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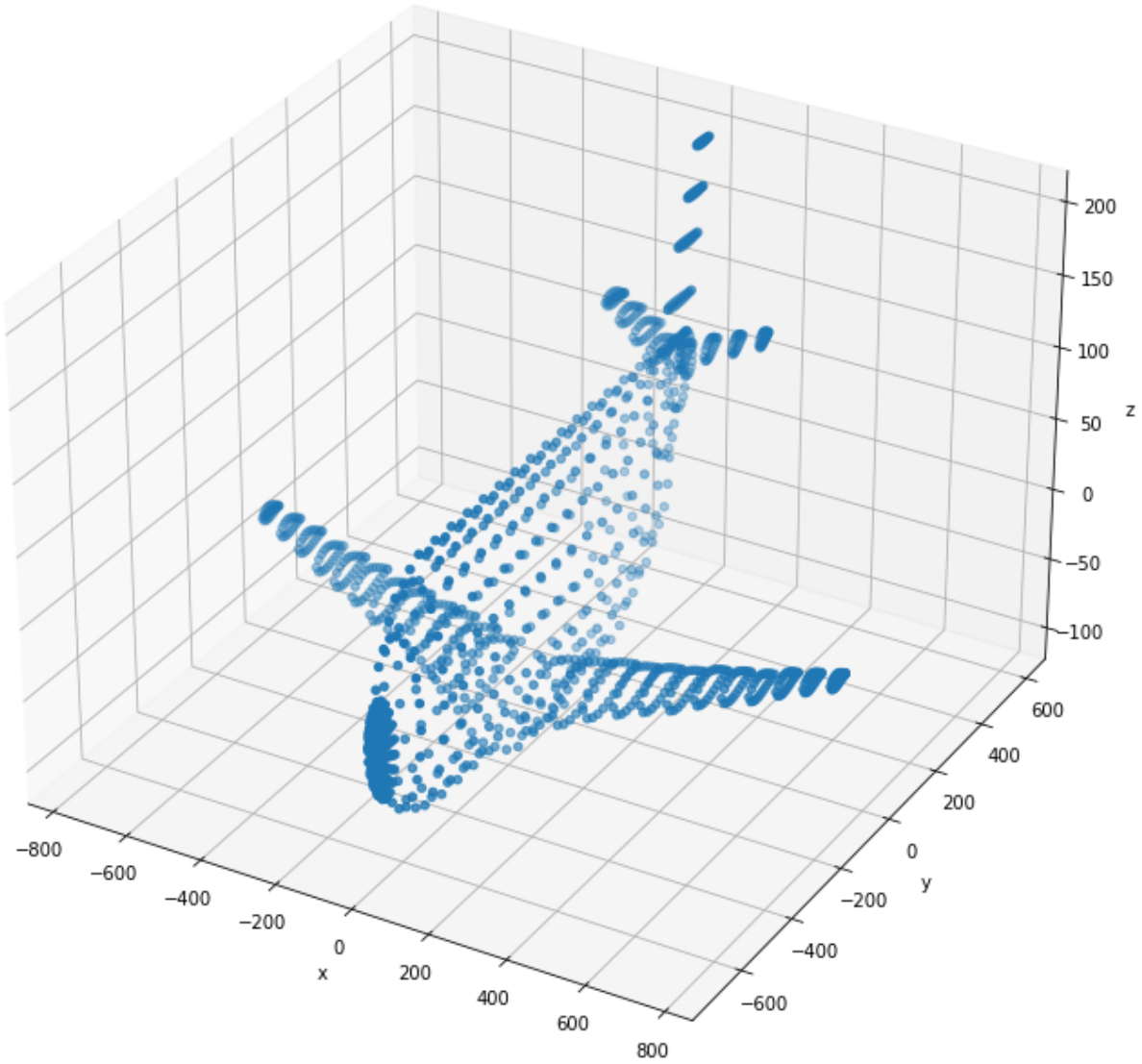
Index No.: 190172K

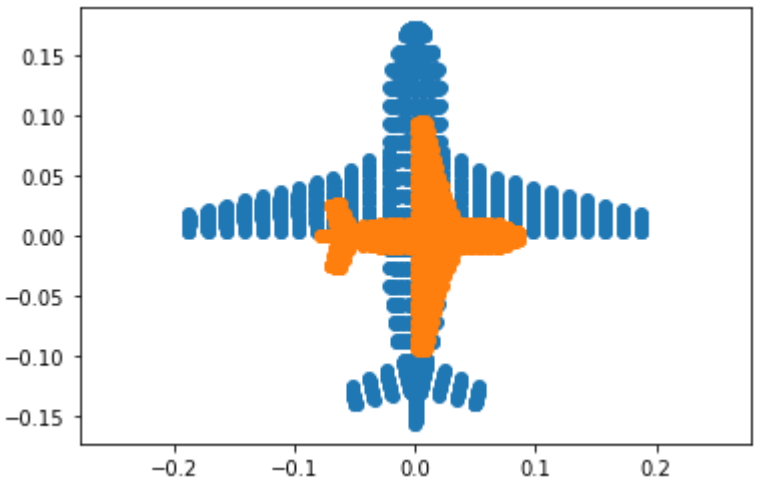
In [ ]:
```
import cv2
import numpy as np
import sympy
import matplotlib.pyplot as plt
import matplotlib.gridspec as gridspec
from plyfile import PlyData,PlyElement
%matplotlib inline
```

Q1

In [ ]:
```
pcd = PlyData.read(r"airplane.ply")
assert pcd is not None

points = np.concatenate((pcd['vertex']['x'].reshape(1, -1), pcd['vertex']['y'].reshape(
points = points - np.mean(points, axis=1).reshape(3,1)

ones = np.ones((1, points.shape[1]))
X = np.concatenate((points,ones),axis=0)

fig = plt.figure(figsize=(12,12))
ax = fig.add_subplot(111, projection="3d")
ax.scatter(points[0,:],points[1,:],points[2,:])
ax.set_xlabel("x")
ax.set_ylabel("y")
ax.set_zlabel("z")

R = np.array([[1,0,0],[0,1,0],[0,0,1]])
K = np.array([[1,0,0],[0,1,0],[0,0,1]])
t = np.array([[0],[0],[-4000]])

P1 = K @ np.concatenate((R,t) , axis=1)

R = np.array([[0,1,0],[1,0,0],[0,0,1]])
K = np.array([[0.5,0,0],[0,0.5,0],[0,0,1]])
t = np.array([[0],[0],[-4000]])

P2 = K @ np.concatenate((R,t) , axis=1)

x1 = P1 @ X
x2 = P2 @ X
x1 = x1 / x1[2, :]
x2 = x2 / x2[2, :]


fig, ax = plt.subplots(1,1, sharex=True, sharey=True)
ax.scatter(x1[0,:], x1[1, :])
ax.scatter(x2[0,:], x2[1, :])
```

```
ax.axis("equal")
plt.show()
```





Q3

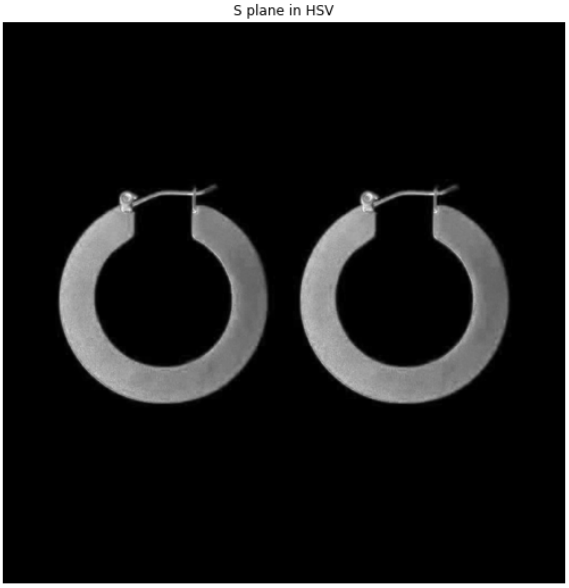
In [ ]:
```
im = cv2.imread(r"earrings.jpg", cv2.IMREAD_COLOR)
assert im is not None

hsv = cv2.cvtColor(im,cv2.COLOR_BGR2HSV)
th , bw = cv2.threshold(hsv[: ,:, 1], 0, 255, cv2.THRESH_BINARY + cv2.THRESH_OTSU)

w = 5
kernel = np.ones((w,w), np.uint8)
opened = cv2.morphologyEx(bw, cv2.MORPH_CLOSE, kernel)

retval, labels, stats , centroids = cv2.connectedComponentsWithStats(bw)
cmaped = cv2.applyColorMap((labels/np.amax(labels)*255).astype("uint8"),cv2.COLORMAP_PA

Z = 720
f = 8
for i,s in enumerate(stats):
    if (i !=0):
        print("Item 1 ", i , "area in pixel =", s[4])
        mm = s[4]*(2.2e-3)**2*(Z**2)/(f**2)
        print("Item 1 ", i , "area in mm^2 =", mm)
fig, ax = plt.subplots(2,2,figsize=(20,20))

ax[0,0].imshow(cv2.cvtColor(im,cv2.COLOR_BGR2RGB))
ax[0,0].axis('off')
ax[0,0].set_title("captured image")

ax[0,1].imshow(cv2.cvtColor(hsv[: ,:, 1],cv2.COLOR_BGR2RGB))
ax[0,1].axis('off')
ax[0,1].set_title("S plane in HSV")

ax[1,0].imshow(cv2.cvtColor(bw,cv2.COLOR_BGR2RGB))
ax[1,0].axis('off')
ax[1,0].set_title("Black&White")

ax[1,1].imshow(cv2.cvtColor(cmaped,cv2.COLOR_BGR2RGB))
ax[1,1].axis('off')
ax[1,1].set_title("Color mapped")
```

```
Item 1  1 area in pixel = 59143
Item 1  1 area in mm^2 = 2318.642172
Item 1  2 area in pixel = 59211
Item 1  2 area in mm^2 = 2321.3080440000003
```

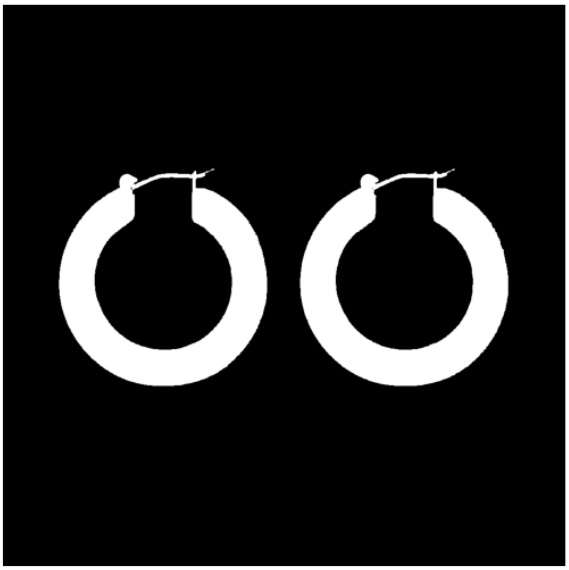
Out[ ]:
```
Text(0.5, 1.0, 'Color mapped')
```

captured image

S plane in HSV



Black&White



Color mapped