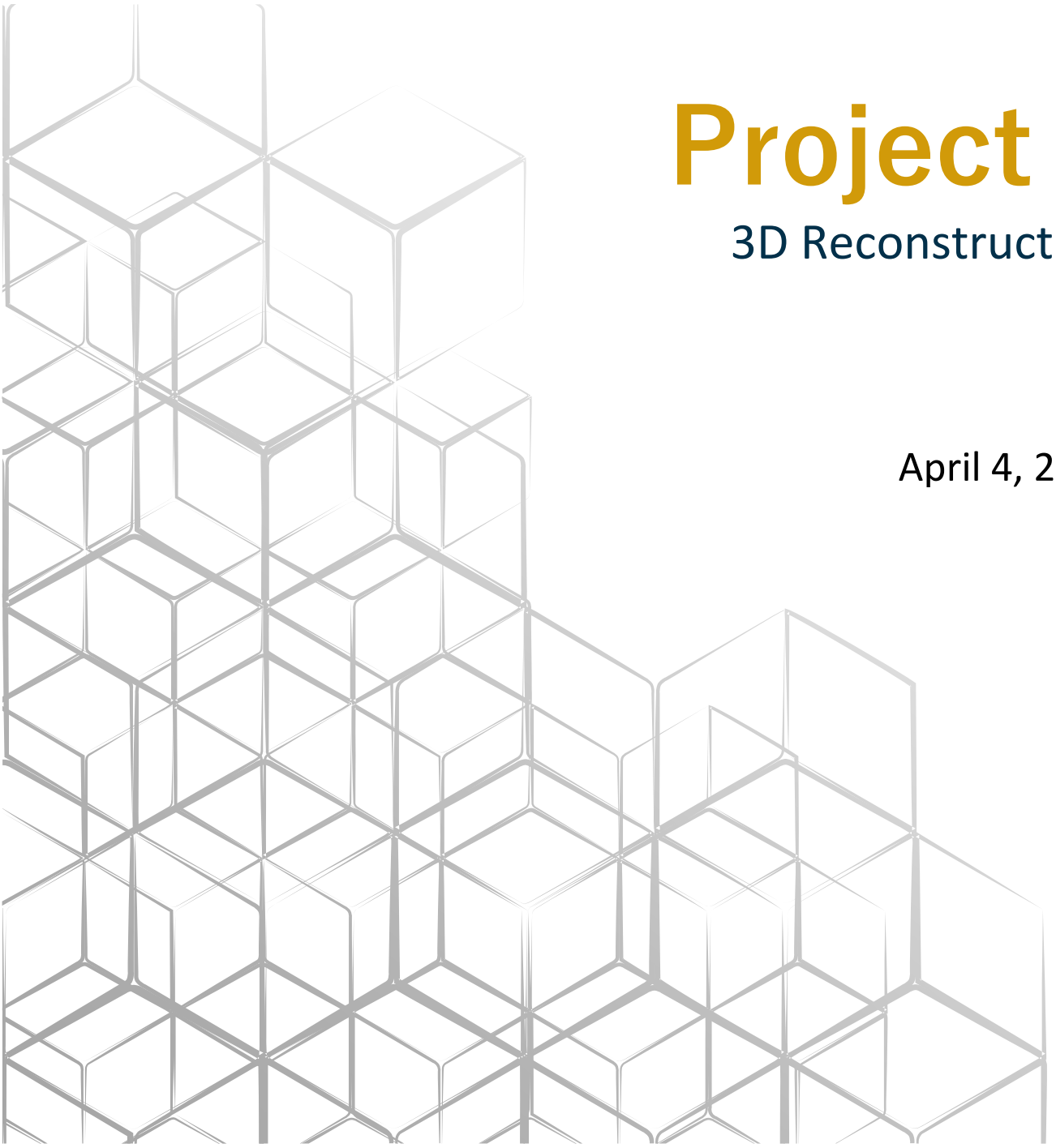
Andrei Harbachov | 301438192

CMPT 412: Computational Vision

Dr. Furukawa



Project 5

3D Reconstruction

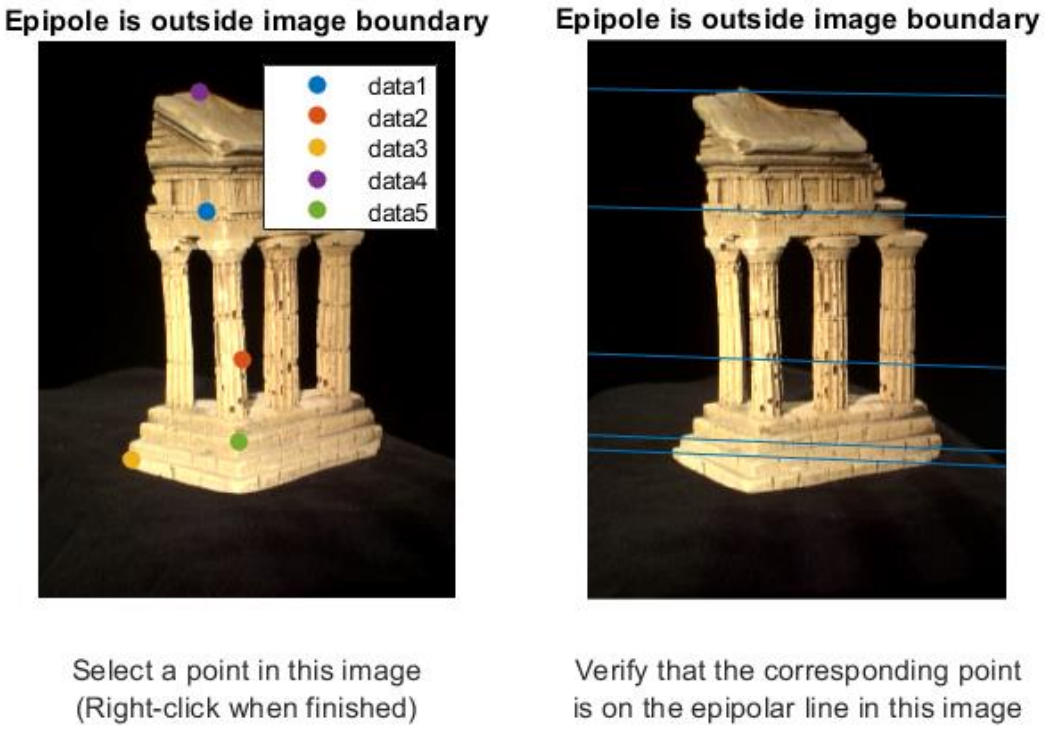
April 4, 2023

3.1 – Sparse Reconstruction

Eight point algorithm

F =

3.56440672208061e-09	-5.92131870254573e-08	-1.65029958888507e-05
-1.30829065677301e-07	-1.31095126436709e-09	0.00112471524600234
3.04775125898786e-05	-0.00108013399649288	-0.00416583180464200

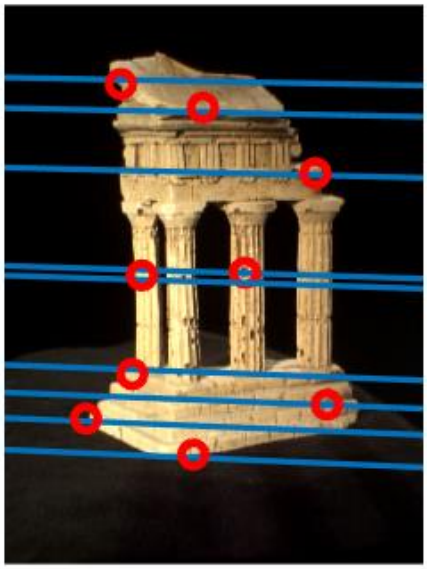


Epipolar Correspondences

Overall, the algorithm performed well, getting the corresponding positions of most points correctly. The only point that has a weird location is the top middle point, since it is moved a couple pixels to the right. Most likely, the reasoning behind that occurrence is similar texture that can be found all along the horizontal line of the epipole. Apart from

that, other points are placed in their corresponding locations with good accuracy. For the similarity metric, I used the Euclidean Distance.

Select a point in this image
(Right-click when finished)



Verify that the corresponding point
is on the epipolar line in this image

coordsIM1 =

```
  136.9103   85.6282
  221.0128  122.5513
  104.0897  485.6282
  233.3205  518.4487
  348.1923  192.2949
  280.5000  305.1154
  157.4231  317.4231
  368.7051  448.7051
  151.2692  422.0385
```

coordsIM2 =

```
  134   91
  228  118
   94  474
  217  515
  357  193
  276  307
  158  310
  370  458
  147  423
```

Essential Matrix

E =

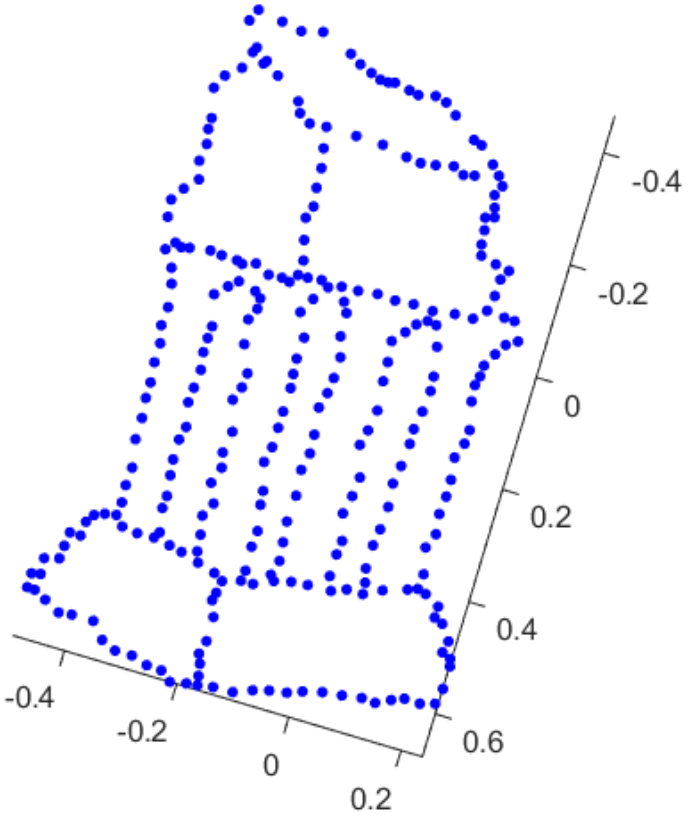
0.00823954017957417	-0.137373312525694	-0.0456779305185729
-0.303520601230357	-0.00305238065728492	1.65535639213192
-0.00112915153572458	-1.67598593970846	-0.00287296483669530

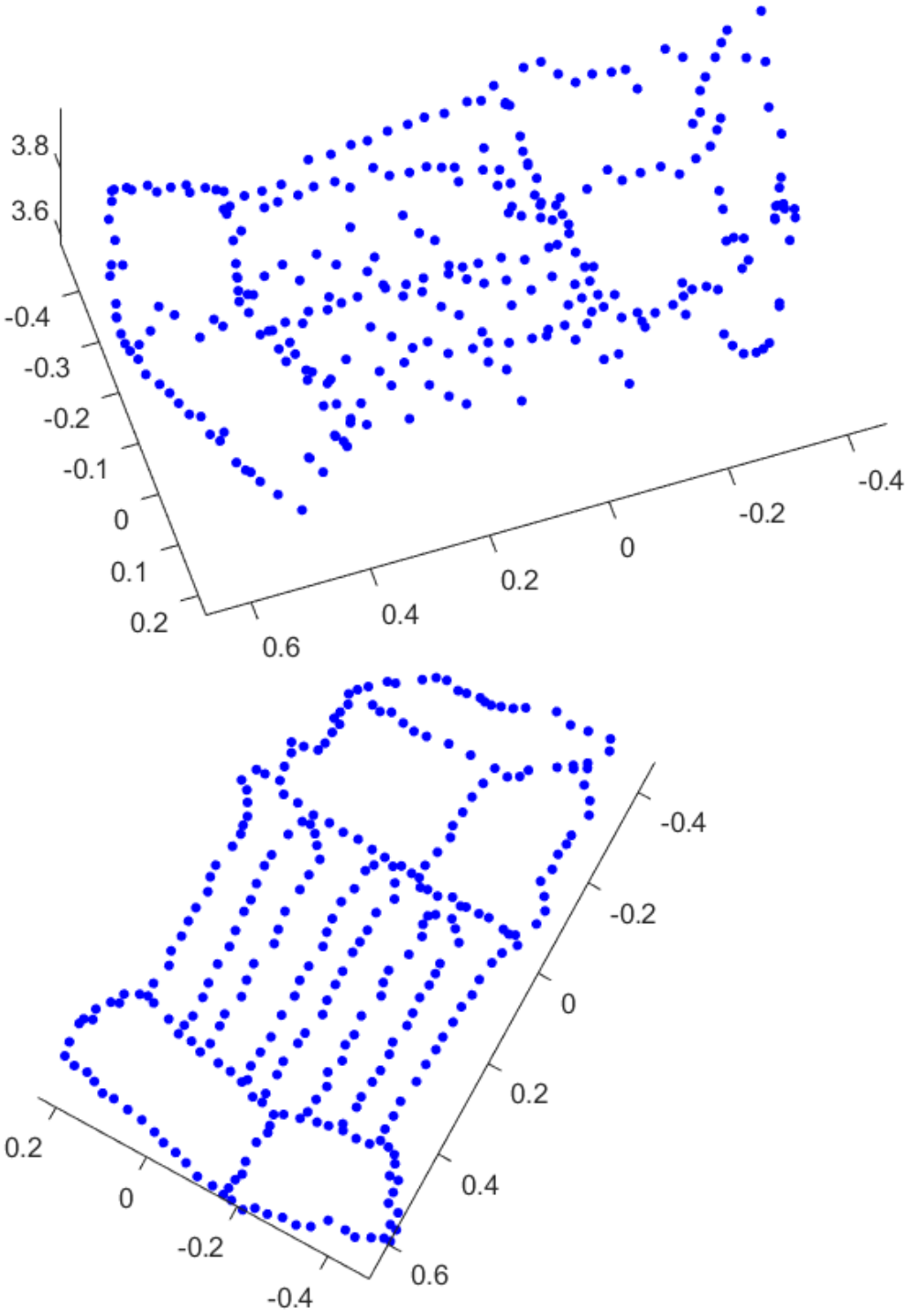
Triangulation

I determined the correct extrinsic matrix by computing 3D point using triangulation and checking if the Z value is positive (else, it is behind the camera).

Re-projection error for image 1: 0.6883
Re-projection error for image 2: 0.6839
Re-projection error average: 0.6861

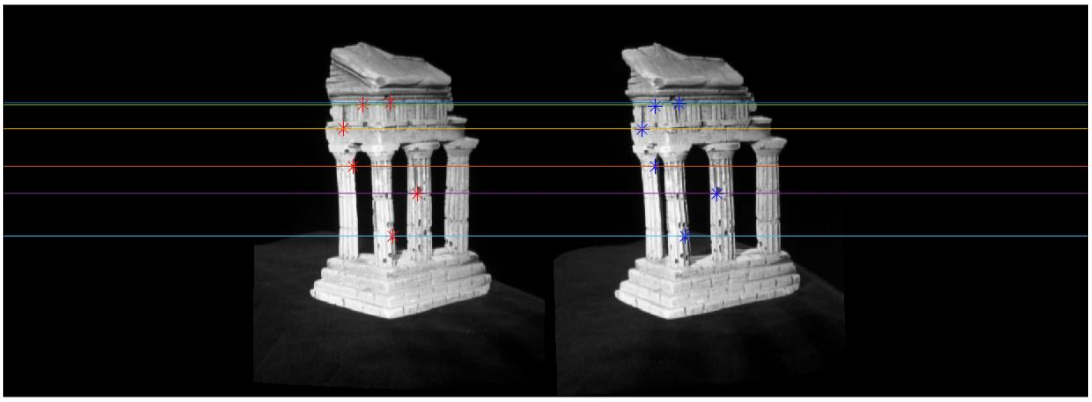
Test Script



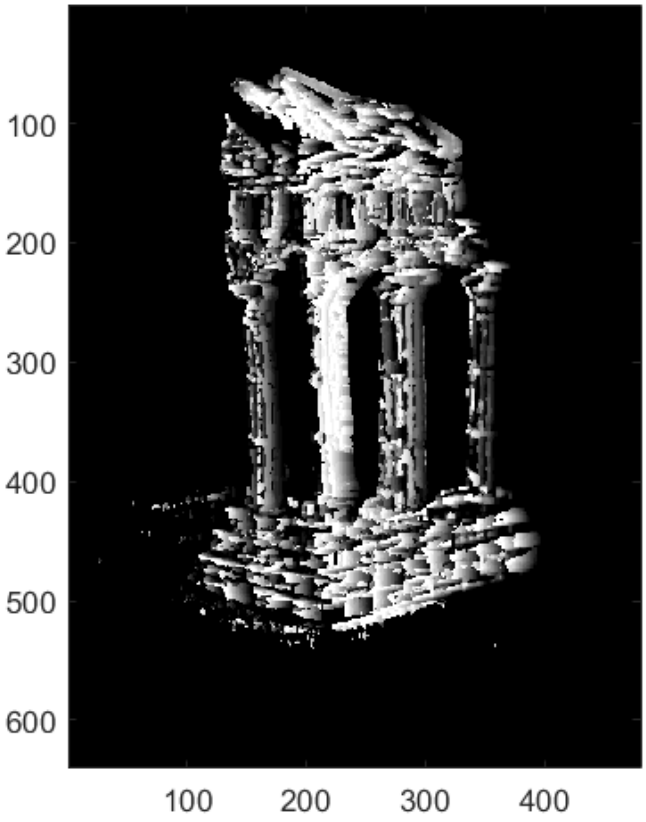


3.2 – Dense Reconstruction

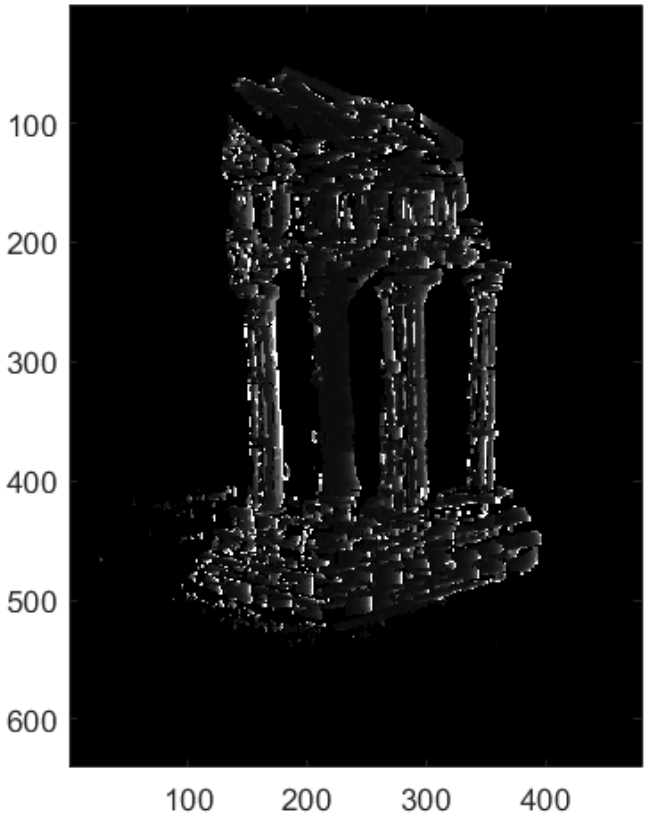
Image Rectification



Dense window matching to find per pixel density



Depth Map



3.3 – Pose Estimation

Estimate Camera Matrix

Reprojected Error with clean 2D points is 0.0000
Pose Error with clean 2D points is 0.0000

Reprojected Error with noisy 2D points is 2.6186
Pose Error with noisy 2D points is 0.0754

Estimate intrinsic/extrinsic parameters

Intrinsic Error with clean 2D points is 2.0000
Rotation Error with clean 2D points is 2.0000
Translation Error with clean 2D points is 0.1841

Intrinsic Error with clean 2D points is 2.0206

Rotation Error with clean 2D points is 2.0000
Translation Error with clean 2D points is 0.1130