Index number: 190128H

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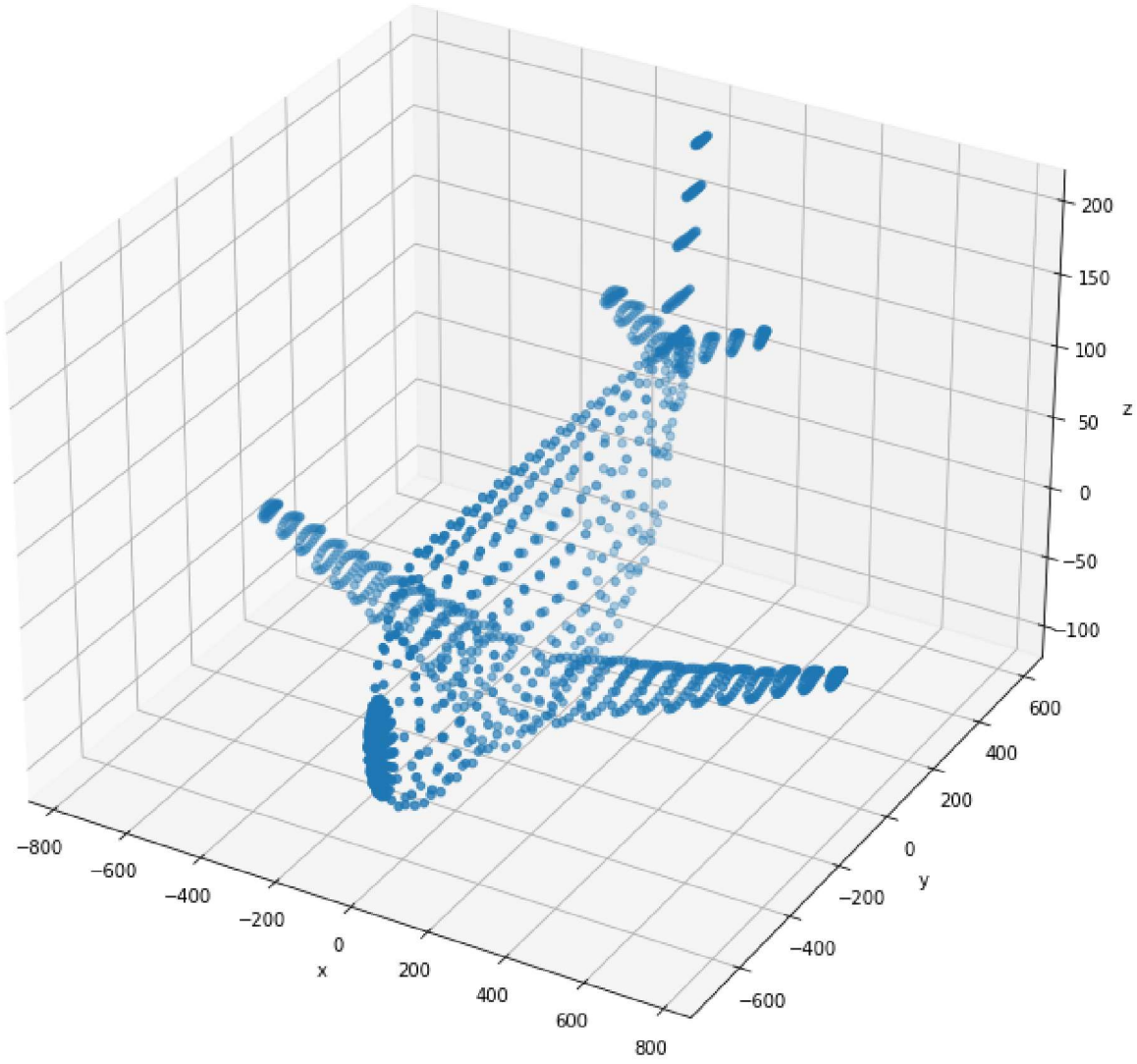
In [ ]:
```
import numpy as np
from plyfile import PlyData, PlyElement
import matplotlib.pyplot as plt

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)
```

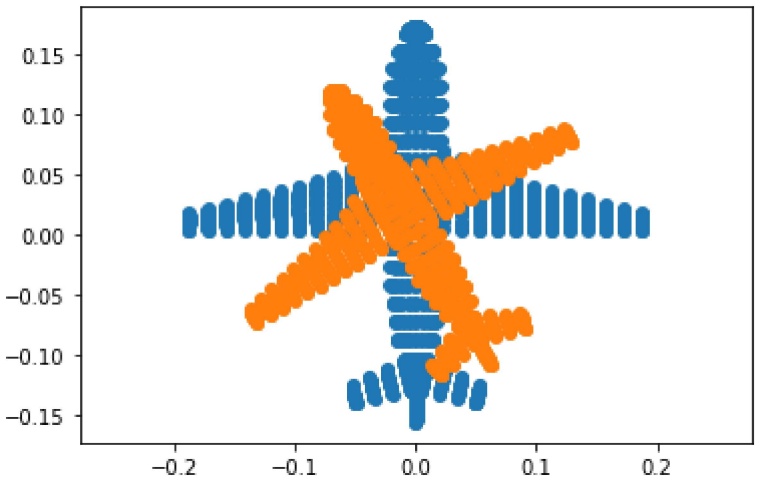
In [ ]:
```
fig=plt.figure(figsize=(12,12))
ax=fig.add_subplot(111,projection = '3d')
ax.scatter(points[0,:],points[1,:],points[2,:])
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_zlabel('z')
```

Out[ ]:
```
Text(0.5, 0, 'z')
```



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

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)


titz = 30*np.pi/180

R=np.array([[np.cos(titz),-np.sin(titz),0],[np.sin(titz),np.cos(titz),0],[0,0,1]])
K=np.array([[0.8,0,0],[0,0.8,0],[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()
```

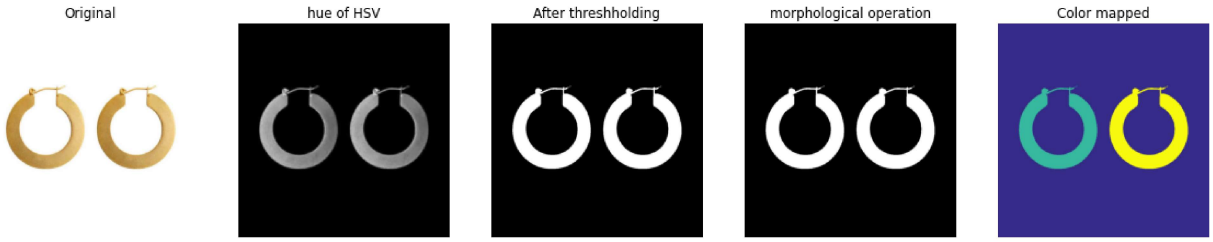


In [ ]:

```
import numpy as np
import cv2 as cv
import matplotlib.pyplot as plt

im=cv.imread("earrings.jpg",cv.IMREAD_COLOR)
assert im is not None

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

w=5
kernal=np.ones((w,w),np.uint8)
opened=cv.morphologyEx(bw,cv.MORPH_CLOSE,kernal)

retval,labels,stats,centroids=cv.connectedComponentsWithStats(bw)
colormapped=cv.applyColorMap((labels/np.amax(labels)*255).astype("uint8"),cv.COLORMAP_

Z=720
f=8
for i,s in enumerate(stats):
    if i!=0:
        print("Items",i,", area in pixels =",s[4])
        print("Items",i,", area in mn^2 =",s[4]*(2.2e-3)**2*(Z*Z)/(f*f))


fig,ax=plt.subplots(1,5,figsize=(20,20))
ax[0].set_title('Original')
ax[0].imshow(cv.cvtColor(im, cv.COLOR_BGR2RGB))
ax[1].set_title('hue of HSV')
ax[1].imshow(cv.cvtColor(hsv[:,:,1], cv.COLOR_BGR2RGB))
ax[2].set_title('After threshholding')
ax[2].imshow(cv.cvtColor(bw, cv.COLOR_BGR2RGB))
ax[3].set_title('morphological operation')
ax[3].imshow(cv.cvtColor(opened, cv.COLOR_BGR2RGB))
ax[4].set_title('Color mapped')
ax[4].imshow(cv.cvtColor(colormapped, cv.COLOR_BGR2RGB))
```

```
for i in range(5):
    ax[i].axis("off")

plt.show()
```

```
Items 1 , area in pixels = 59143
Items 1 , area in mn^2 = 2318.642172
Items 2 , area in pixels = 59211
Items 2 , area in mn^2 = 2321.3080440000003
```



In [ ]:

```
import cv2 as cv
import numpy as np
import matplotlib . pyplot as plt
im = cv . imread('allenkeys.jpg' , cv .IMREAD_REDUCED_GRAYSCALE_2)
canny = cv .Canny(im, 50, 150)

# Copy edges to the images that will display the results in BGR
canny_color = cv . cvtColor ( canny , cv .COLOR_GRAY2BGR)


lines = cv.HoughLines ( canny , 1 , np.pi/180 , 170 , None , 0 , 0)
if lines is not None :
    for i in range (0 , len (lines)):
        rho = lines[i][0][0]
        theta = lines[i][0][1]
        a = np.cos(theta)
        b = np.sin(theta )
        x0 = a*rho
        y0 = b*rho
        pt1 = (int(x0 + 1000*(-b)) , int(y0 + 1000*(a)))
        pt2 = (int(x0 - 1000*(-b)) , int(y0 - 1000*(a)))
        cv.line(canny_color , pt1 , pt2 , (0 ,0 ,255) , 1 , cv.LINE_AA)

fig, ax = plt.subplots(1,5,figsize=(20,4))
ax[0].imshow(im,cmap = 'gray', vmin = 0, vmax=255)
ax[0].title.set_text('original')
ax[0].axis('off')
ax[0].xaxis.tick_top()

ax[1].imshow(cv.cvtColor(canny,cv.COLOR_BGR2RGB))
ax[1].title.set_text('canny')
ax[1].axis('off')
ax[1].xaxis.tick_top()

ax[2].imshow(cv.cvtColor(canny_color,cv.COLOR_BGR2RGB))
ax[2].title.set_text('canny color')
ax[2].axis('off')
ax[2].xaxis.tick_top()

# cv.namedWindow( 'Image' , cv.WINDOW_AUTOSIZE)
# cv.imshow( 'Image' , im)
```

```
# cv.waitKey(0)
# cv.imshow( 'Image' , canny )
# cv.waitKey(0)
# cv.imshow('Image' , canny_color )
r = cv.selectROI('Image' , canny_color , showCrosshair = True , fromCenter =False)
cv.waitKey(0)
cv.destroyAllWindows()
print (r)
x0 , y0 = int (r[0] +r[2]/2) , int(r[1]+r[3]/2)
m = b/a # Gradient
m = np.tan(np.median(lines[ : , 0, 1]))
c = y0 - m*x0 # Inte r cept
cv.line(canny_color , (0 , int(c)) , (im.shape[0] , int(m*im.shape[0] +  c)) , (0 ,255

ax[3].imshow(cv.cvtColor(canny_color,cv.COLOR_BGR2RGB))
ax[3].title.set_text('canny color with line')
ax[3].axis('off')
ax[3].xaxis.tick_top()


dy = 1
y_sub_pixel = np.arange(0 , im.shape[0] - 1 , dy )
f_sub_pixel = np.zeros_like(y_sub_pixel)
f_sub_pixel_nn = np.zeros_like(y_sub_pixel)

for i , y in enumerate(y_sub_pixel):
    f_sub_pixel_nn[i] = im[i,y]

# # Your code hear to generate the pix el values along the lin e
ax[4].plot(f_sub_pixel_nn)
ax[4].title.set_text('f_sub_pixel_nn')
```

```
(0, 0, 0, 0)
```