liuzhenboo / EKF-2D-SLAM

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README.md

NPU最优估计大作业

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学号：2019201920

完成工作

- 一维状态量的KF仿真
- 二维状态量的EKF仿真
- 应用EKF实现2D-SLAM

一维状态量的KF仿真

系统建模：

```
x+ = F_x *x + F_u * u + F_n * n
y  = H * x + v
```

其中：

```
F_x = 1;
F_u = 1;
F_n = 1;
u = 1;
H = 0.5;
Q = 1;
R = 1;
```

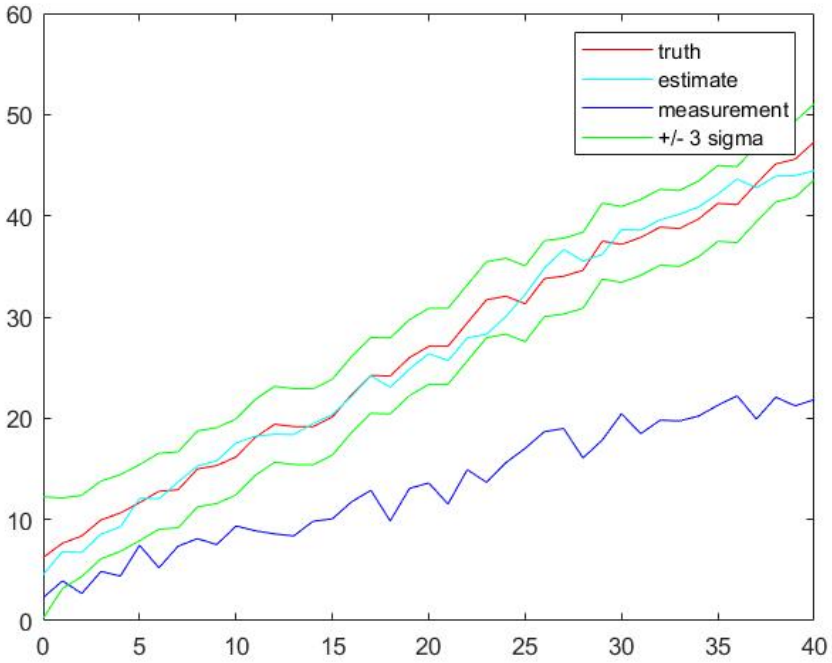
状态先验：

```
x = 0;
P = 1e4;
```

仿真初值：

```
X = 7;
```

仿真结果：



二维状态量的EKF仿真

系统模型：

```
x+ = f ( x, u, n )
y  = h ( x ) + v
```

系统定义：

```
x = [px py vx vy]'
y = [d, a]'
u = [ax, ay]'
n = [nx, ny]'
v = [vd, va]'

px+ = px + vx*dt
py+ = py + vy*dt
vx+ = vx + ax*dt + nx
```

```
vy+ = vy + ay*dt + ny

d = sqrt(px^2 + py^2) + vd
a = atan2(py, px) + va

Q = diag([.1 0.1].^2)
R = diag([.1 1*pi/180].^2)
```

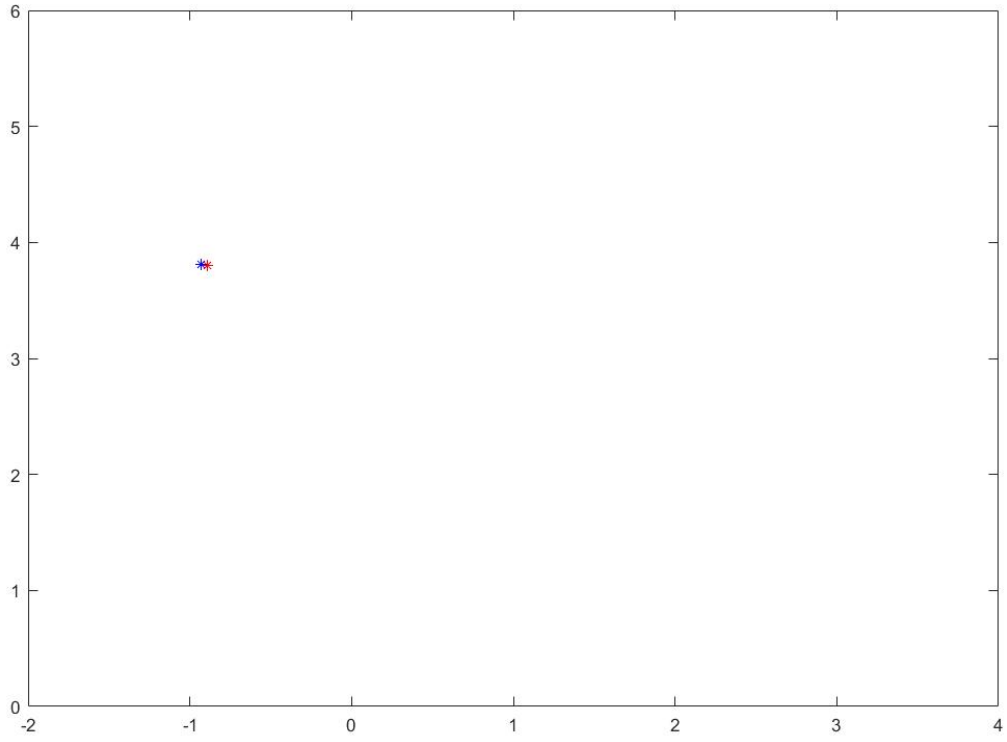
状态先验：

```
x = [1 1 0 0]'
P = diag([1 1 1 1].^2)
```

仿真初值：

```
X = [2 1 -1 1]'
```

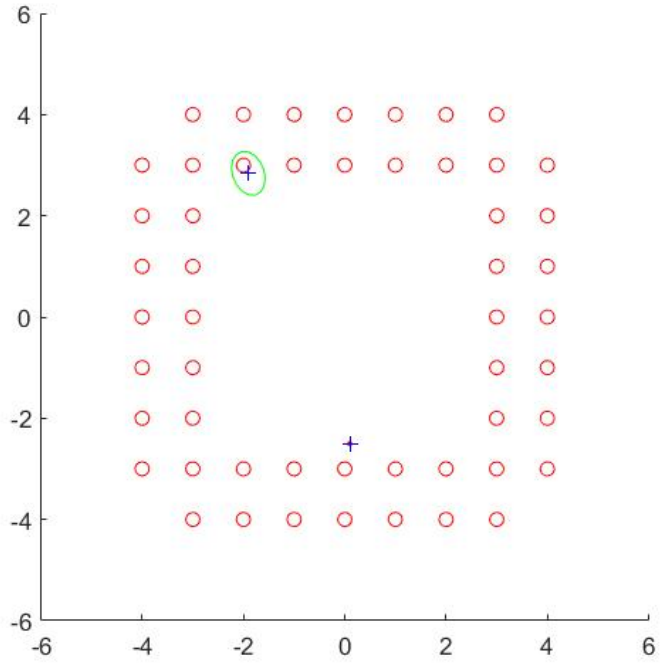
仿真结果：



应用EKF实现2D-SLAM

问题定义

某移动机器人按照给定的运动方程在一个环境中运动，并且环境中有n个固定点；这个机器人身上装有某种传感器，一定范围内该种传感器能够量测到某些固定点到自己的距离与角度，现在要根据运动方程和量测信息估算机器人的位置和n个固定点的位置。



EKF-SLAM步骤

状态变量X为当前机器人的位置(x,y,α,...Mi...),Mi为截至到当前观测过的固定点坐标。

- 运动更新

运动更新时，固定点坐标不变，所以只需要根据运动方程更新(x,y,α)及其协方差与互协方差即可。

- 观测到曾经观测过的固定点

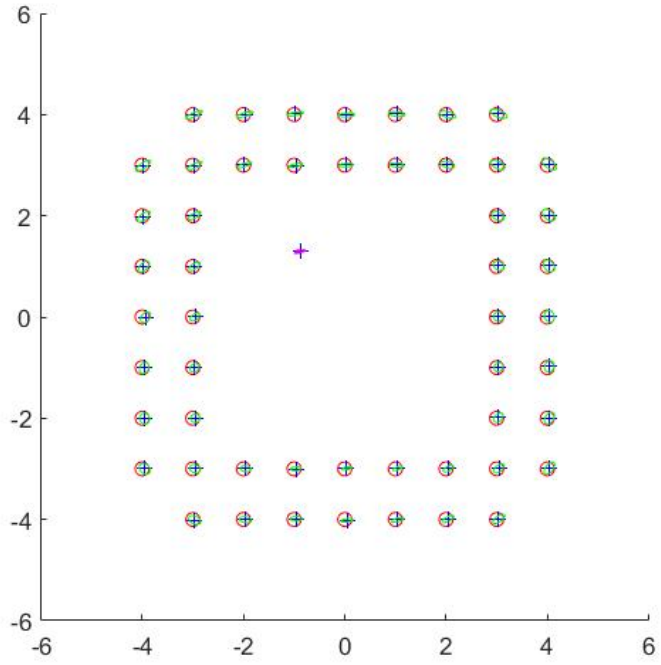
这时候依次对观测到的特征点信息进行EKF更新

```
Landmark observations are processed in the EKF usually one-by-one
```

- 观测到新的固定点

这时候观测到新的固定点，需要进行状态增广。根据逆观测方程，使用观测信息推测出新加的增广状态均值与方差，然后加入到总体的状态与协方差矩阵中。

仿真结果：


6
4
2
0
-2
-4
-6
-6
-4
-2
0
2
4
6