

Mike Leske  
R00183658

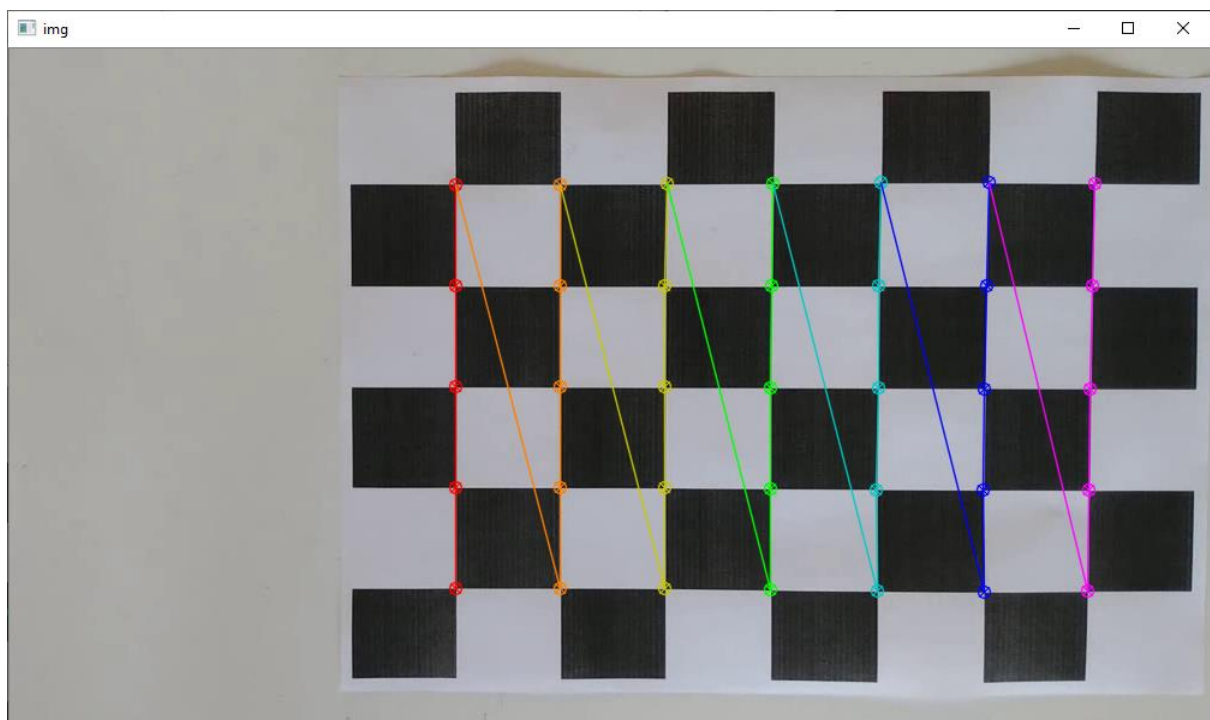
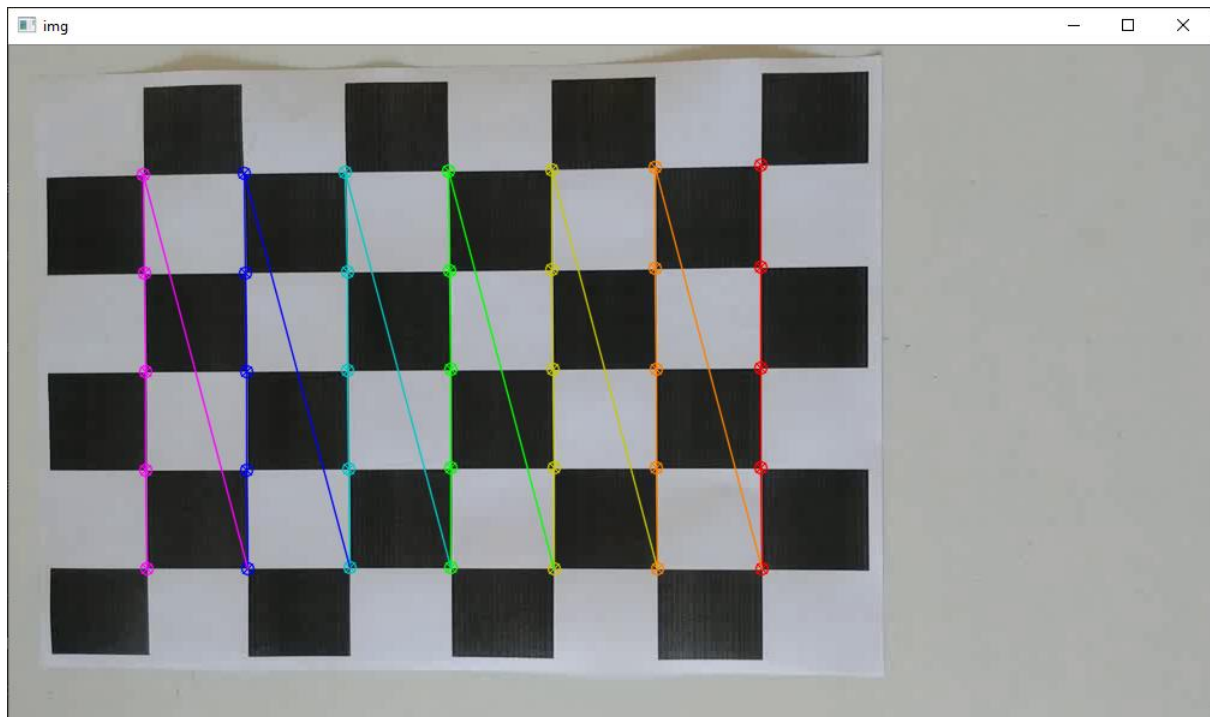
COMP9074 – Machine Vision  
Assignment 2 – Scene Reconstruction

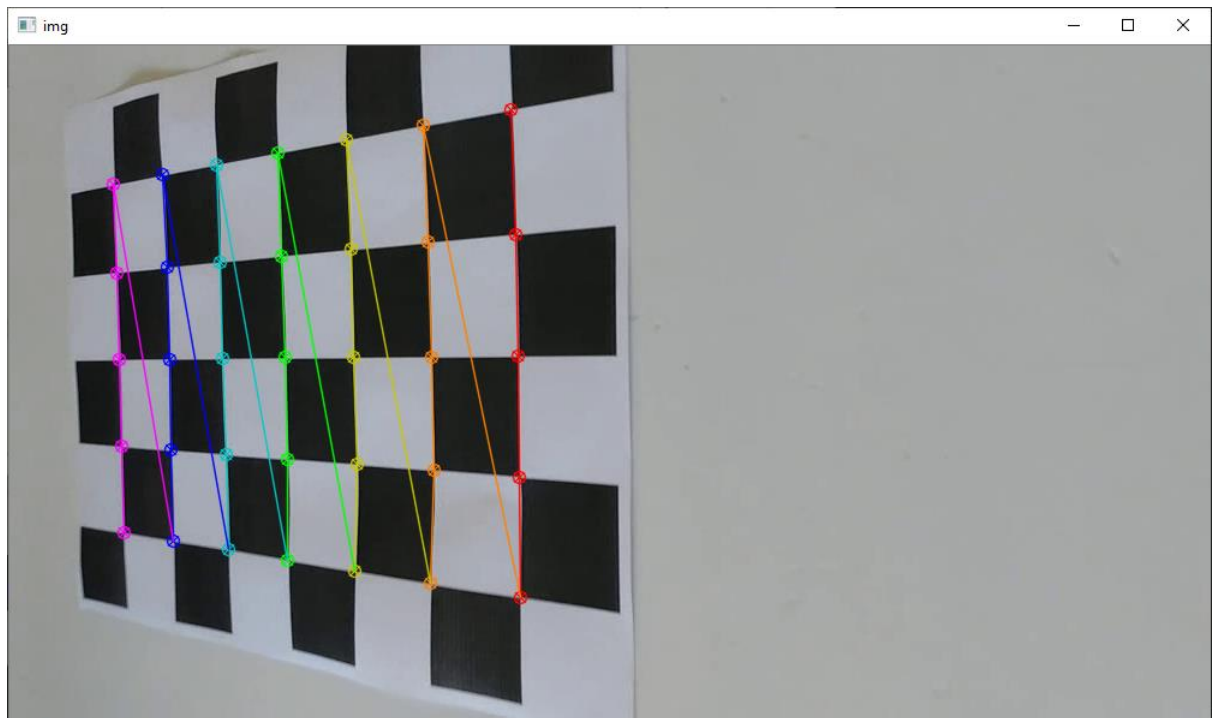
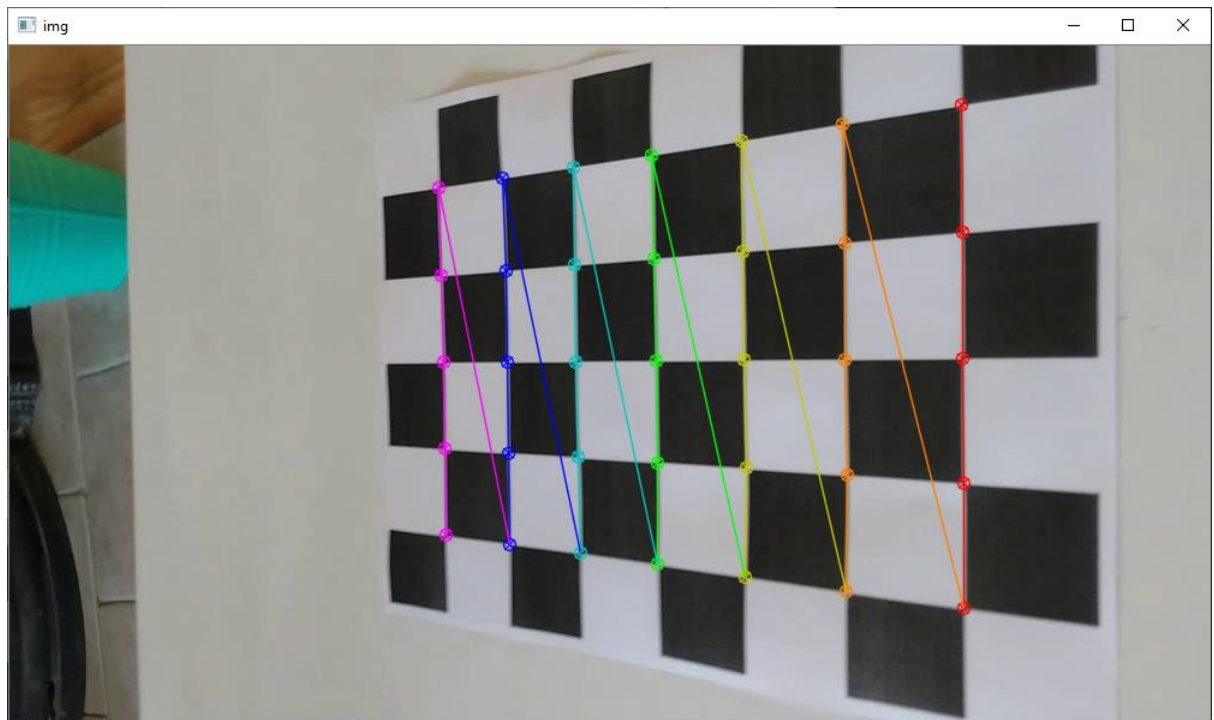
# Introduction

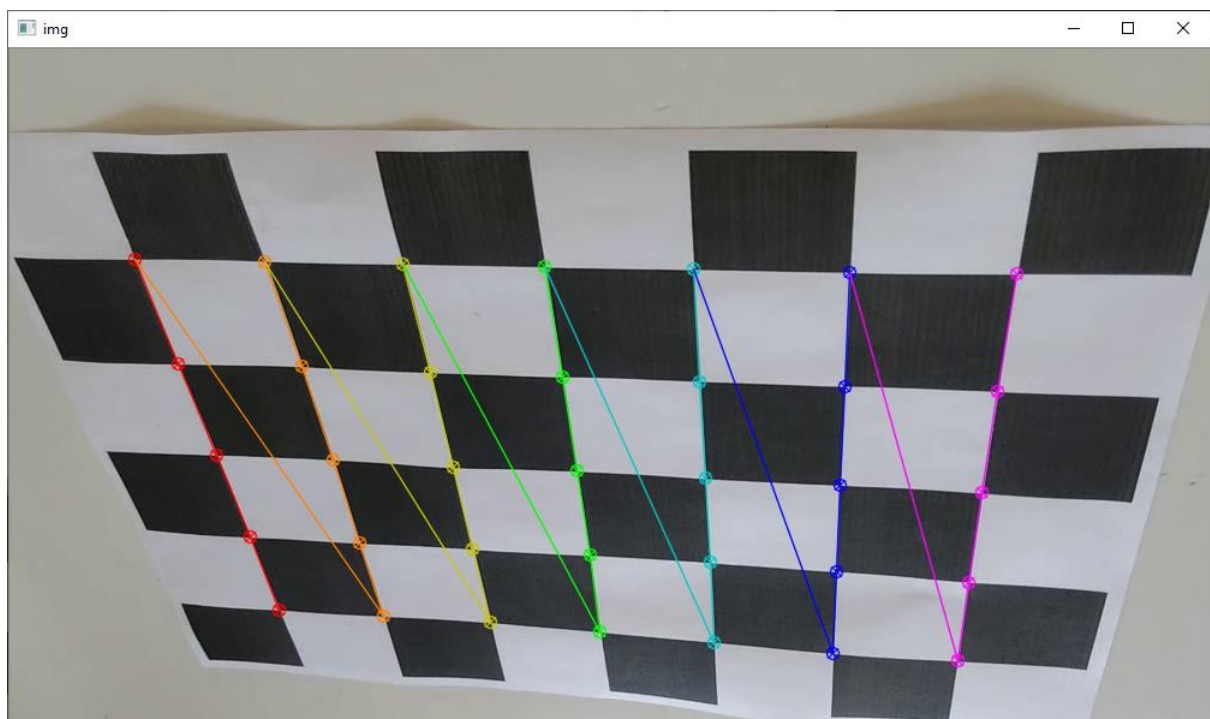
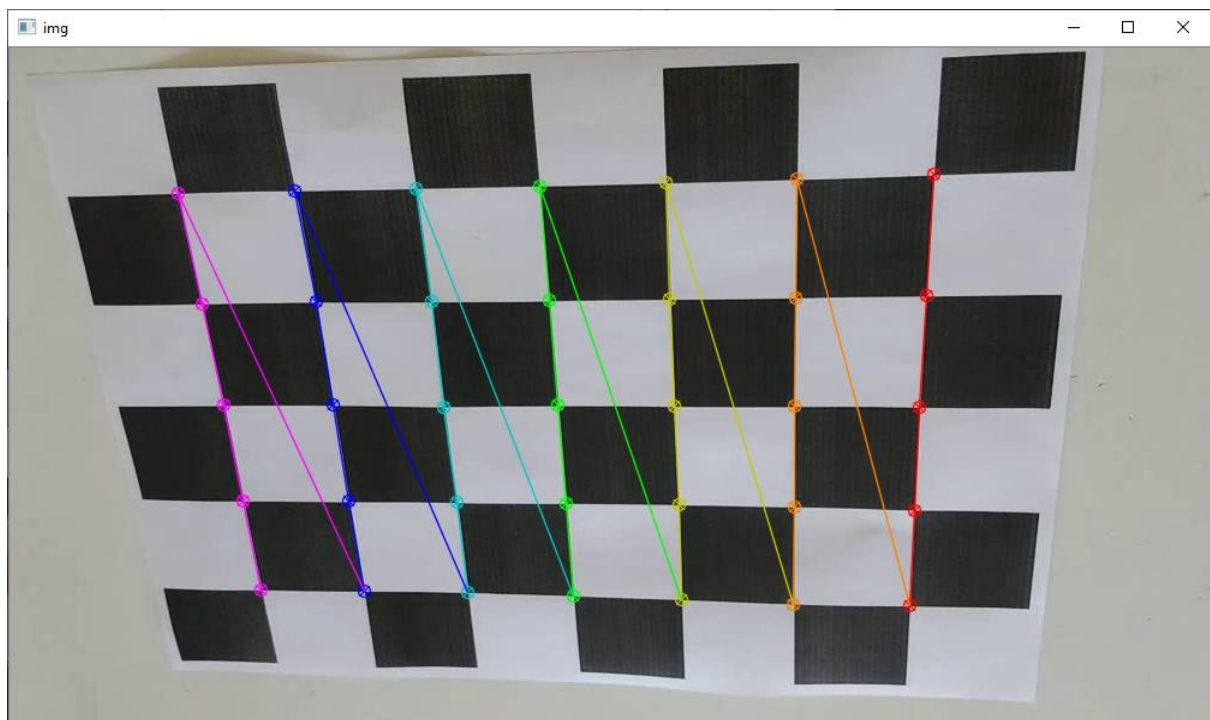
1. This document summarizes the outputs of the different assignment stages and mainly includes screenshots of intermediate results.
2. The code has been structured to meet very closely the tasks within the assignment, which at some points is not the most efficient way, but should help in correcting each section.
3. The code belonging to a specific part and subtask is prepended with a large code comment to make immediately visible to which assignment task it belongs.
4. If a task has several subtasks, these are identified as a) to e) and referenced within the code – if possible.
5. Sometimes, I merged 2 tasks into 1 python function. In these cases I tried to specify which code belongs to which task.

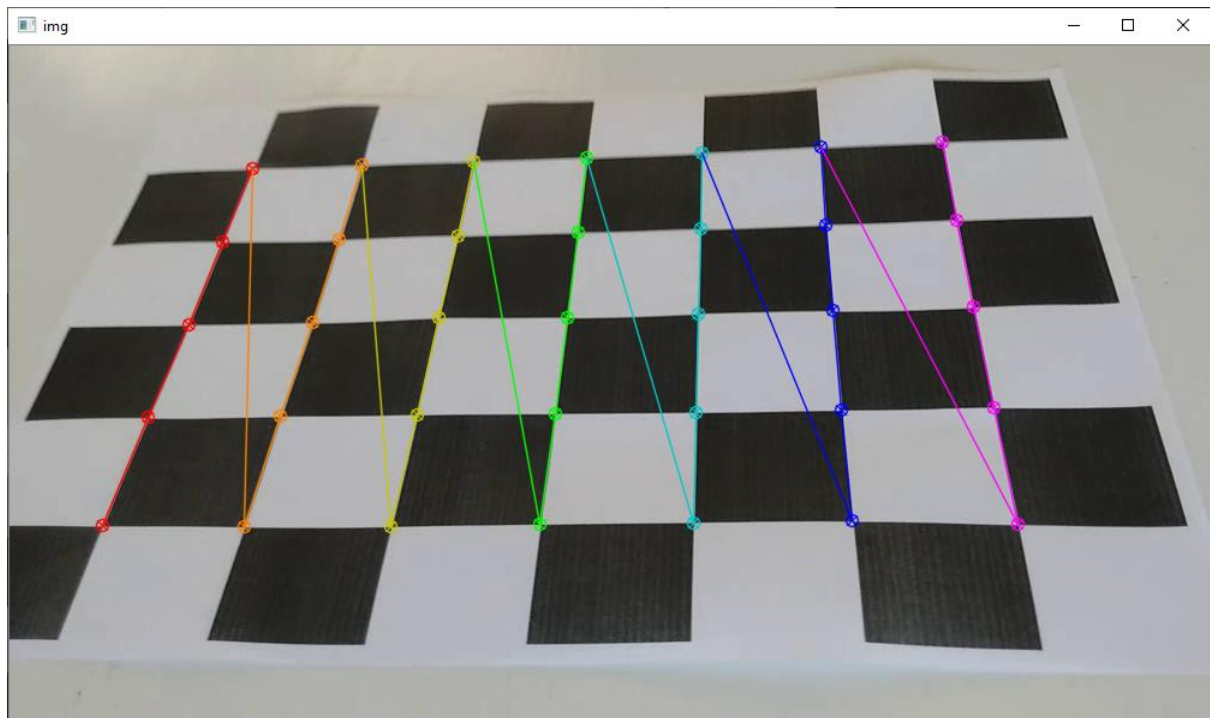
# Task 1

A









**B**

Camera calibration matrix

Camera matrix :

```
[[995.5208214    0.    484.8467233 ]
 [  0.    954.67887059 285.41629875]
 [  0.         0.         1.         ]]
```

# Task 2

## A

The movies contains 30 frames

Total features found: 108

Tracks found in both frames: 68

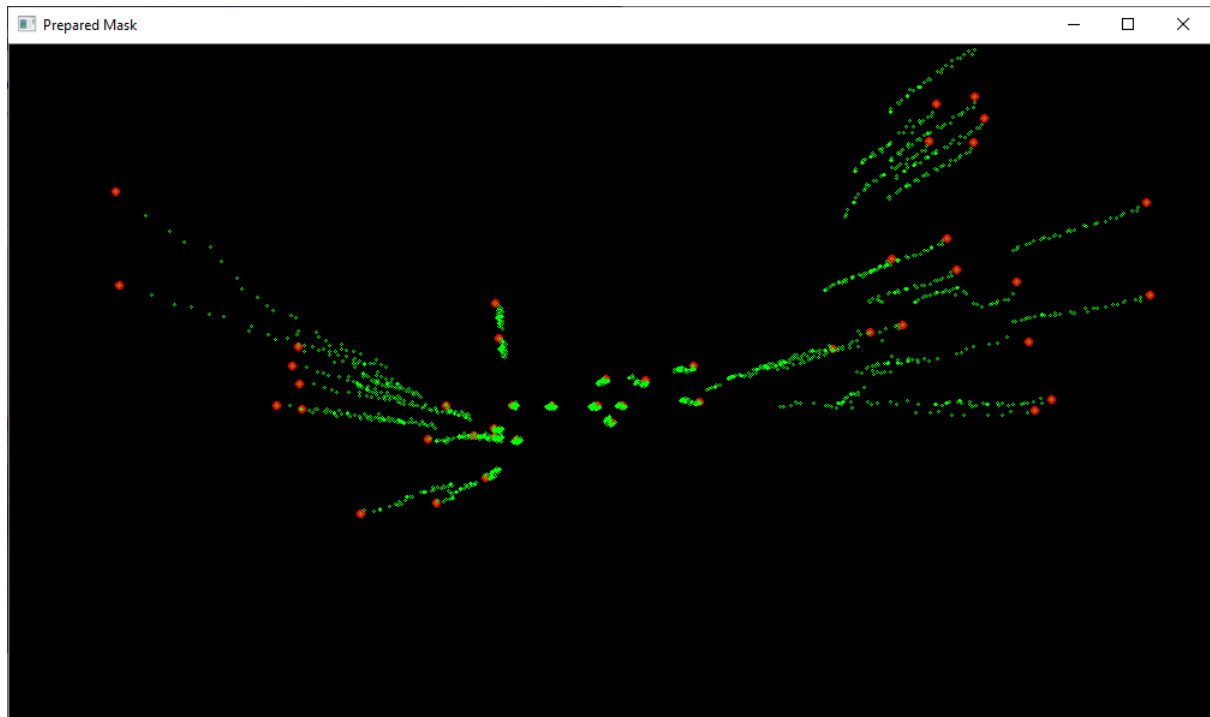
```
[0, 3, 4, 5, 6, 10, 11, 12, 13, 14, 16, 17, 19, 21, 22, 23, 24, 25,
26, 27, 31, 34, 36, 37, 38, 40, 41, 42, 47, 48, 51, 52, 53, 57, 58,
60, 61, 64, 68, 69, 70, 73, 74, 75, 76, 78, 79, 80, 84, 85, 86, 87,
88, 89, 90, 91, 92, 93, 94, 95, 98, 100, 101, 102, 103, 104, 105,
106]
```

Features tracked in .mp4 video:





Features tracked projected onto back mask. Red dots represent the features' location in frame 30. The green dots represent the features' locations in previous frames.



Map projected onto last frame. Same color coding as above applies.

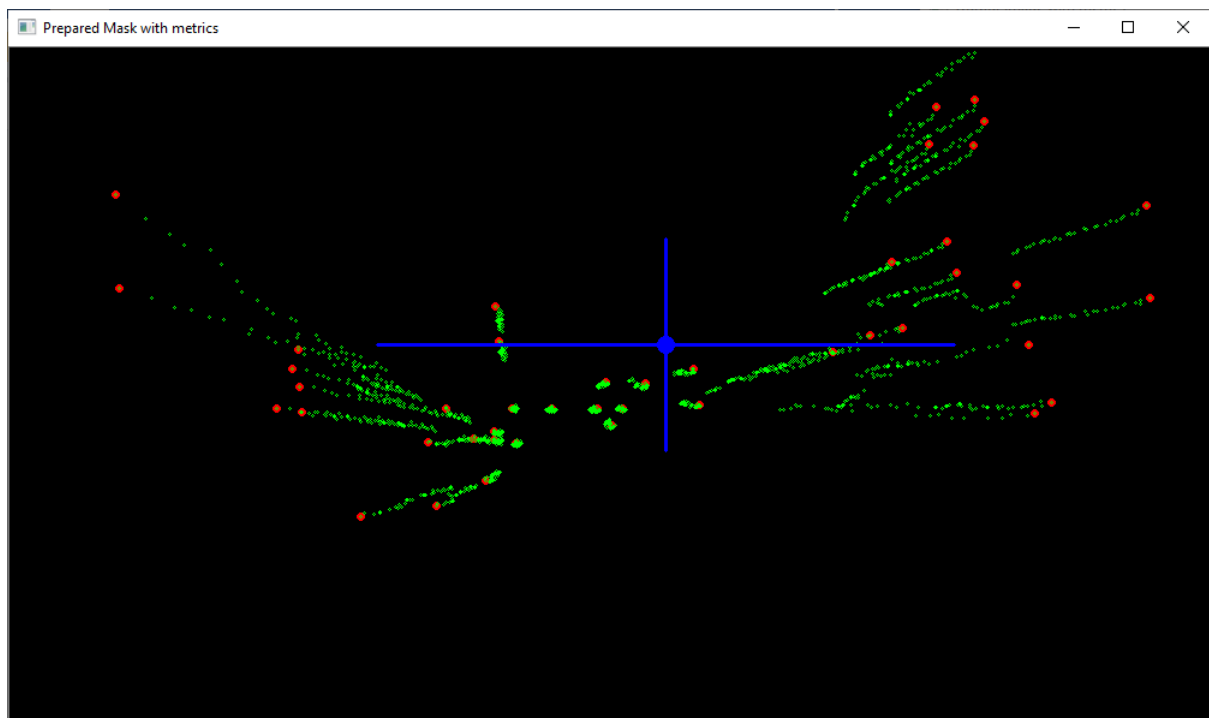




B

```
Mean feat coord frame0: [529.3189975514132, 271.21814357533174]
Stdev feat coord frame0: [152.5639248225053, 68.2424176615977]
Mean feat coord frame30: [546.4723993189194, 247.79610500616187]
Stdev feat coord frame30: [240.41765195016114, 88.1525838708281]
```

Mask with tracked features, plus frame 30 mean location of features and stdev shown in blue.



Updated mask projected on frame 30.



C, D, E, F

Single run with 8-point DLT algorithm and calculation of fundamental matrix F.

```
Num of inliers : 9
Num of outliers: 59
Inliers sum    : 0.0132288082618789
```

## G

Best fundamental matrix after 10000 iterations of 8-point DLT algorithms + outlier calculation.

```
Best F:
[[-8.43171300e-07 -3.47928967e-05  1.17353467e-02]
 [ 3.43101656e-05  9.62236136e-08 -1.57667420e-02]
 [-1.07715461e-02  1.59903806e-02 -2.75642877e-01]]
```

Inliers : 59

Outliers: 9

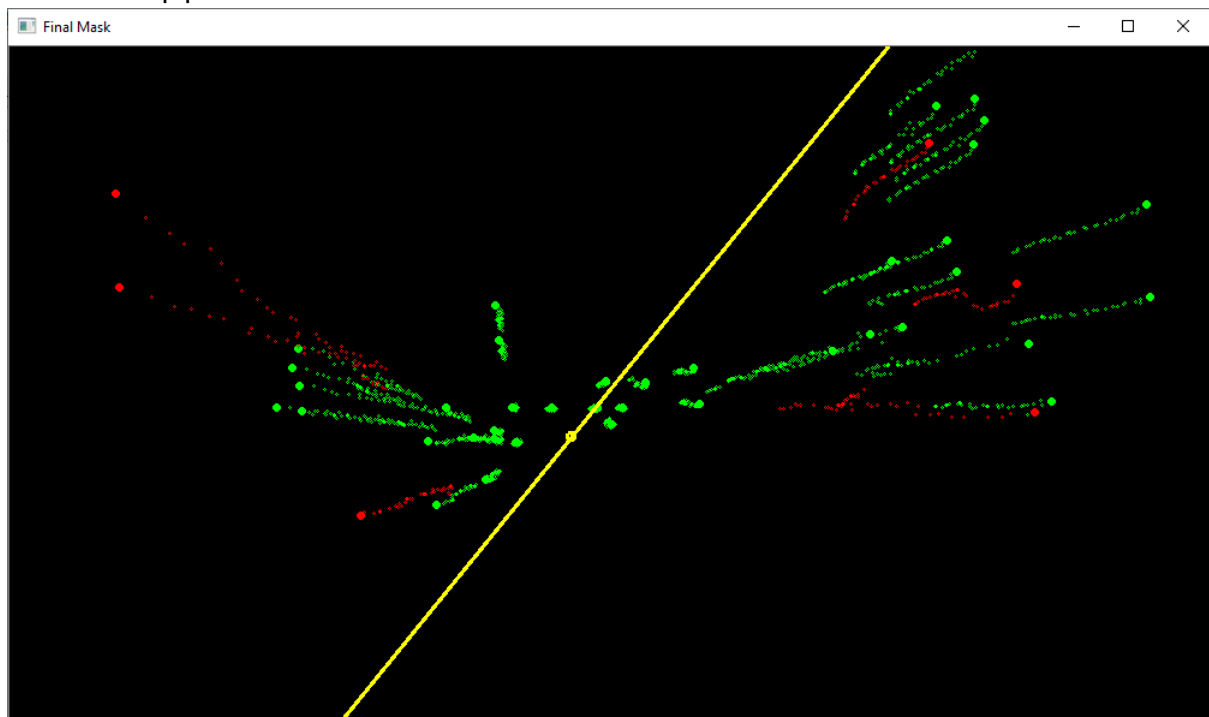
Inliers Sum: 103.46124889177312

## H

Epipoles:

```
[458.62081159 326.17723313  1.      ]
[460.48705484 325.26265495  1.      ]
```

Mask with epipole line



2 epipoles projected into frame 0



Final image with mask (incl epipoles) layed on top of frame 30



# Task 3

## A

Essential matrix  $\hat{E}$ :

Essential Matrix  $E_{\text{hat}}$ :

```
[[ 6.95302664e-01  4.02817876e+01 -5.90598297e-01]
 [-4.21876794e+01  8.83267139e-01  2.57083851e+00]
 [ 9.10240354e-02 -2.92477269e+00  3.42184854e-02]]
```

Essential matrix reconstructed from USV with equal lambda:

Essential Matrix  $E$  with equal lambda:

```
[[ -3.52814814e+00  4.10743411e+01 -4.76275015e-01]
 [-4.11084058e+01 -3.51165100e+00  2.54305640e+00]
 [ 3.93750205e-01 -2.96752363e+00  2.60192816e-02]]
```

## B

Verify that  $R_1$  and  $R_2$  are rotation matrices with:  $\text{Det}(R) = 1$  and  $R.T \times R = I$

$\text{Det}(R_1)$ : 1.000000000000000002

$\text{Det}(R_2)$ : 1.000000000000000002

$R_1$ :

```
[[ 1.  0. -0.]
 [ 0.  1. -0.]
 [-0. -0.  1.]]
```

$R_2$ :

```
[[ 1.  0. -0.]
 [ 0.  1.  0.]
 [-0.  0.  1.]]
```

$t_1$ : [ -1.00477542 -0.04644783 -13.85241869]

$t_2$ : [ 1.00477542 0.04644783 13.85241869]

$S_1$ :

```
[[ -0.          -13.85241869   0.04644783]
 [ 13.85241869  -0.          -1.00477542]
 [-0.04644783   1.00477542  -0.          ]]
```

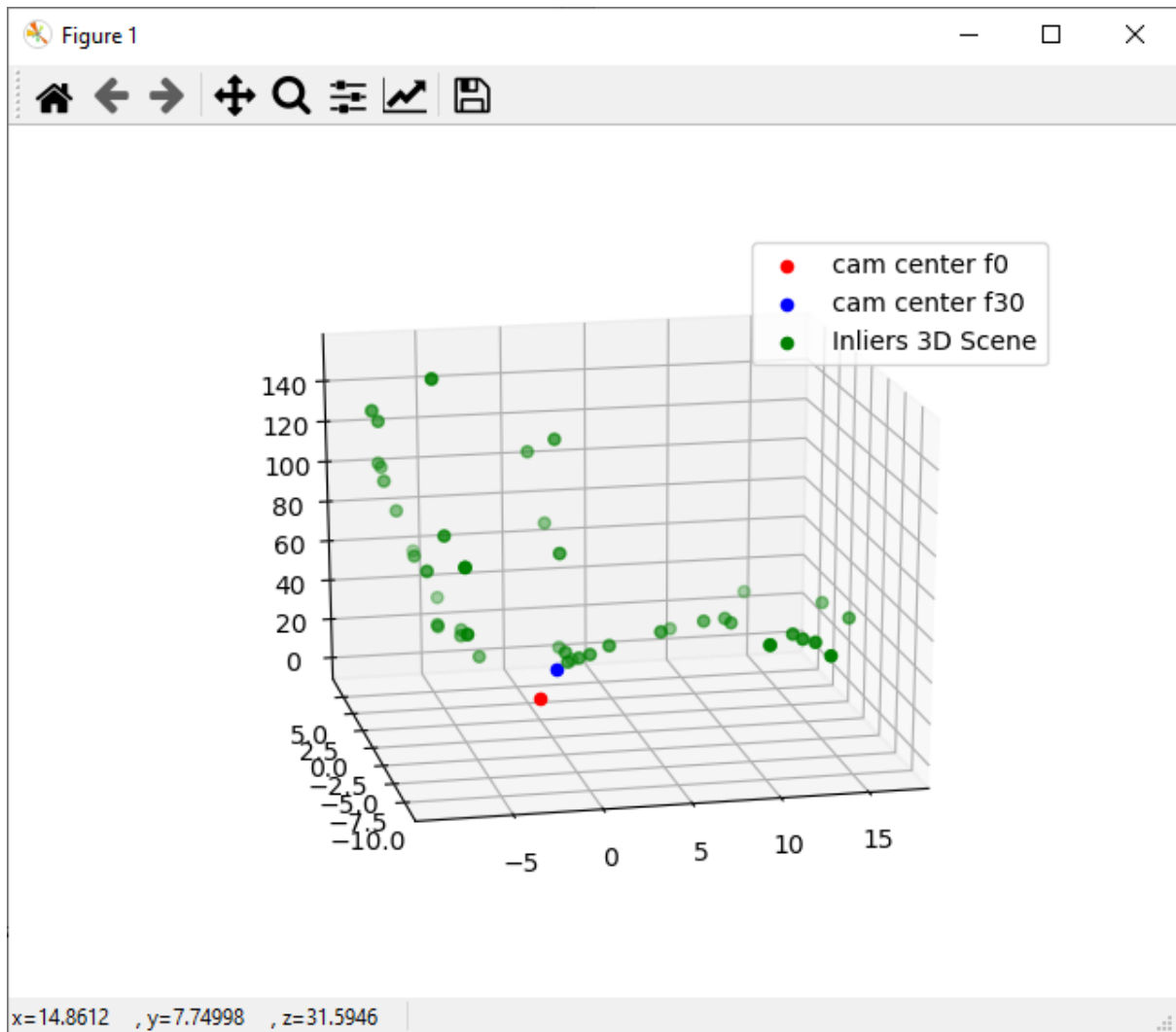
$S_2$ :

```
[[  0.          13.85241869  -0.04644783]
 [-13.85241869   0.          1.00477542]
 [ 0.04644783  -1.00477542   0.          ]]
```

C

```
Inliers per solution: [1, 58, 0, 0]
Outliers per solution: [58, 1, 59, 59]
Best solution: 1
```

D



**Note:**

The output of the 3D scene inliers unfortunately varies heavily from run to run. This impacts the result of 3E to appear between looking meaningful and useless.

E

