EE5175 -Image Signal Processing

Lab-2

Occlusion detection

import libraries

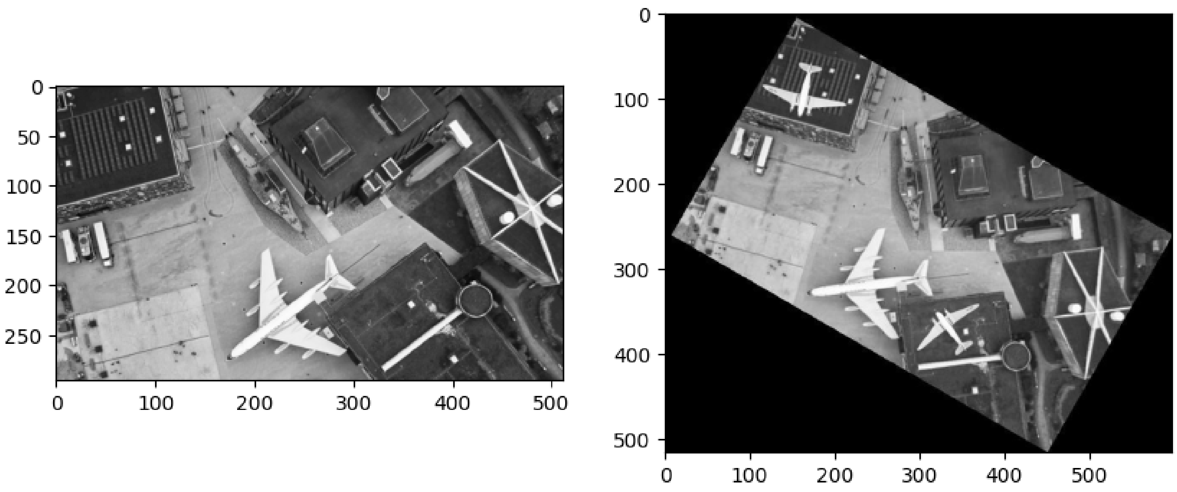
In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
from skimage.io import imread
import os
import math as m
```

read image

In [2]:
```
img_1 = imread('./IMG1.png')
img_2 = imread('./IMG2.png')
```

plot images

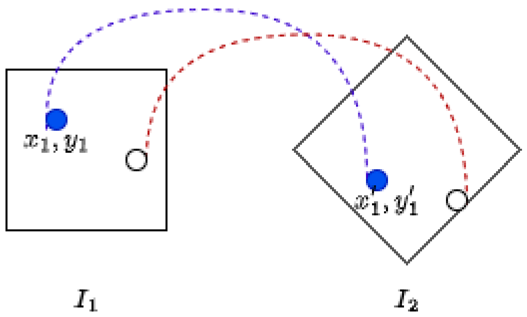
In [3]:
```
plt.figure(figsize=(10,10))
plt.subplot(1,2,1)
plt.imshow(img_1 , 'gray')
plt.subplot(1,2,2)
plt.imshow(img_2 , 'gray')
plt.show()
```



points given

In [4]:
```
points_1 = np.array([[29, 124], [157, 372]])
points_2 = np.array([[93, 248], [328, 399]])
```

matrix formation



$$x_i^{'} = \frac{ax_i + by_i + c}{h}$$

$$y_i^{'} = \frac{-bx_i + ay_i + d}{h}$$

$$A_i\bar{h} = 0$$

$$A_i = \begin{bmatrix} x_i & y_i & 1 & 0 & -x_i^{'} \\ y_i & -x_i & 0 & 1 & -y_i^{'} \end{bmatrix}$$

NOTE: All the notations used here are as used in the class

In [5]:
```
def matrix_form(points_1, points_2):
    num_of_corr = len(points_1)

    mat_ = np.zeros((2*num_of_corr, 5))
    for i in range(num_of_corr):
        x, y = points_1[i]
        x_dash, y_dash = points_2[i]
        mat_[2*i] = [x, y, 1, 0, -x_dash]
        mat_[2*i+1] = [y, -x, 0, 1, -y_dash]
#           print(mat_)
    return mat_
```

homography matrix from SVD

https://en.wikipedia.org/wiki/Singular_value_decomposition

https://math.stackexchange.com/questions/3509039/calculate-homography-with-and-without-svd

In [6]:
```
def homography_matrix(matrix_):
    u, s, v_transpose = np.linalg.svd(matrix_)  #svd of the form decreasing order
    a, b, c, d, h = v_transpose[-1]    # required elements to form the matrix in the
    H = np.array([[a, b, c], [-b, a, d], [0, 0, h]]).reshape(3,3)  # reshaping it t
    return H
```

Bilinear Interpolation

In [7]:
```
def bilinear_interploation(source , x , y ):
    '''
    input params : source =  source image
```

```
                    x =  x coordinate
                    y = y coordinate

        output : returns a target image
    '''

    xx = source.shape[0]   # shape of the input image
    yy = source.shape[1]

    x_dash = m.floor(x)    #  floor value of the coordinate (x ' and y' as mentione
    y_dash = m.floor(y)

    a = x - x_dash       # finding a and b i.e difference between actual and the fl
    b = y - y_dash

    if x_dash >= 0 and y_dash>=0 and x_dash <= xx-2 and y_dash <= yy-2:  ##formula
        target_img =(1-a)*(1-b)*source[x_dash,y_dash]+ (1-a)*b*source[x_dash,y_dash

    else:
        target_img = 0     # without using this condition , zeros wouldn't be creat

    return target_img
```

Image after Homography

In [8]:

```
def get_image(source_image, H):
    x, y = np.shape(source_image)
    H_inverse = np.linalg.inv(H)
    target_image = np.zeros((x, y))

    for xt in range(x):
        for yt in range(y):
            vec = np.array([xt, yt, 1]) #making all the coordinates to homography (
            # req = inverse_h * given (H_inv = (3*3) homogeneous coord of vec(3*1))
            temp = H_inverse@vec
            xs = temp[0]/temp[-1]
            ys = temp[1]/temp[-1]
            #normalizing after diving and using the x and y in bilinear transformat
            val = bilinear_interploation(source_image, xs, ys)
            target_image[xt, yt] = val

    return target_image
```

In [9]:

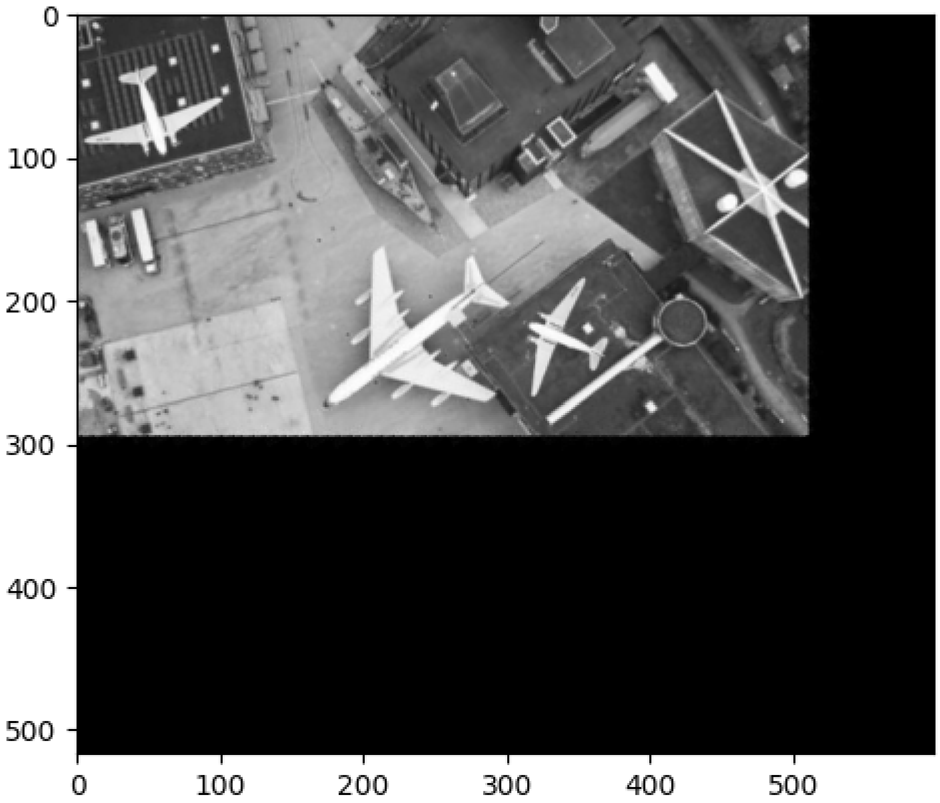
```
A = matrix_form(points_2, points_1)  # corresponding points in 2 and same in 1
H = homography_matrix(A)  # finding matrix H
new_image = get_image(img_2, H) # new image
```

In [10]:

```
plt.imshow(new_image,'gray')
```

Out[10]:

```
<matplotlib.image.AxesImage at 0x22b7f6a5e10>
```



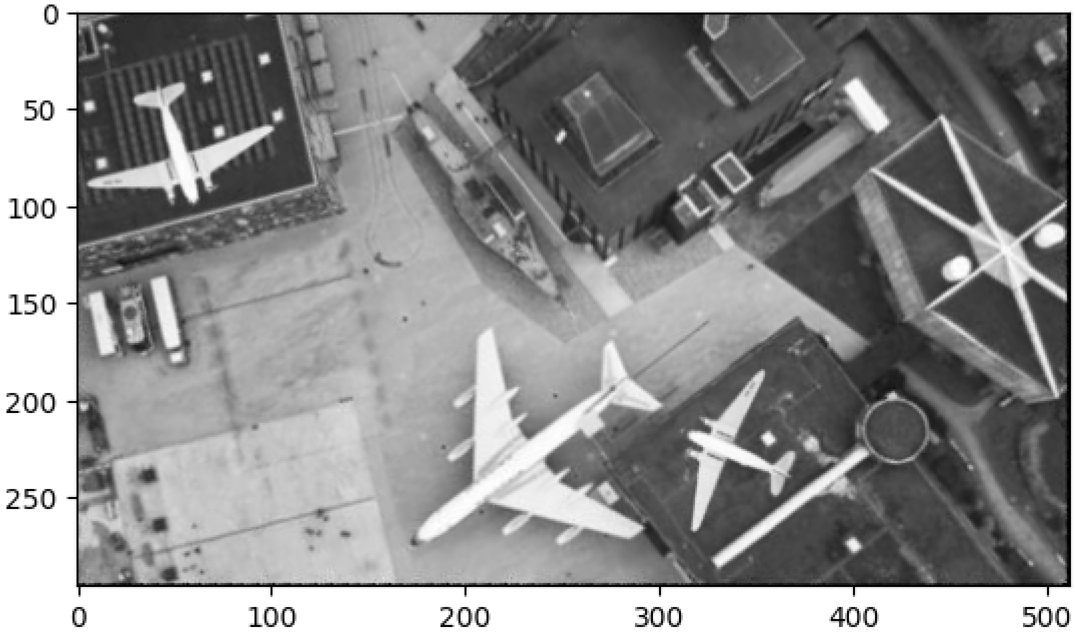
In [11]:
```
x1,y1 = img_1.shape
```

In [12]:
```
img2_crop = new_image[:x1,:y1]
```

copped image

In [13]:
```
plt.imshow(img2_crop,'gray')
```

Out[13]:
```
<matplotlib.image.AxesImage at 0x22b7f716e30>
```



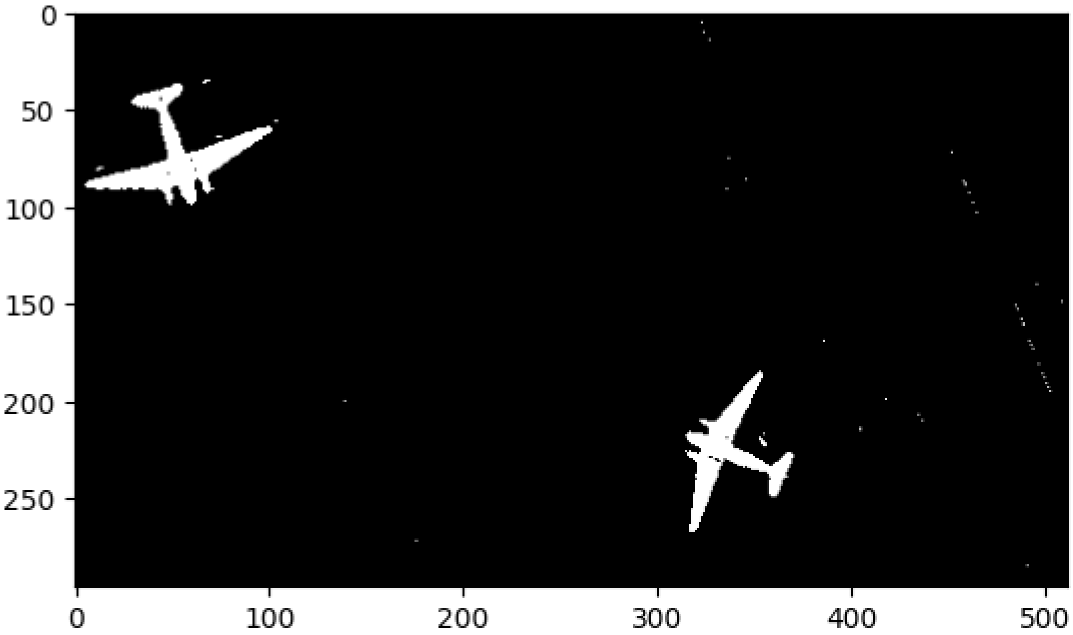
subtracted image and applying threshold

In [14]:

```
plt.imshow(img2_crop - img_1>70 , cmap ='gray')
```

Out[14]:

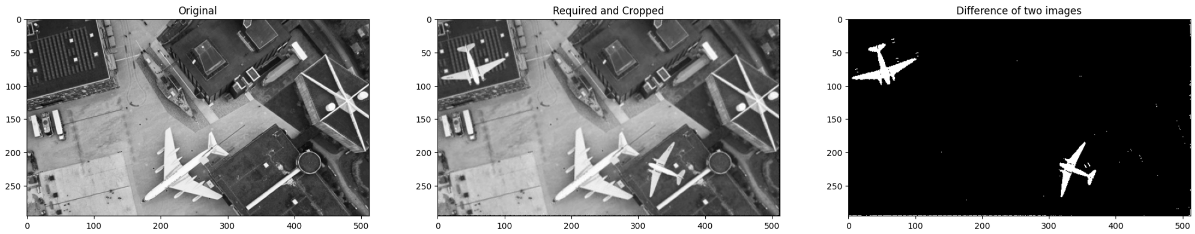
```
<matplotlib.image.AxesImage at 0x22b7fc804f0>
```



final plot

In [16]:

```
plt.figure(figsize=(25,18))
plt.subplot(1,3,1)
plt.imshow(img_1,cmap ='gray')
plt.title('Original')
plt.subplot(1,3,2)
plt.imshow(img2_crop,cmap ='gray')
plt.title('Required and Cropped')
plt.subplot(1,3,3)
plt.imshow(abs(img2_crop - img_1)>80 , cmap ='gray')
plt.title('Difference of two images')
plt.show()
```



Learnings

- points 1 to points 2 if we do the homography , image moves out and not aligned to old one , so it must 2 to 1 always
- proper alignment of image points are needed , else it will result in different image and we cannot detect the difference

- can be called as a registration task (we are given the points)
- need to try this on SIFT and SURd to see if its able to given this (if given what is the error)