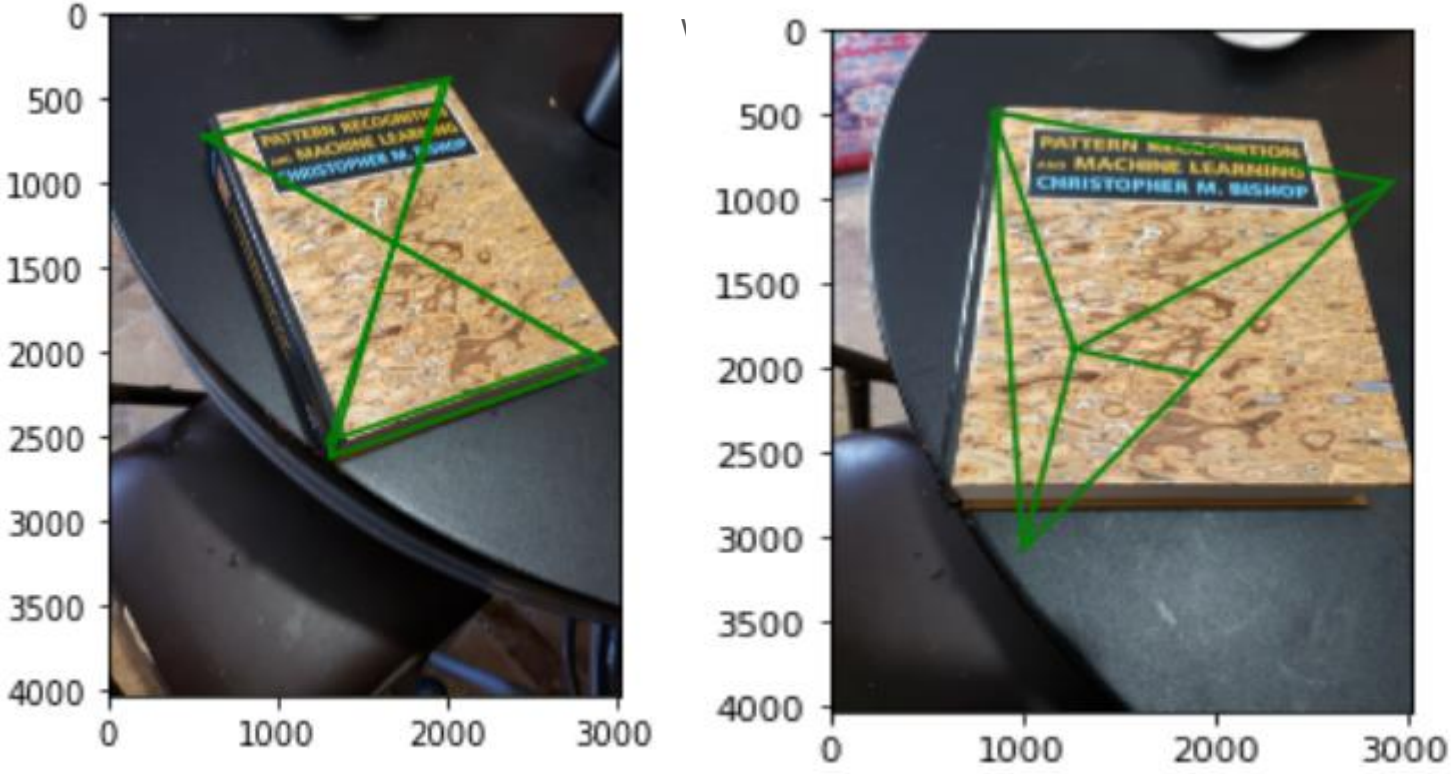




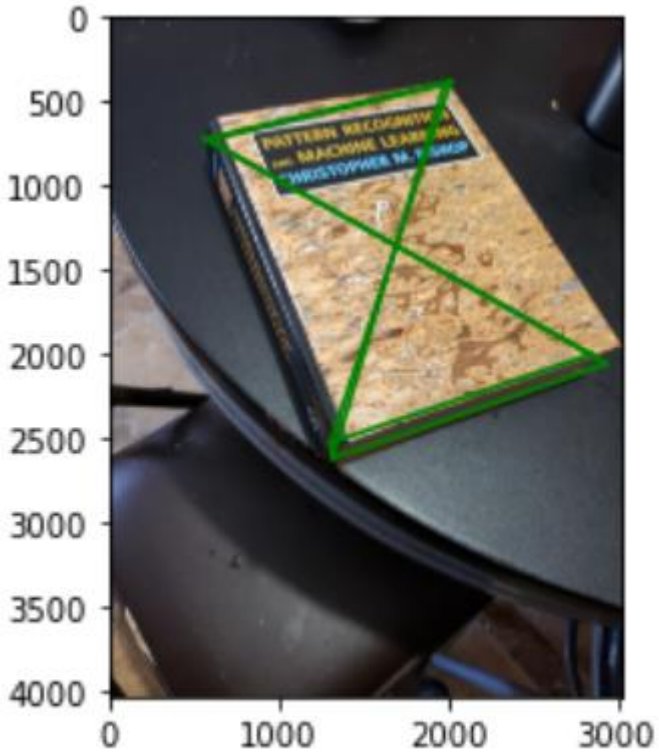
Part 2: Estimation with Your Own Images

- What would happen to the projected points if you increased/decreased the x coordinate, or the other coordinates of the camera center t? Write down a description of your expectations in the appropriate part of your writeup submission.
- Perform this shift for each of the camera coordinates and then recompose the projection matrix and visualize the result in the Jupyter notebook. Was the visualized result what you expected?

Part 2: Estimation with Your Own Images



Part 3: Camera Coordinates



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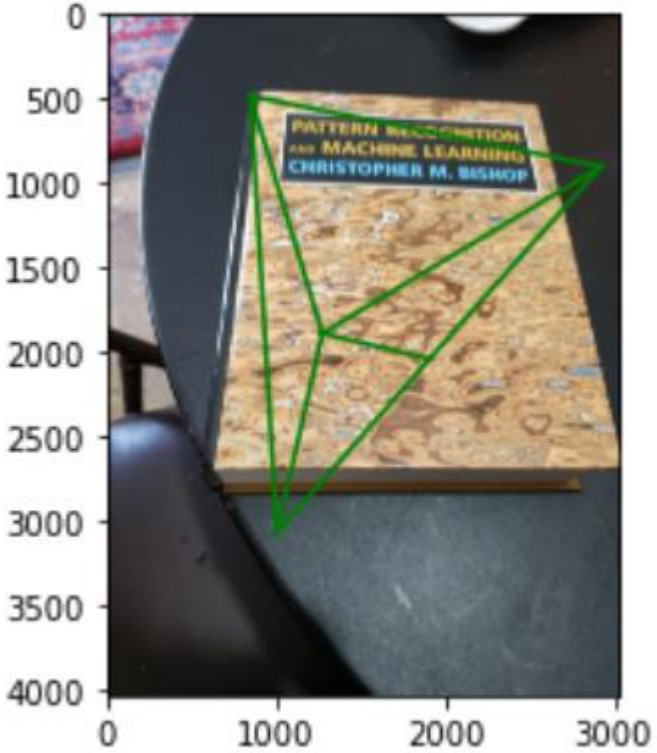


Part 3: Camera Coordinates

The first three rows of the transformation matrix are just the extrinsic parameters of our camera, why is that?

Say if we know the coordinates of 3D points in camera 1 coordinate system, and we want to transform them into camera 2 coordinate system, what should we do? You may assume that the poses of both cameras are known.

Part 4: DLT

<insert visualization of projected 3D points and actual 2D points for image provided by us and the total residual here>

Part 4: DLT

Why do we need the cross product trick?

Because X crossed with PX = 0, the cross product of two vectors of same direction is zero hence the equality removes the scale factor. So, the cross product should be zero.

We pick up the eigenvector with the smallest eigenvalue. Will this eigenvalue be exactly zero? Why/why not?

No, because we do not consider zero vector for eigenvector.

EC: RANSAC Iterations Questions

How many RANSAC iterations would we need to find the fundamental matrix with 99.9% certainty from your Mount Rushmore and Notre Dame SIFTNet results assuming that they had a 90% point correspondence accuracy?

14 iterations

One might imagine that if we had more than 9 point correspondences, it would be better to use more of them to solve for the fundamental matrix. Investigate this by finding the number of RANSAC iterations you would need to run with 18 points.

We need 42 iterations

If our dataset had a lower point correspondence accuracy, say 70%, what is the minimum number of iterations needed to find the fundamental matrix with 99.9% certainty?

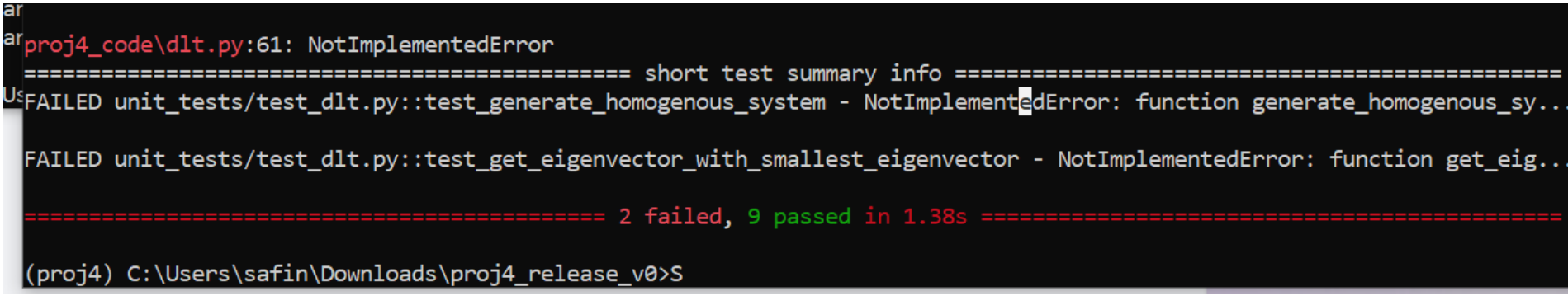
167 iterations is needed.

EC: RANSAC

<insert the number of inliers from your best model here>

<insert the image and total residual here>

Tests


proj4_code\dlt.py:61: NotImplementedError
========== short test summary info ==========
FAILED unit_tests/test_dlt.py::test_generate_homogenous_system - NotImplementedError: function generate_homogenous_sy...
FAILED unit_tests/test_dlt.py::test_get_eigenvector_with_smallest_eigenvector - NotImplementedError: function get_eig...
========== 2 failed, 9 passed in 1.38s ==========
(proj4) C:\Users\safin\Downloads\proj4_release_v0>S

Conclusions

<Describe what you have learned in this project. Feel free to include any challenges you ran into.>

I learned the difference between camera center, rotation matrix, intrinsic matrix and project matrix. Transforming points in the world coordinate system to camera coordinate system.

The main challenge I faced during this project was the fact that I didn’t understand the concept fully. I gather more information online and saw what TAs posted on Piazza which gave me a better understanding.