```
A=[4 2.3 0 1 0 0 0 0 -1024 -588.8 0 -256;0 0 0 0 4 2.3 0 1 -736 -423.2 0 -184;5 3.1 0 1 0 0 0 0
```

```
A = 12×12
10^3 ×
    0.0040    0.0023         0    0.0010         0         0         0         0 ···
         0         0         0         0    0.0040    0.0023         0    0.0010
    0.0050    0.0031         0    0.0010         0         0         0         0
         0         0         0         0    0.0050    0.0031         0    0.0010
    0.0060    0.0030         0    0.0010         0         0         0         0
         0         0         0         0    0.0060    0.0030         0    0.0010
    0.0040    0.0033         0    0.0010         0         0         0         0
         0         0         0         0    0.0040    0.0034         0    0.0010
    0.0050    0.0041         0    0.0010         0         0         0         0
         0         0         0         0    0.0050    0.0041         0    0.0010
      ⋮
      ⋮
```

```
C=transpose(A)
```

```
C = 12×12
10^3 ×
    0.0040         0    0.0050         0    0.0060         0    0.0040         0 ···
    0.0023         0    0.0031         0    0.0030         0    0.0033         0
         0         0         0         0         0         0         0         0
    0.0010         0    0.0010         0    0.0010         0    0.0010         0
         0    0.0040         0    0.0050         0    0.0060         0    0.0040
         0    0.0023         0    0.0031         0    0.0030         0    0.0034
         0         0         0         0         0         0         0         0
         0    0.0010         0    0.0010         0    0.0010         0    0.0010
   -1.0240   -0.7360   -1.6300   -0.6550   -2.5320   -0.9780   -1.2480   -0.4640
   -0.5888   -0.4232   -1.0016   -0.4061   -1.2660   -0.4890   -1.0608   -0.3944
      ⋮
      ⋮
```

```
F=A*C
```

```
F = 12×12
10^6 ×
    1.4608    1.0499    2.3423    0.9434    3.4463    1.3311    1.9824    0.7371 ···
    1.0499    0.7547    1.6835    0.6781    2.4770    0.9568    1.4249    0.5298
    2.3423    1.6835    3.7664    1.5171    5.5328    2.1371    3.1985    1.1892
    0.9434    0.6781    1.5171    0.6111    2.2279    0.8606    1.2891    0.4793
    3.4463    2.4770    5.5328    2.2279    8.1919    3.1642    4.6346    1.7231
    1.3311    0.9568    2.1371    0.8606    3.1642    1.2222    1.7901    0.6656
    1.9824    1.4249    3.1985    1.2891    4.6346    1.7901    2.7802    1.0336
    0.7371    0.5298    1.1892    0.4793    1.7231    0.6656    1.0336    0.3843
    2.2514    1.6181    3.6364    1.4655    5.2808    2.0397    3.1505    1.1713
    1.2075    0.8679    1.9503    0.7860    2.8323    1.0940    1.6897    0.6283
      ⋮
      ⋮
```

```
G=eig(F)
```

```
G = 12×1
10^7 ×
   -0.0000
   -0.0000
    0.0000
    0.0000
    0.0000
    0.0000
    0.0000
```

```
    0.0000
    0.0000
    0.0015
      ⋮
```

```
Z=qr(G)
```

```
Z = 12×1
10^7 ×
    3.1112
    0.0000
   -0.0000
   -0.0000
   -0.0000
   -0.0000
   -0.0000
   -0.0000
   -0.0000
   -0.0000
      ⋮
```

```
Z
```

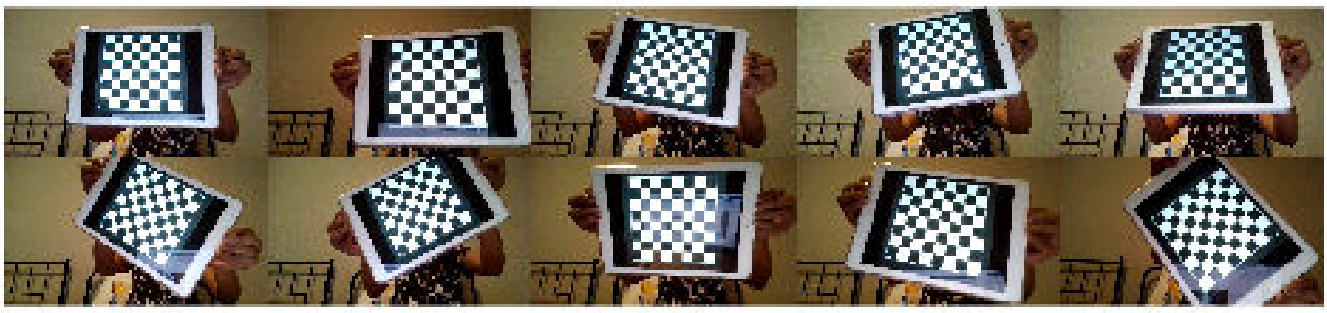
```
Z = 12×1
10^7 ×
    3.1112
    0.0000
   -0.0000
   -0.0000
   -0.0000
   -0.0000
   -0.0000
   -0.0000
   -0.0000
   -0.0000
      ⋮
```

```
images=imageSet('C:\Users\DELL\OneDrive\Desktop\Spring\CV\IMG');
imageFileNames = images. ImageLocation;
celldisp(imageFileNames)
```

```
imageFileNames{1} =

C:\Users\pooja\OneDrive\Documents\MATLAB\CV\Image1.png


imageFileNames{2} =

C:\Users\pooja\OneDrive\Documents\MATLAB\CV\Image10.png


imageFileNames{3} =

C:\Users\pooja\OneDrive\Documents\MATLAB\CV\Image2.png
```

```
imageFileNames{4} =

C:\Users\pooja\OneDrive\Documents\MATLAB\CV\Image3.png


imageFileNames{5} =

C:\Users\pooja\OneDrive\Documents\MATLAB\CV\Image4.png


imageFileNames{6} =

C:\Users\pooja\OneDrive\Documents\MATLAB\CV\Image5.png


imageFileNames{7} =

C:\Users\pooja\OneDrive\Documents\MATLAB\CV\Image6.png


imageFileNames{8} =

C:\Users\pooja\OneDrive\Documents\MATLAB\CV\Image7.png


imageFileNames{9} =

C:\Users\pooja\OneDrive\Documents\MATLAB\CV\Image8.png


imageFileNames{10} =

C:\Users\pooja\OneDrive\Documents\MATLAB\CV\Image9.png
```

```
montage (imageFileNames,'Size', [2 5])
```



```
[imagePoints, boardSize]= detectCheckerboardPoints(imageFileNames);
```

```
Warning: The checkerboard must be asymmetric: one side should be even, and the other should be odd.
Otherwise, the orientation of the board may be detected incorrectly.
```

```
squareSize= 25; % millimeters
worldPoints = generateCheckerboardPoints (boardSize, squareSize);
[params, ~, estimationErrors]=estimateCameraParameters (imagePoints, worldPoints);
paramStruct = toStruct (params) ;
```

```
% Display Intrinsic Matrix
MyIntrinsicMatrix = paramStruct. IntrinsicMatrix;
My_fx1 = MyIntrinsicMatrix(1,1);
My_fy1 = MyIntrinsicMatrix(2,2);
My_AxisSkew = MyIntrinsicMatrix(1,2);
My_Principal_Offset_X= MyIntrinsicMatrix(3,1);
My_Principal_Offset_Y= MyIntrinsicMatrix(3,2);
sprintf ('The fx of the camera is %2.3f', My_fx1)
```

```
ans =
'The fx of the camera is 385.608'
```

```
sprintf ('The fy of the camera is %2.3f',My_fy1)
```

```
ans =
'The fy of the camera is 385.598'
```

```
sprintf ('The axis skew of the camera is %2.3f', My_AxisSkew)
```

```
ans =
'The axis skew of the camera is 0.000'
```

```
result=inv(MyIntrinsicMatrix)
```

```
result = 3×3
    0.0026         0         0
         0    0.0026         0
   -0.8911   -0.4023    1.0000
```

```
p=[296.9895 118.8167 1]
```

```
p = 1×3
  296.9895  118.8167    1.0000
```

```
p*result
```

```
ans = 1×3
   -0.1209   -0.0941    1.0000
```

```
q=[324.3621  140.8990 1]
```

```
q = 1×3
  324.3621  140.8990    1.0000
```

```
q*result
```

```
ans = 1×3
   -0.0499   -0.0369    1.0000
```

```
m= [262.2148   78.9893 1]
```

```
m = 1×3
  262.2148   78.9893    1.0000
```

```
M=m*result
```

```
M = 1×3
   -0.2111   -0.1974    1.0000
```

```
n=[416.0186  231.5869 1]
```

```
n = 1×3
  416.0186  231.5869    1.0000
```

```
N=n*result
```

```
N = 1×3
    0.1878    0.1983    1.0000
```

```
K=[M;N]
```

```
K = 2×3
   -0.2111   -0.1974    1.0000
    0.1878    0.1983    1.0000
```

```
dist = pdist(K,'euclidean')
```

```
dist = 0.5619
```

```
principalPoint= params. PrincipalPoint;
principalPointError=estimationErrors.IntrinsicsErrors.PrincipalPointError
```

```
principalPointError = 1×2
    1.3958    1.6816
```

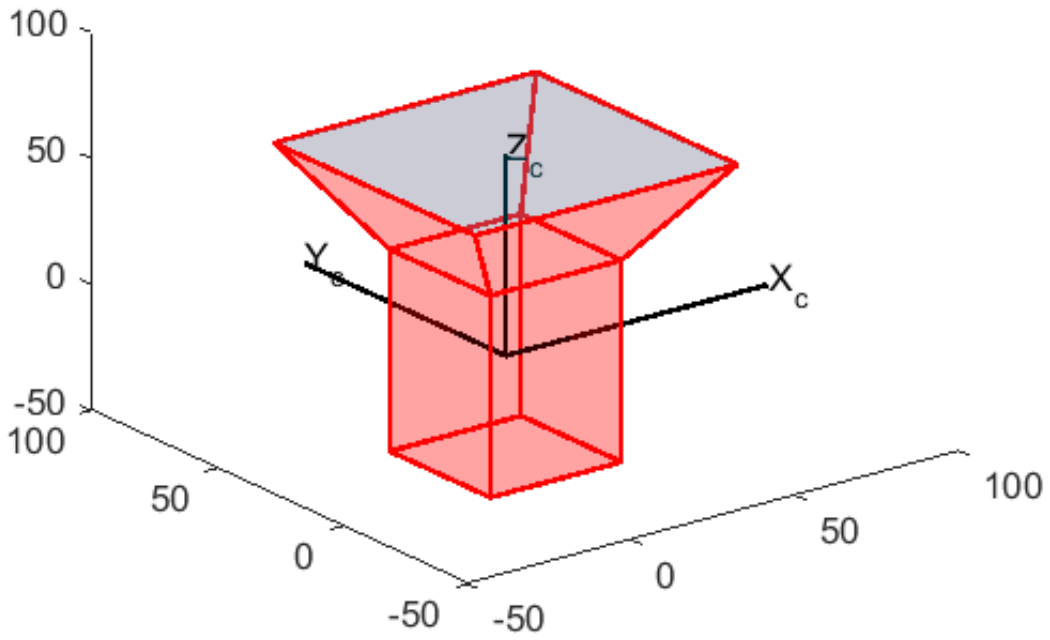
```
fig = figure;
ax = axes ('Parent', fig);
imshow (imageFileNames {1}, 'InitialMagnification', 60, 'Parent', ax);
hold (ax,'on')
```

```
vectors= params. TranslationVectors;
errors = 1.96 * estimationErrors.ExtrinsicsErrors.TranslationVectorsError;
fig = figure;
ax=axes ('Parent', fig, 'CameraViewAngle', 5,'CameraUpVector', [0, -1, 0] ,...
    'CameraPosition', [-1500, -1000, -6000]) ;
legend ('Estimated principal point');
```

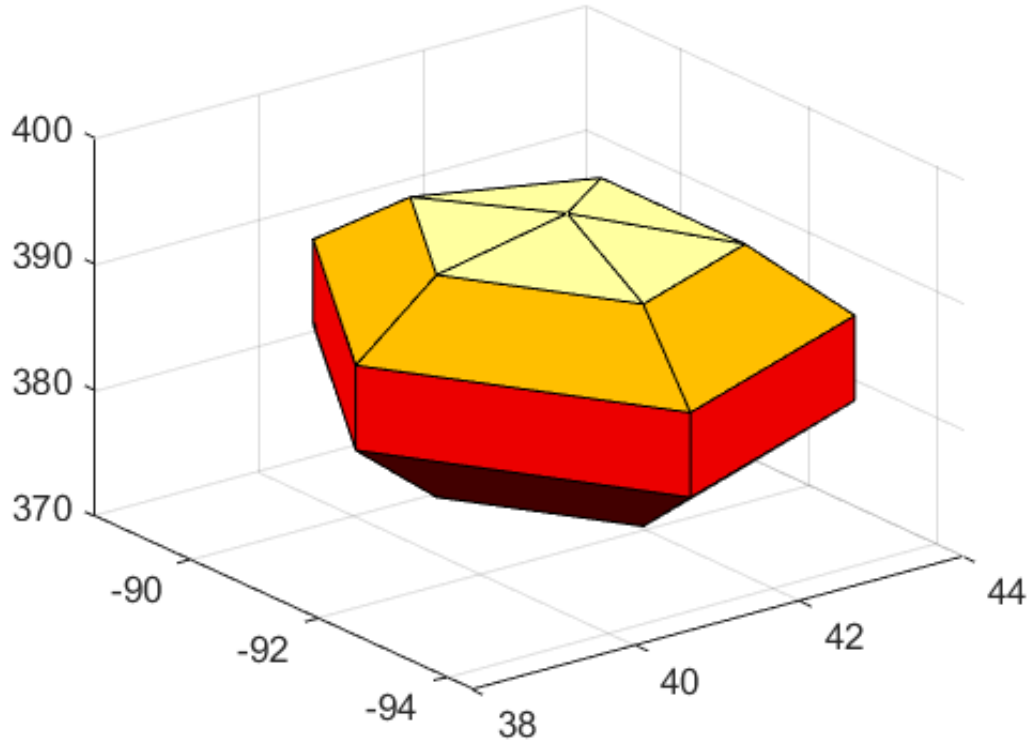
```
Warning: Ignoring extra legend entries.
```

```
title ('Principal Point assumption');
hold(ax,'off');
```

```
plotCamera ('Size', 40, 'AxesVisible', true);
```




```
% Plot an ellipsoid showing 95% confidence volume of uncertainty of % location of each checkerb

labelOffset = 10;

for i=1:params. NumPatterns

ellipsoid (vectors (i,1), vectors (i, 2), vectors (i,3), errors (i,1), errors (i,2), errors (i,

text(vectors (i,1)+ labelOffset, vectors (i, 2) + labelOffset, vectors (1,3) + labelOffset, nu

end

colormap('hot');
```


400
390
380
370
-90
-92
-94
38
40
42
44