**Assignment 02- Fitting and Alignment-200148M**

**Question-01**

# Load the image

im = cv.imread('the\_berry\_farms\_sunflower\_field.jpeg', cv.IMREAD\_REDUCED\_COLOR\_4)

# Apply Gaussian blur to reduce noise

blurred = cv.GaussianBlur(im, (**9**, **9**), **0.1**)

# Convert the image to grayscale

gray = cv.cvtColor(blurred, cv.COLOR\_BGR2GRAY)

# Define parameters for blob detection

min\_sigma = **3**

max\_sigma = **30**

threshold = .**1**

# Detect blobs using Laplacian of Gaussians

blobs = blob\_log(gray, min\_sigma=min\_sigma, max\_sigma=max\_sigma, threshold=threshold)

blobs[:, **2**] = blobs[:, **2**] \* sqrt(**2**)

max\_radius\_index = np.argmax(blobs[:, **2**])

largest\_circle\_params = blobs[max\_radius\_index]

y, x, r = largest\_circle\_params

print(f"Radius (r): {r}")

print(f"Center (x, y): ({x}, {y})")

# Draw circles on the original color image

Figure 1

**for** blob **in** blobs:

y, x, r = blob # Blob format is (y, x, r)

cv.circle(im, (int(x), int(y)), int(r), (**0**, **0**, **255**), **2**)

**parameters of the largest circles.**

* Radius (r): 42.42640687
* Center (x, y): (234.0, 0.0)

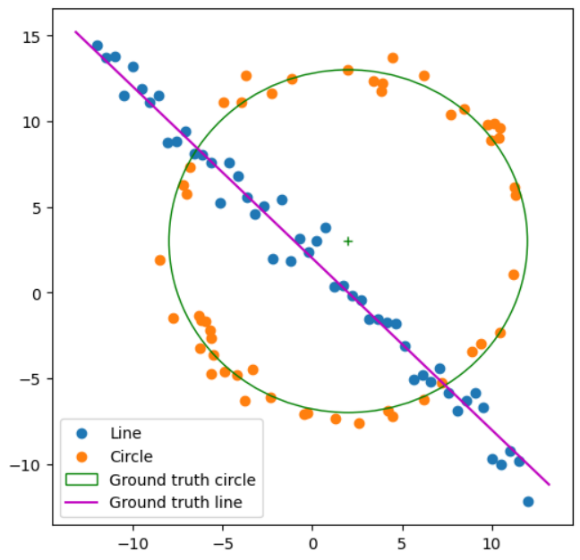
**Question-02**

Figure 3 Line Estimation using RNASAC.

A diagram of a graph

Description automatically generated

Figure 2 Noisy Point Set Generation

**def** **circle\_equation**(points):

""" Return the center and radius of the circle from three points """

p1,p2,p3 = points[**0**], points[**1**], points[**2**]

temp = p2[**0**] \* p2[**0**] + p2[**1**] \* p2[**1**]

bc = (p1[**0**] \* p1[**0**] + p1[**1**] \* p1[**1**] - temp) / **2**

cd = (temp - p3[**0**] \* p3[**0**] - p3[**1**] \* p3[**1**]) / **2**

det = (p1[**0**] - p2[**0**]) \* (p2[**1**] - p3[**1**]) - (p2[**0**] - p3[**0**]) \* (p1[**1**] - p2[**1**])

# Center of circle

cx = (bc\*(p2[**1**] - p3[**1**]) - cd\*(p1[**1**] - p2[**1**])) / det

cy = ((p1[**0**] - p2[**0**]) \* cd - (p2[**0**] - p3[**0**]) \* bc) / det

radius = np.sqrt((cx - p1[**0**])\*\***2** + (cy - p1[**1**])\*\***2**)

**return** ((cx, cy), radius)

**def** **get\_inliers**(data\_list, center, r):

""" Returns the list of inliers to a model of a circle from a set of points. The threshold value is taken as 1/5th of the radius """

inliers = []

thresh = r//**3**

**for** i **in** range(len(data\_list)):

error = np.sqrt((data\_list[i][**0**]-center[**0**])\*\***2** + (data\_list[i][**1**]-center[**1**])\*\***2**) - r

**if** error < thresh:

inliers.append(data\_list[i])

**return** np.array(inliers)

**def** **random\_sample**(data\_list):

""" Returns a list of 3 random samples from a given list """

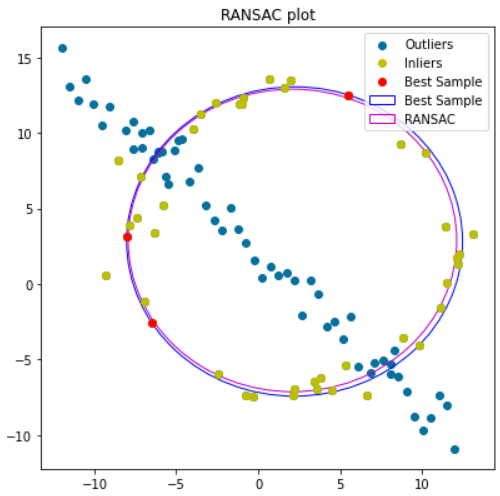
sample\_list = []

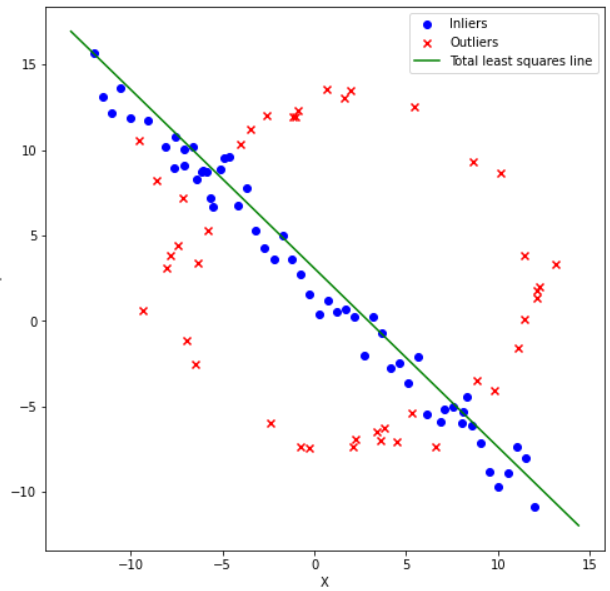
random.seed(**0**)

rand\_nums = random.sample(range(**1**, len(data\_list)), **3**)

**for** i **in** rand\_nums:

sample\_list.append(data\_list[i])

 **return** np.array(sample\_list)



**Part(d) -** Focusing on fitting the circle first may lead to a less accurate line fit because it leaves fewer data points for detecting and modeling the line where it intersects with the circle.

**Question-03**

**for** i **in** range(**2**):

im = cv.imread(ims[i])

cv.imshow("Wadham College",im)

corners = []

cv.setMouseCallback("Wadham College", mouse\_click), cv.waitKey(**0**), cv.destroyAllWindows()

h, w = np.shape(im)[**0**], np.shape(im)[**1**]

zero\_matrix = np.array([[**0**], [**0**], [**0**]])

x1, y1, x2, y2, x3, y3, x4, y4 = corners[**0**][**0**], corners[**0**][**1**], corners[**1**][**0**], corners[**1**][**1**], corners[**2**][**0**], corners[**2**][**1**], corners[**3**][**0**], corners[**3**][**1**]

flag\_im = cv.imread("Flag\_of\_the\_United\_Kingdom.png")

fh, fw , ch= flag\_im.shape

f1, f2, f3, f4 = np.array([[**0**, **0**, **1**]]), np.array([[fw-**1**, **0**, **1**]]), np.array([[fw-**1**, fh-**1**, **1**]]), np.array([[**0**, fh-**1**, **1**]])

matrix\_A = np.concatenate((np.concatenate((zero\_matrix.T,f1, -y1\*f1), axis = **1**), np.concatenate((f1, zero\_matrix.T, -x1\*f1), axis = **1**),

np.concatenate((zero\_matrix.T,f2, -y2\*f2), axis = **1**), np.concatenate((f2, zero\_matrix.T, -x2\*f2), axis = **1**),

np.concatenate((zero\_matrix.T,f3, -y3\*f3), axis = **1**), np.concatenate((f3, zero\_matrix.T, -x3\*f3), axis = **1**),

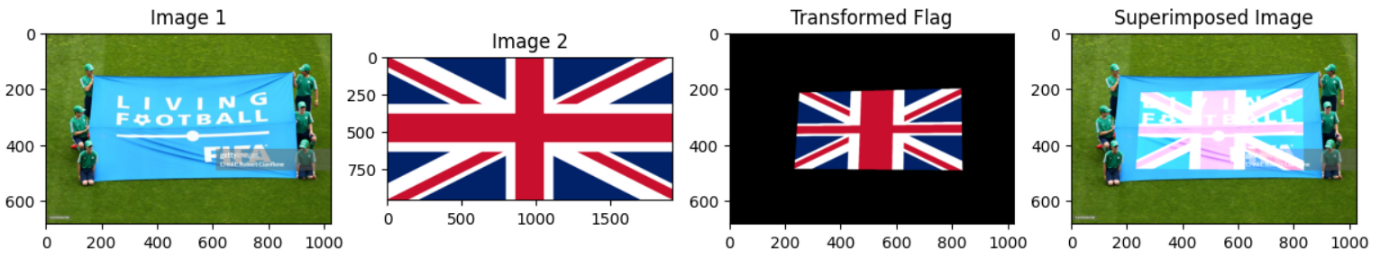
np.concatenate((zero\_matrix.T,f4, -y4\*f4), axis = **1**), np.concatenate((f4, zero\_matrix.T, -x4\*f4), axis = **1**)), axis = **0**, dtype=np.float64)

W, v = np.linalg.eig(((matrix\_A.T)**@matrix\_A**))

temph= v[:,np.argmin(W)]

H = temph.reshape((**3**,**3**))

transformed\_flag = cv.warpPerspective(flag\_im, H, (w, h))

A flag with a red and blue stripe

Description automatically generated final = cv.add(transformed\_flag, im)

**Question-04**



Figure 2 **Question 4(a)**

**Part(b)**

**def** **homography**(pts1, pts2):

mean1, mean2 = np.mean(pts1, axis=**0**), np.mean(pts2, axis=**0**)

s1, s2 = len(pts1)\*np.sqrt(**2**)/np.sum(np.sqrt(np.sum((pts1-mean1)\*\***2**, axis=**1**))), len(pts1)\*np.sqrt(**2**)/np.sum(np.sqrt(np.sum((pts2-mean2)\*\***2**, axis=**1**)))

tx1, ty1, tx2, ty2 = -s1\*mean1[**0**], -s1\*mean1[**1**], -s2\*mean2[**0**], -s2\*mean2[**1**]

T1, T2 = np.array(((s1, **0**, tx1), (**0**, s1, ty1), (**0**, **0**, **1**))), np.array(((s2, **0**, tx2), (**0**, s2, ty2), (**0**, **0**, **1**)))

A = []

**for** i **in** range(len(pts1)):

X11, X21 = T1 \* np.concatenate((pts1[i], [**1**])).reshape(**3**, **1**), T2 \* np.concatenate((pts2[i], [**1**])).reshape(**3**, **1**)

A.append((-X11[**0**][**0**], -X11[**1**][**0**], -**1**, **0**, **0**, **0**, X21[**0**][**0**]\*X11[**0**][**0**], X21[**0**][**0**]\*X11[**1**][**0**], X21[**0**][**0**]))

A.append((**0**, **0**, **0**, -X11[**0**][**0**], -X11[**1**][**0**], -**1**, X21[**1**][**0**]\*X11[**0**][**0**], X21[**1**][**0**]\*X11[**1**][**0**], X21[**1**][**0**]))

A = np.array(A)

U, S, V = np.linalg.svd(A, full\_matrices=**True**)

h = np.reshape(V[-**1**], (**3**, **3**))

H = linalg.inv(T2) \* h \* T1

H = (**1** / H.item(**8**)) \* H

A black background with white numbers

Description automatically generated **return** H



Figure 3 Computed homography

**Part(c)**