Homework 2

Task 1 If there are 100 lines in the grating, what is the smallest detectable change in motor-shaft angle?

360/100=3.6

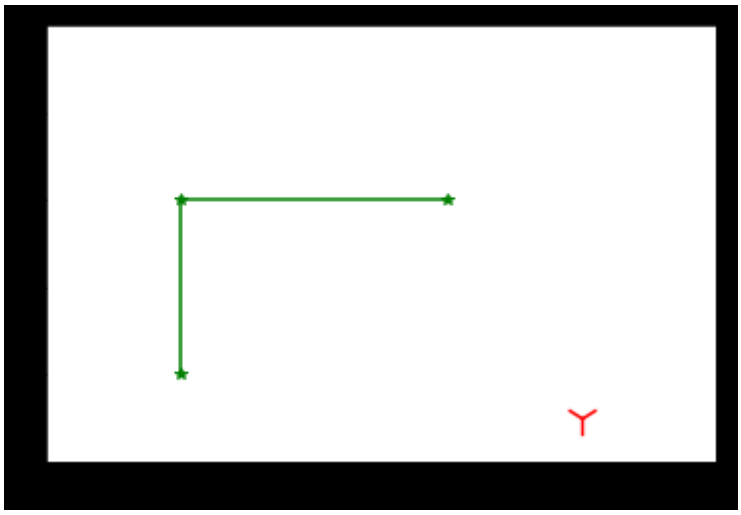
3.6/4=0.9

Task 2 Explain how to determine the rotation directions if the following encoders are used. List two concerns while choosing an encoder.

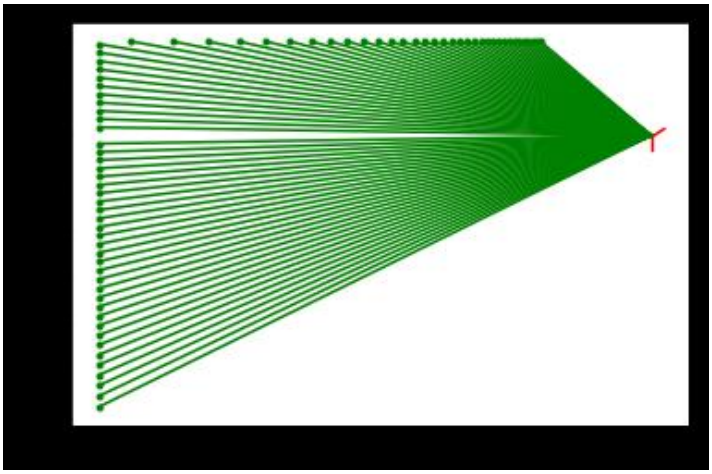
The ordering of which square wave produces a rising edge first identifies the direction of rotation. The accuracy of optical encoders and one or two。

Task 3 Simulate the process of mapping of a room by using a moving range sensor which knows its location accurately (randomly walking, or moving along a circle)

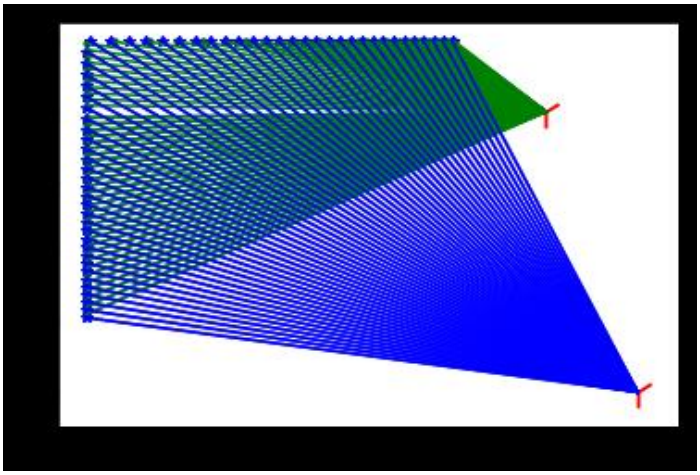
The environment picture is: (the green line is wall, and the red point is robot)



After using a moving range sensor: (the green point are sensed by robot)



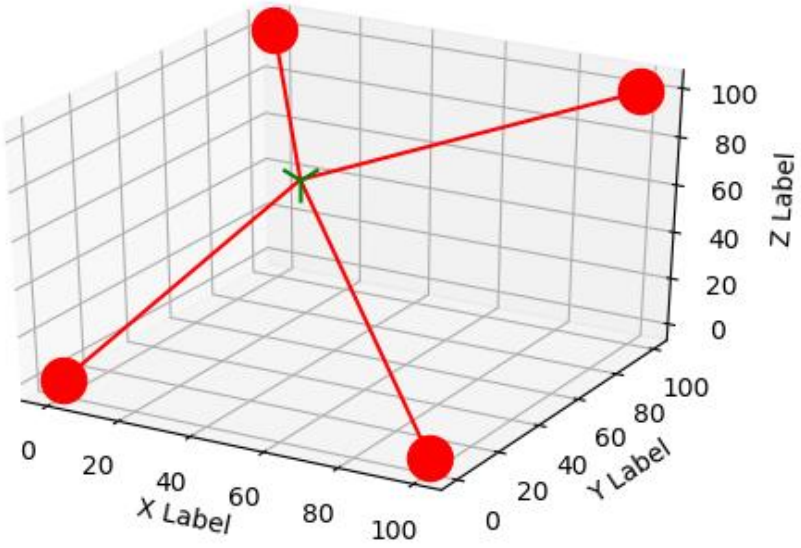
And then randomly walking:



Task 4 Simulate the process of localization with GPS signals. When sender-receiver clocks are either synchronized or not synchronized, how many satellites are needed to achieve 3D accurate positions, respectively?

synchronized :3 not synchronized :4

The four red points are our GPS, and the red lines are signals



My code: (python3, jupter)

Task 3

```
import matplotlib.pyplot as plt
import numpy as np
import math

def has_point(k,b):#最简单的实现返回那个点的坐标
    if k==0:
        return -1
    x2=(3-b)/k
```

```
    y1=k*1+b
    if x2<=3 and x2>=1:
        return x2,3.0
    elif y1<=3 and y1>=1:
        return 1.0,y1
    else:
        return -1

x=[1,1,3]
y=[1,3,3]#墙
plt.plot(x, y, 'g*')
plt.plot(x[:2], y[:2],'g')
plt.plot(x[1:], y[1:],'g')
thex=[]
they=[]

robot=[4, 0.5]#robot 当前位置
plt.scatter(robot[0],robot[1],color='r',marker='1',s=300)

for i in range(0,180):
    deltat = i*math.pi/180#每次多转 1 度
    x1 = robot[0] + 10*math.cos(deltat)
    y1 = robot[1] + 10*math.sin(deltat)
    k=math.tan(deltat)
    b=y1-x1*k#计算当前发射信号的角度的函数
    if has_point(k,b)!=-1:
        [x2,y2]=has_point(k,b)
        thex.append(x2)
        they.append(y2)

plt.xlim(0,5)
plt.ylim(0,5)

plt.show()


plt.plot(thex,they, 'y*')
plt.scatter(robot[0],robot[1],color='r',marker='1',s=300)
for i in range(len(thex)):
    plt.plot([thex[i],robot[0]],[they[i],robot[1]],'b')
plt.show()
```

Task 4

```
import numpy as np
import matplotlib.pyplot as plt
from sympy import *

#四个 gps 的点
G1=[100,100,100,0.03]
G2=[0,0,0,0.06]
G3=[0,100,100,0.055]
G4=[100,0,0,0.06]


d=[109,13,14,9]

#新建的变量
```

```
x=symbols('x')
y=symbols('y')
z=symbols('z')
v=symbols('v')

c=3*(10**3)

#解方程
solution=solve([
    ((G1[0]-x)**2+(G1[1]-y)**2+(G1[2]-z)**2)-(c*(G1[3]-v)-d[0])**2,
    ((G2[0]-x)**2+(G2[1]-y)**2+(G2[2]-z)**2)-(c*(G2[3]-v)-d[1])**2,
    ((G3[0]-x)**2+(G3[1]-y)**2+(G3[2]-z)**2)-(c*(G3[3]-v)-d[2])**2,
    ((G4[0]-x)**2+(G4[1]-y)**2+(G4[2]-z)**2)-(c*(G4[3]-v)-d[3])**2],
    [x,y,z,v]
)

target=list(solution[0])

#画图
import mpl_toolkits.mplot3d
ax=plt.subplot(111,projection='3d')

for e in range(0,len(target)):
    target[e]=float(target[e])

x,y,z=np.linspace(target[0],G1[0],10),np.linspace(target[1],G1[1],10),n
p.linspace(target[2],G1[2],10)
ax.plot(x,y,z,c='r')


x,y,z=np.linspace(target[0],G2[0],10),np.linspace(target[1],G2[1],10),n
p.linspace(target[2],G2[2],10)
ax.plot(x,y,z,c='r')

x,y,z=np.linspace(target[0],G3[0],10),np.linspace(target[1],G3[1],10),n
p.linspace(target[2],G3[2],10)
ax.plot(x,y,z,c='r')

x,y,z=np.linspace(target[0],G4[0],10),np.linspace(target[1],G4[1],10),n
p.linspace(target[2],G4[2],10)
ax.plot(x,y,z,c='r')

ax.scatter(target[0],target[1],target[2], c='g', marker='1',s=300)
ax.scatter(G1[0],G1[1],G1[2], c='r', marker='o',s=300)
ax.scatter(G2[0],G2[1],G2[2], c='r', marker='o',s=300)
ax.scatter(G3[0],G3[1],G3[2], c='r', marker='o',s=300)
ax.scatter(G4[0],G4[1],G4[2], c='r', marker='o',s=300)

ax.set_xlabel('X Label')
ax.set_ylabel('Y Label')
ax.set_zlabel('Z Label')
plt.savefig('test2png.png', dpi=100)
plt.show()
```