ELEC 546 Assignment #5 Camera calilbration

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1 Reading assignment

I pledge that I have read the reading materials.

2 Practical Assignment

2.1 Calibration using a 3D object

2.1.1 A. Intrinsic parameter computations

The intrinsic parameter K is shown below.

```
K:
 [[ 3.38625072e+03  1.27159260e+01  8.52916937e+02]
 [ 1.85319235e+00  3.42886718e+03  6.27551184e+02]
 [-8.88178420e-16  1.11022302e-15  1.00000000e+00]]
```

2.1.2 B. Intrinsic and extrinsic parameter computation

I calculate:

```
P:
[[ 2.24468524e-01  2.82252106e-02 -4.46581005e-02  6.47418343e-01]
 [ 3.13049122e-03 -1.77345292e-01 -1.43567369e-01  6.89636308e-01]
 [-8.96065658e-07  2.74079257e-05 -5.24236468e-05  1.17447045e-03]]
```

```
K:
[[ 3.80781877e+03 -8.16178109e+00  8.32399977e+02]
 [ 0.00000000e+00  3.78129094e+03  7.60763925e+02]
 [ 0.00000000e+00  0.00000000e+00  1.00000000e+00]]
```

```
R:
[[ 0.99974008  0.02211926 -0.00552403]
 [ 0.01704062 -0.88594483 -0.46347748]
 [-0.01514576  0.46326288 -0.88609148]]
```

```
t:
[-1.46772505 -0.91125501 19.85150442]
```

And reprojection error is 0.4413167951852476.

- Describe the DLT algorithm
  The Direct Linear Transform(DLT) algorithm is used to solve a set of variables from a set of similarity relations. In this problem, we use it to calculate extrinsic parameter of camera P which is a projection of 3D points into 2D.

- minimum number of points needed.
  For computing P, the minimum number of point correspondences is 6.

- how to obtain K, R and t?
  First, we need to calculate P. Second, we need to factorize it into K[R, t], where K is triangular and R is a rotation. This can be done by RQ-factorization.

2.2 Calibration using a planar object

Intrinsic parameters are:
Intrinsic Matrix is:

```
[[7672.84955933718  0 0]
 [0 7646.17400876554  0]
 [1730.84477482484  1084.52555749346  1]]
```

Focal length is : [7672.84955933718 7646.17400876554]
Principal point is: [1730.84477482484 1084.52555749346]
Radial distortion is: [-0.0316426458021663 5.43300894732541]
Tangential distortion is: [-0.0316426458021663 5.43300894732541]
Mean reprojection error is: 3.367286786148870
Focal length error is : [110.909055694071 110.621239772380]
Principal point error is: [36.0983798249066 72.7694828591789]
Radial distortion error is: [0.100210401515602 2.39635685060516]
Tangential distortion error is: [0 0]
Here is pattern centric imgae:

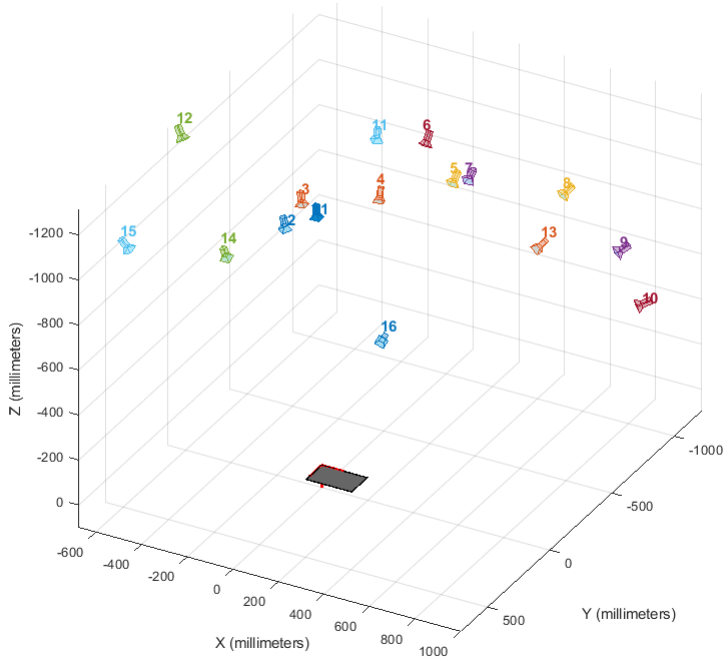

Figure 1: Pattern centric

Here is camera centric imgae:

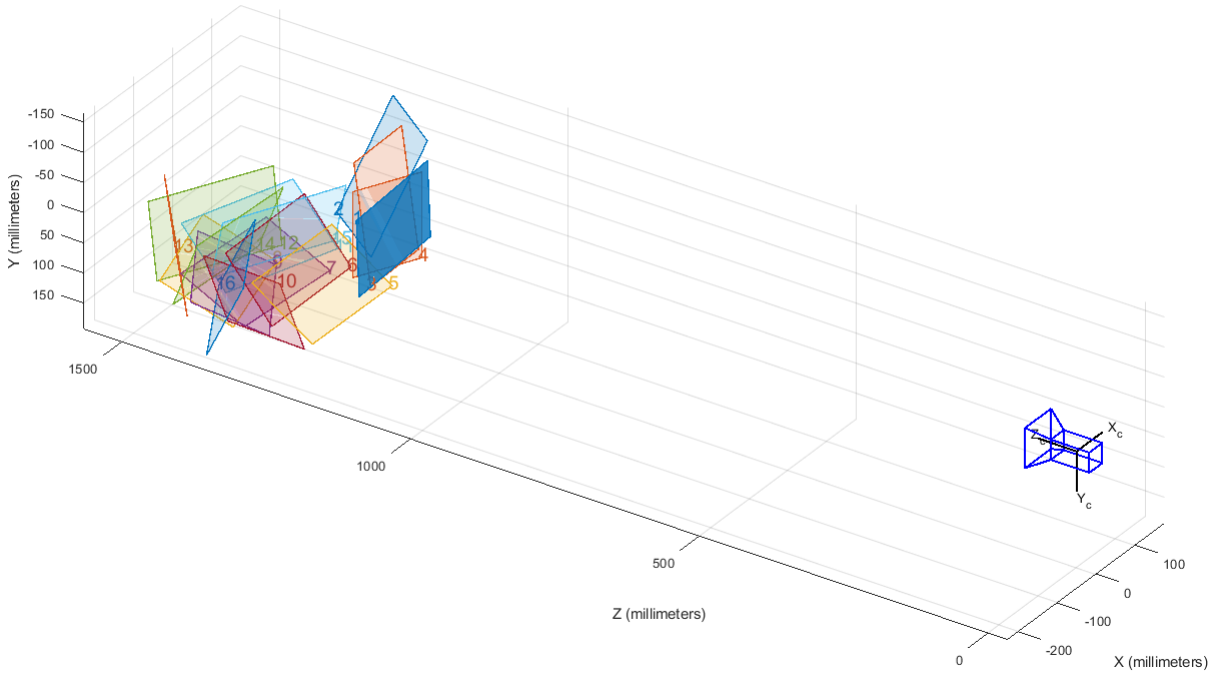

Figure 2: Camera centric

2.2.1 Describe this calibration technique

This calibration algorithm uses a lot of different images of a template image.Detect feature points in images and calculate ideal intrinsic and extrinsic parameters and use MLE to improve accuracy.