CSCI 677 Homework 3

Structure from Motion

Nikhit Mago
ID: 1239414525

1. Analysis of results

The SFM pipeline works well and creates decent 3d points for the 3 images. The first pair (01) has the best reconstruction, followed by the second and third. I would try to improve the quality of the reconstruction by firstly getting more images, then using a more robust feature matching algorithm, experimenting more with ratio test. I feel like the number of inlier matches could improve by focussing on higher recall. I feel that doing bundle adjustment of all 3 pairs would also improve the quality of reconstruction as it minimizes the loss function. Images 1,2 gave the most amount of matches but has the worst 3d construction. This means that better features need to be extracted from the pair of images with higher recall.

2. Numerical Results

0-1 pair

```
Rotation Matrix:

[[ 9.97716915e-01  1.81644432e-03  6.75104254e-02]
 [-5.13681684e-04  9.99813421e-01 -1.93095585e-02]
 [-6.75329041e-02  1.92307942e-02  9.97531695e-01]]

Translation Matrix:

[[-0.96637982]
 [ 0.05989382]
 [ 0.25004554]]

Projection Matrix:

[[ 1.33493627e+03  1.73255119e+01  8.61570558e+02 -1.15090876e+03]
 [-3.45216945e+01  1.39613889e+03  4.72621373e+02  2.08240502e+02]
 [-6.75329041e-02  1.92307942e-02  9.97531695e-01  2.50045537e-01]]
```

0-2 pair

```
Rotation Matrix:

[[ 0.99366447 -0.11114253 -0.01668106]
 [-0.11099209 -0.99377403  0.00969168]
 [-0.01765437 -0.00777881 -0.99981389]]

Translation Matrix:

[[-0.99695341]
 [ 0.05834013]
 [ 0.05177186]]

Projection Matrix:

[[ 1.36769080e+03 -1.60484328e+02 -7.92669860e+02 -1.34600502e+03]
 [-1.62758895e+02 -1.38203038e+03 -4.87101712e+02  1.06823145e+02]
 [-1.76543651e-02 -7.77880721e-03 -9.99813889e-01  5.17718640e-02]]
```

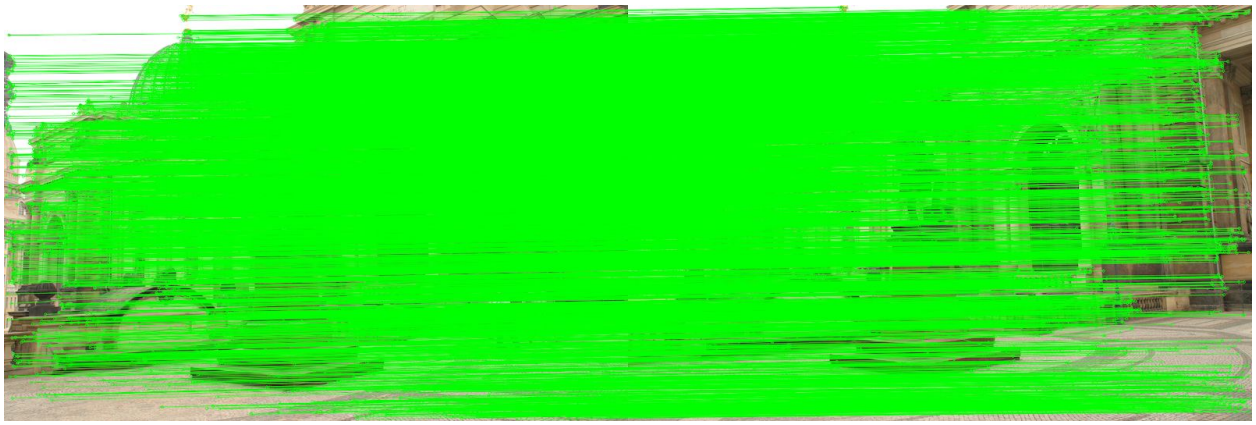
1-2 pair

```
Rotation Matrix:

[[ 0.99992043  0.00276777  0.0123073 ]
 [-0.00285546  0.99997062  0.0071133 ]
 [-0.01228725 -0.00714788  0.99989896]]

Translation Matrix:

[[ 0.98569327]
 [-0.00558125]
 [ 0.16845658]]

Projection Matrix:

[[ 1.38051778e+03 -1.65375124e+00  7.86655431e+02  1.49984579e+03]
 [-1.01112963e+01  1.38315080e+03  5.10448940e+02  7.65953456e+01]
 [-1.22872511e-02 -7.14787927e-03  9.99898961e-01  1.68456577e-01]]
```

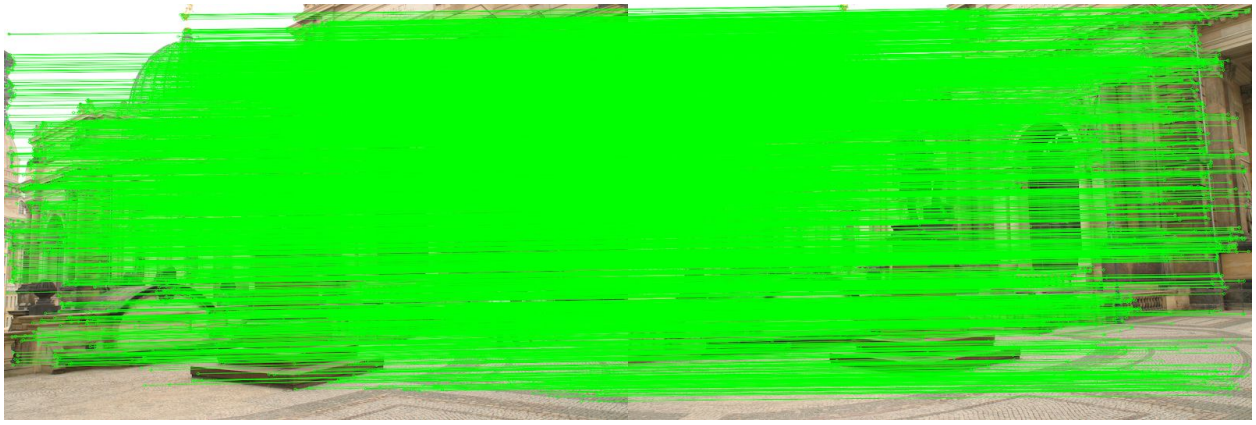
3. Visual Results

0-1 pair

SIFT match



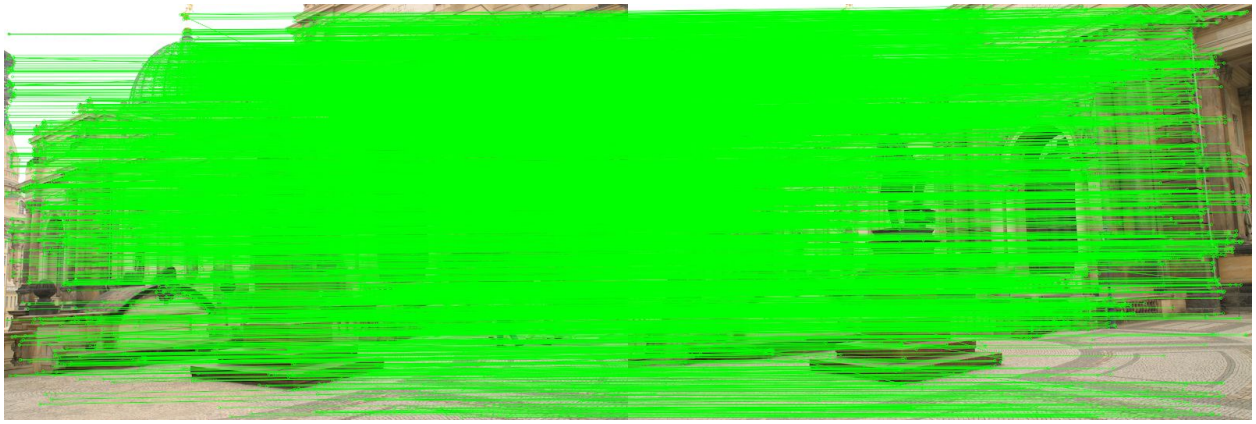
Inlier match



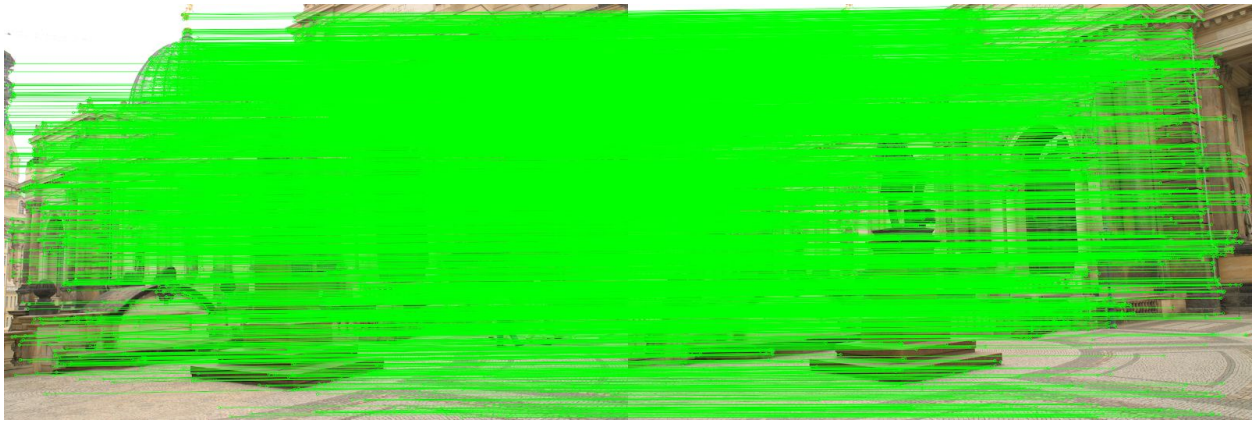
Epipolar lines

0-2 pair

SIFT match



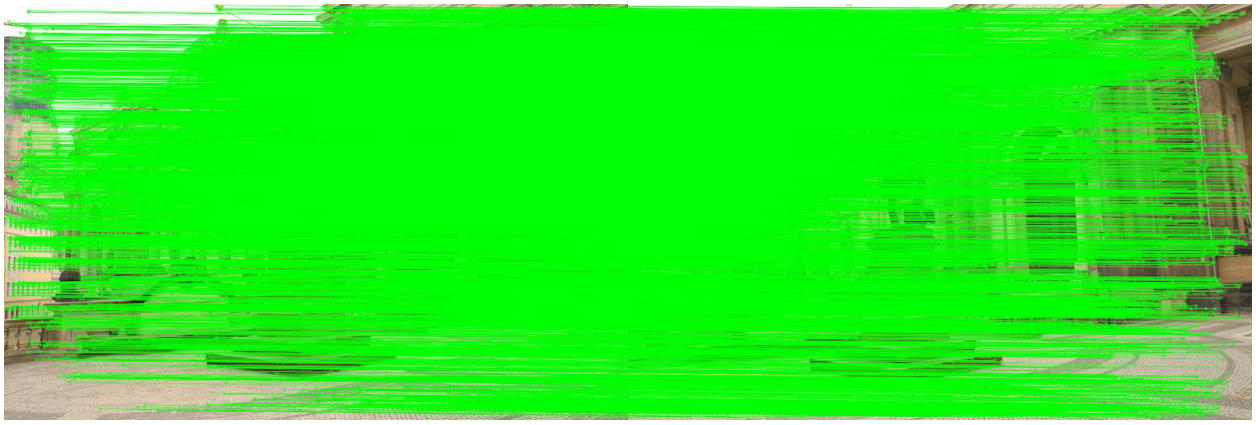
Inlier match



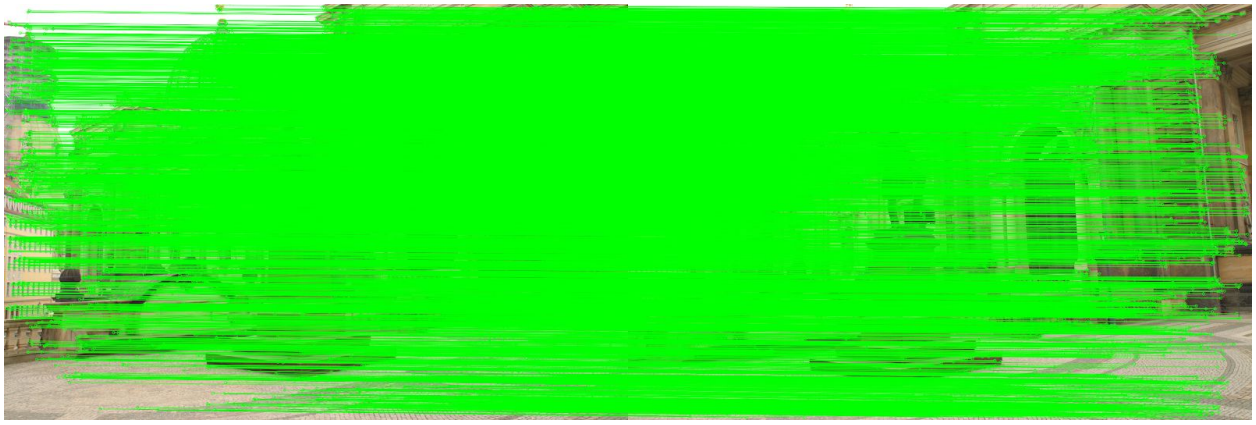
Epipolar lines

1-2 pair

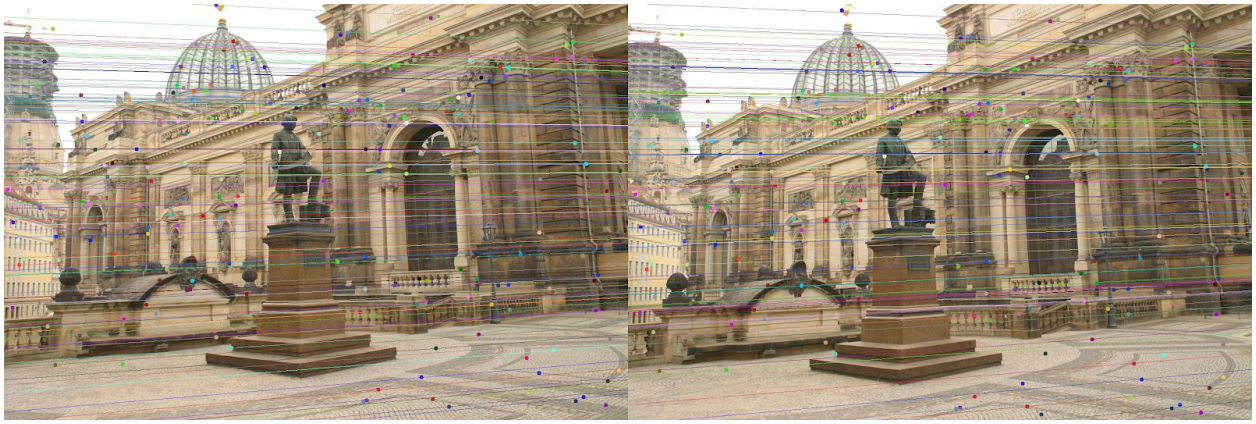
SIFT match



Inlier match

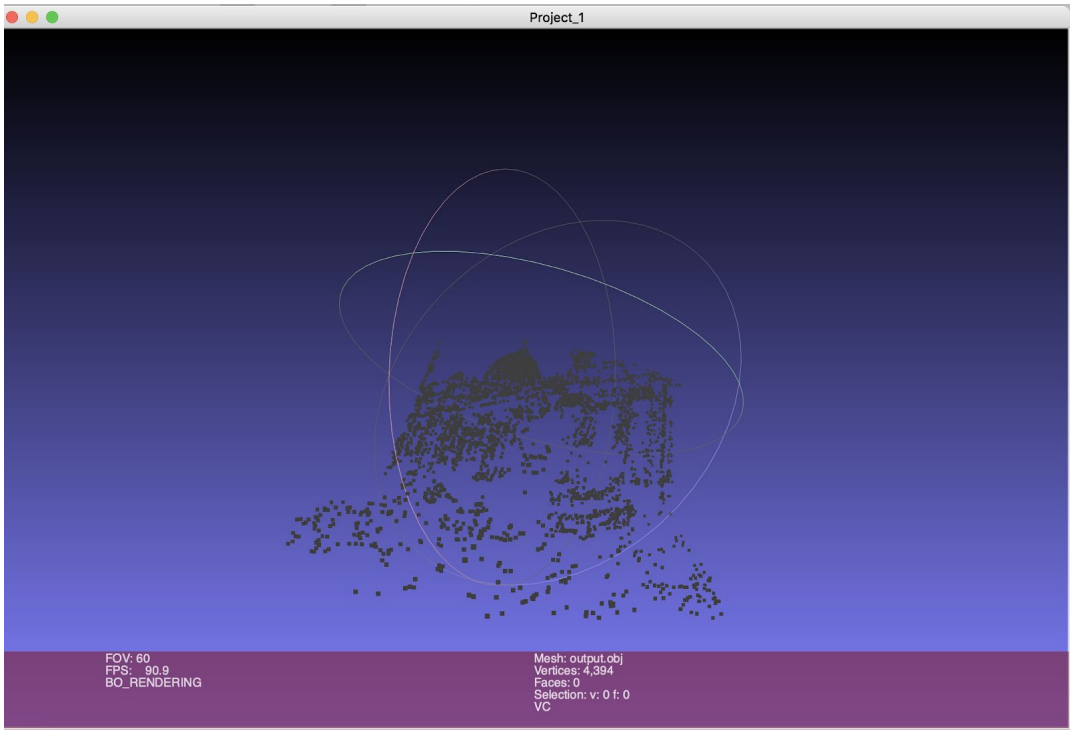


Epipolar lines

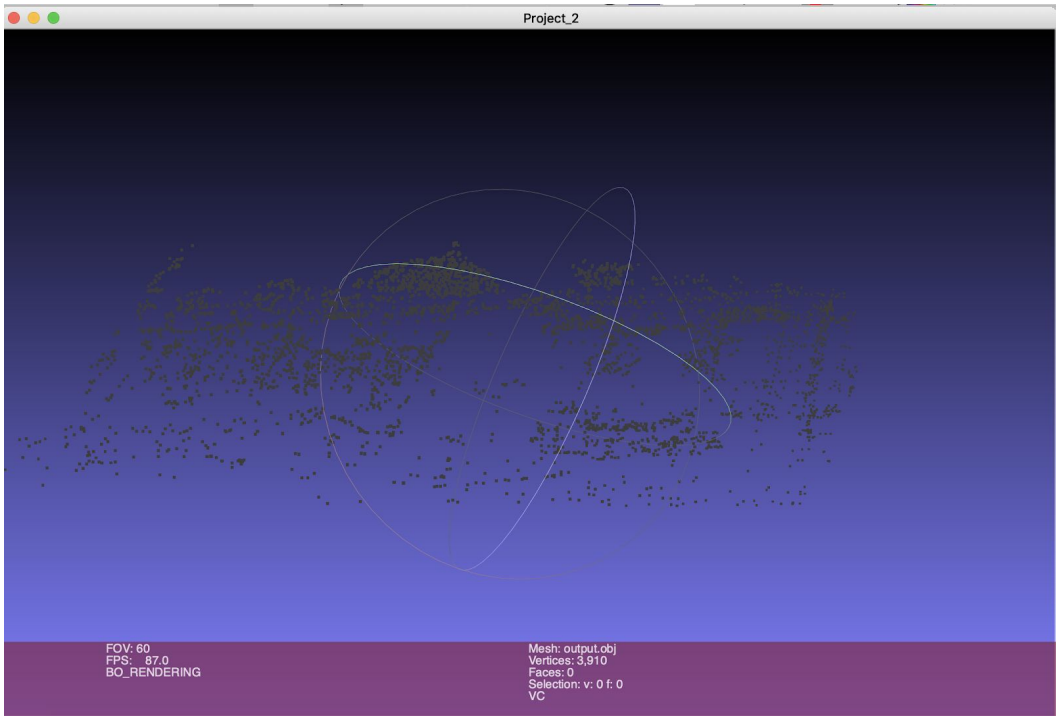


4. 3D Reconstruction

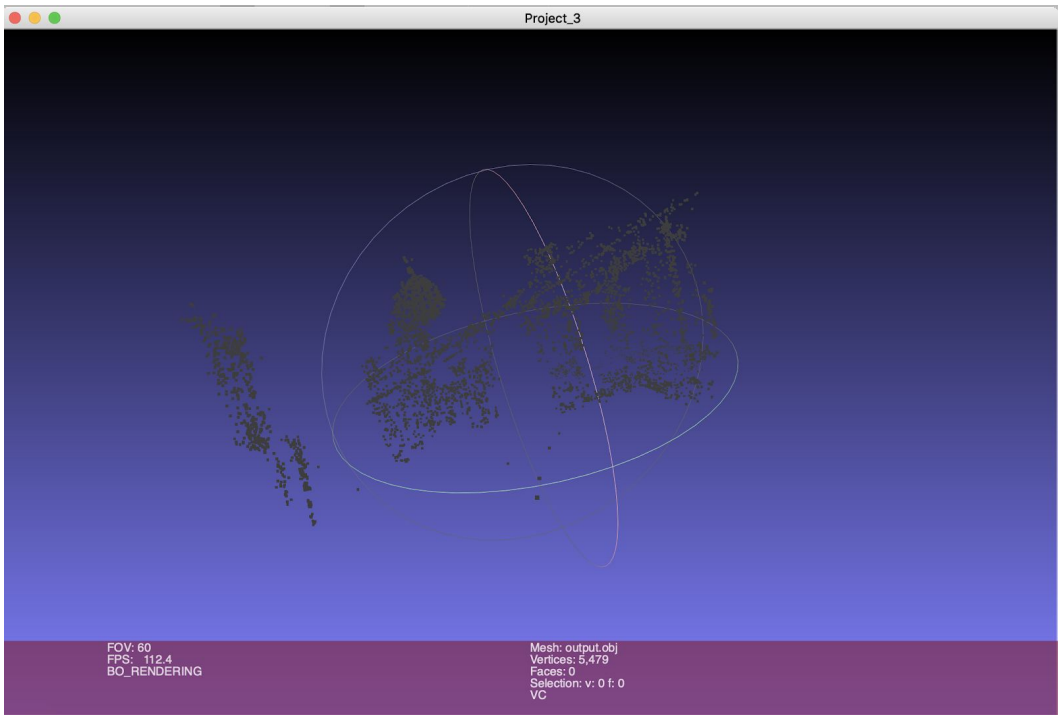
0-1 pair



0-2 pair



1-2 pair



4. Parameters and Additional Information

The parameter, **t**, for the ratio test was chosen to be **0.75**.

Keypoint descriptors for image 1

Keypoint descriptors for image 2

Keypoint descriptors for image 3