Name : Dilshan J.V.A.P

Index number : 190144D

Exercise 8

In [ ]:

```
import numpy as np
import matplotlib.pyplot as plt
import cv2 as cv
from scipy.linalg import null_space
```

1

In [ ]:

```
f = open(r'templeSparseRing/templeSR_par.txt', 'r')
assert f is not None
n = int(f.readline())
# Reading the informaiton of the first image
l = f.readline().split()
im1_fn = l[0]
K1 = np.array([float(i) for i in l[1:10]]).reshape ((3,3))
R1 = np.array([float(i) for i in l[10:19]]).reshape((3,3))
t1 = np.array([float(i) for i in l[19:22]]).reshape((3,1))
# Reading the informaiton of the second image
l = f.readline().split()
im2_fn = l[0]
K2 = np.array([float(i) for i in l[1:10]]).reshape((3,3))
R2 = np.array([float(i) for i in l[10:19]]).reshape((3,3))
t2 = np.array([float(i) for i in l[19:22]]).reshape((3,1))
```

2

In [ ]:

```
im1 = cv.imread(r'templeSparseRing/' + im1_fn, cv.IMREAD_COLOR)
im2 = cv.imread(r'templeSparseRing/' + im2_fn, cv.IMREAD_COLOR)
assert im1 is not None
assert im2 is not None
# Compute P1 and P2
P1 = K1 @ np.hstack((R1, t1)) # P = K*[R|t]
P2 = K2 @ np.hstack((R2, t2)) # P = K*[R|t]
print('P1 = \n', P1)
print('P2 = \n', P2)
```

```
P1 =
 [[ 4.80251845e+01  1.44011271e+03 -5.71648932e+02  7.53293366e+01]
 [ 1.53577034e+03 -6.41434324e+01 -1.63127843e+02  1.85810055e+02]
 [ 4.88387837e-02 -1.81568392e-01 -9.82164799e-01  6.14604846e-01]]
P2 =
 [[-1.55882371e+02  1.44377186e+03 -5.42436214e+02  6.81806220e+01]
 [ 1.34928131e+03 -8.41979541e+01 -7.49443961e+02  1.99929996e+02]
 [-3.40999743e-01 -1.74474039e-01 -9.23730472e-01  6.00850565e-01]]
```

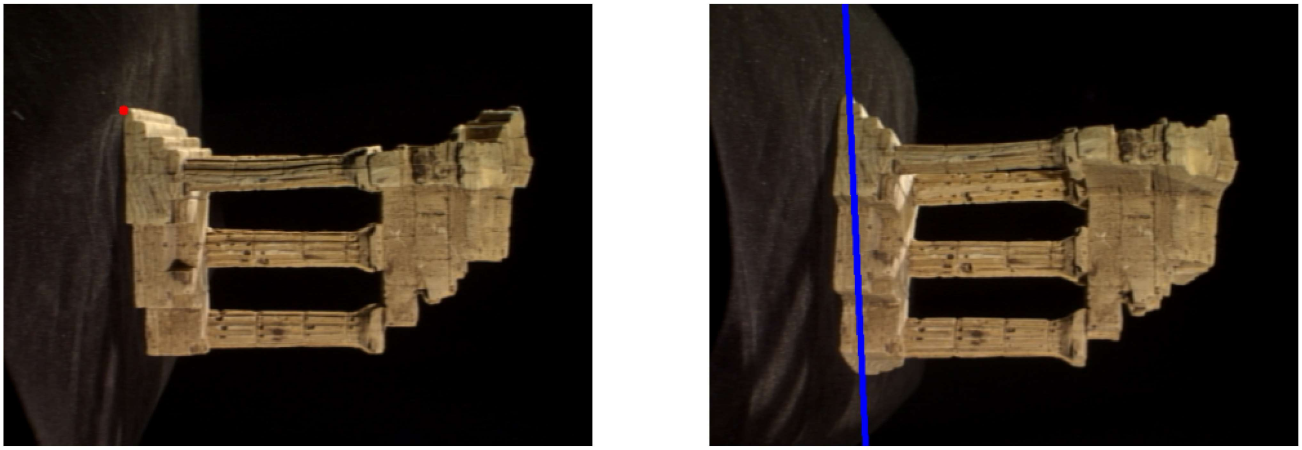
3

In [ ]:

```
def skew(x):
    x = x.ravel()
    return np.array([[0, -x[2], x[1]], [x[2], 0, -x[0]], [-x[1], x[0], 0]])
C = null_space(P1)
C = C * np.sign(C[0, 0])
e2 = P2 @ C
e2x = skew(e2)
F = e2x @ P2 @ np.linalg.pinv(P1)
print('F = \n', F)
x = np.array([130, 115, 1])
cv.circle(im1, (x[0], x[1]), 5, (0, 0, 255), -1)
l2 = F @ x.T
p1 = np.array([0, (l2[0]*0 + l2[2])/l2[1]]).astype(int)
```

```
p2 = np.array([500, (l2[0]*500 + l2[2])/l2[1]]).astype(int)
cv.line(im2, (p1[0], p1[1]), (p2[0], p2[1]), (255,0, 0), 5)
fig, ax = plt.subplots(1, 2, figsize=(18, 18))
ax[0].imshow(cv.cvtColor(im1, cv.COLOR_BGR2RGB))
ax[0].axis('off')
ax[1].imshow(cv.cvtColor(im2, cv.COLOR_BGR2RGB))
ax[1].axis('off')
plt.show()
```

```
F =
 [[-2.87071497e-04 -3.96261289e-02  2.94221686e+02]
 [-3.55039713e-02  1.65329260e-04  1.78860854e+01]
 [-2.76702814e+02  2.12942175e+01 -9.06669374e+03]]
```

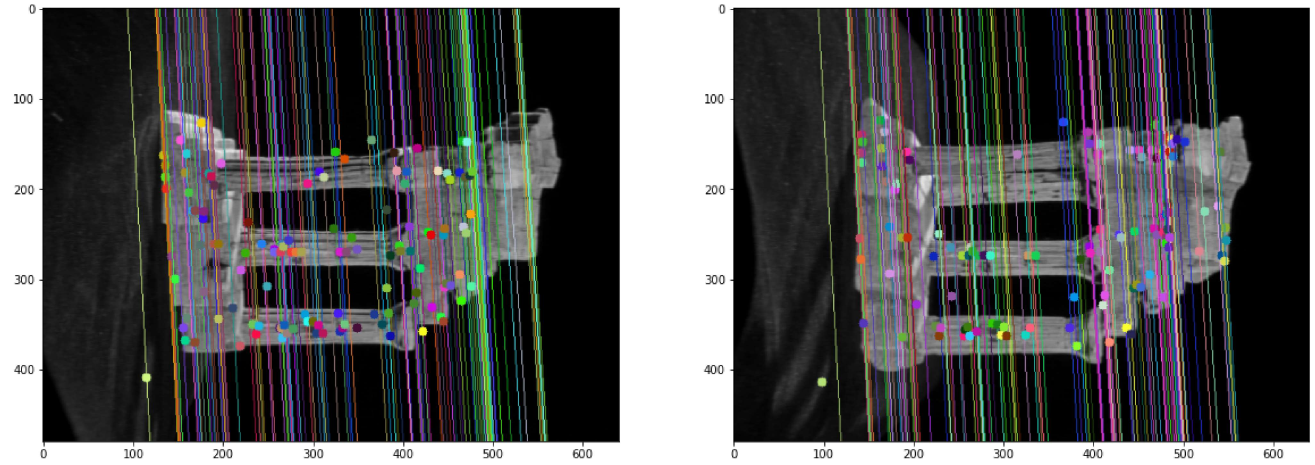


4

In [ ]:

```
image1 = cv.imread (r'templeSparseRing/'+im1_fn,0)
image2 = cv.imread (r'templeSparseRing/'+im2_fn,0)
sift = cv.SIFT_create()
kp1, desc1 = sift.detectAndCompute(image1, None)
kp2, desc2 = sift.detectAndCompute(image2, None)
FLANN_INDEX_KDTREE = 1
indx_para = dict(algorithm = FLANN_INDEX_KDTREE,trees = 5)
search_para = dict (checks = 50)
flann = cv.FlannBasedMatcher(indx_para, search_para)
matches = flann.knnMatch(desc1, desc2, k=2)
points1, points2 = [],[]

for i, (m,n) in enumerate (matches) :
    if m.distance < 0.8*n.distance:
        points2.append (kp2 [m.trainIdx].pt)
        points1.append (kp1 [m.queryIdx] .pt)

points1= np.int32 (points1)
points2 = np.int32 (points2)

F ,mask = cv. findFundamentalMat(points1, points2, cv.FM_LMEDS)
pointsl = points1[mask.ravel () == 1]
points2 = points2 [mask.ravel () == 1]

def drawlines (img1, img2, lines, pts1,pts2):
    r,c = img1. shape
    img1 = cv.cvtColor (img1, cv. COLOR_GRAY2BGR)
    img2 = cv.cvtColor (img2, cv.COLOR_GRAY2BGR)
    for r,pt1, pt2 in zip (lines, pts1, pts2) :
        color = tuple(np. random.randint(0, 255, 3).tolist())
        x0,y0 = map(int, [0,-r[2]/r[1]])
        x1,y1 = map (int, [c,-(r[2]+r[0]*c)/r[1]])
        img1 = cv.line (img1,(x0, y0) , (x1, y1), color, 1)
        img1 = cv.circle (img1, tuple (pt1), 5, color, -1)
        img2 = cv.circle (img2, tuple (pt2) , 5, color, -1)
    return img1, img2
lins1 = cv.computeCorrespondEpilines (points2.reshape(-1, 1, 2),2,F)
lins1 = lins1.reshape (-1, 3)
image3, image4 = drawlines (image1, image2, lins1, points1, points2)
```

```
lins2 = cv.computeCorrespondEpilines (points2.reshape (-1,1,2) , 2, F)
lins2 = lins2.reshape (-1, 3)
image5, image6 = drawlines (image2, image1, lins2, points2, points1)
plt. figure (figsize=(20, 20) )
plt. subplot (121), plt. imshow (image3)
plt. subplot (122), plt. imshow (image5)
plt.show()
```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