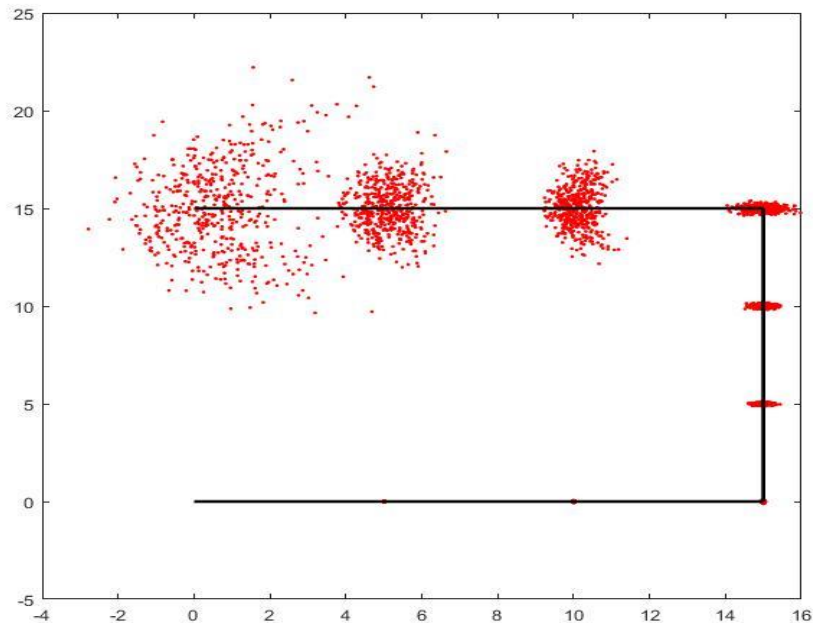# Homework 4

Task 1 Please generate samples of the odometry-based motion model (N=500)

实现过程主要参照第五章的课件，sample 产生的方法采用 normal distribution，实现的工具是用 matlab，下图是我生成的图：

My code: (matlab)

Sample 采用正态分布，代码如下：

```matlab
function [ randVal ] = sample( variance )
    maxVal = variance;
    minVal = -maxVal;
    randVal = ((1/2)*sum(minVal + (maxVal-minVal).*rand(12,1)));
end
```

Odometry Motion Model 代码实现如下：

```matlab
function [ newX,newY,newTheta] = sample_motion_model( xT,x2T,aT )
%Simple odometry-based motion model.
%Argumentts are xT=(x,y,theta),
    O_trans=sqrt((x2T(1)-xT(1)).^2+(x2T(2)-xT(2)).^2);
    O_rot1=atan2(x2T(2)-xT(2),x2T(1)-xT(1))-xT(3);
    O_rot2=x2T(3)-xT(3)-O_rot1

    varianceVal = aT(1)*abs(O_rot1)+aT(2)*O_trans;
    newRot1 =O_rot1+sample(varianceVal);

    varianceVal = aT(3)*O_trans + aT(4)*(abs(O_rot1)+abs(O_rot2));
    newRot_trans = O_trans + sample(varianceVal);

    varianceVal = (aT(1)*abs(O_rot2)+aT(2)*O_trans);
```

```
    newRot2 = O_rot2+sample(varianceVal);

    newX = xT(1)+newRot_trans*cos(xT(3)+newRot1);
    newY = xT(2)+newRot_trans*sin(xT(3)+newRot1);
    newTheta = xT(3)+newRot1+newRot2;
end
```

主程序的 code 如下：

```
xs=zeros(500,1);
ys=zeros(500,1);
thetas = zeros(500,1);
xT_array = [0,0,0;5,0,0;10,0,0;15,0,0;
            15,5,pi/2;15,10,pi/2;15,15,pi/2;
            10,15,pi;5,15,pi;0,15,pi];
aT = [.0004;.0002;.0004;.0004];

for j=1:size(xT_array,1)-1
    aT=aT*2;
    for i=1:500
        [xs(i),ys(i),thetas(i)]=sample_motion_model(xT_array(j,:),xT_arr
        ay(j+1,:),aT);
    end
    plot(xs,ys,'r.');
    hold on;
end

plot([0;15],[0;0],'k','LineWidth',2)
plot([15;15],[0;15],'k','LineWidth',2)
plot([15;0],[15;15],'k','LineWidth',2)

hold off;
```
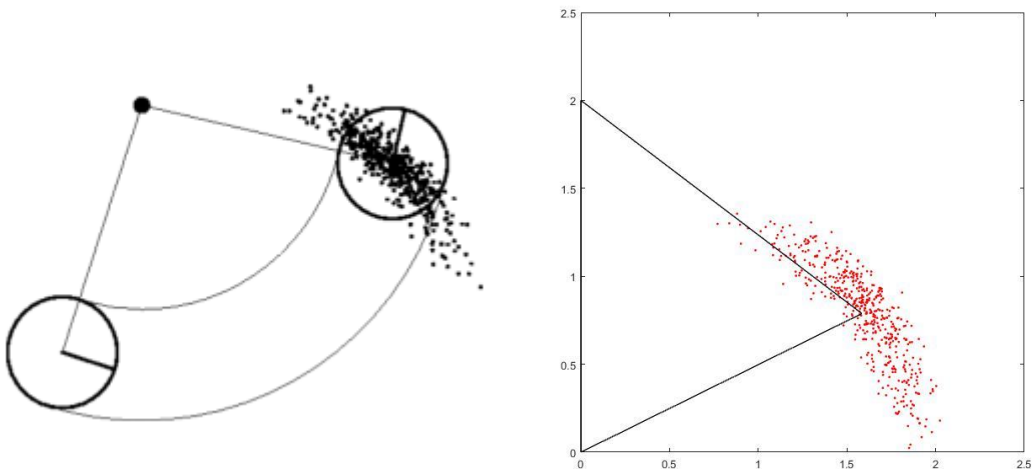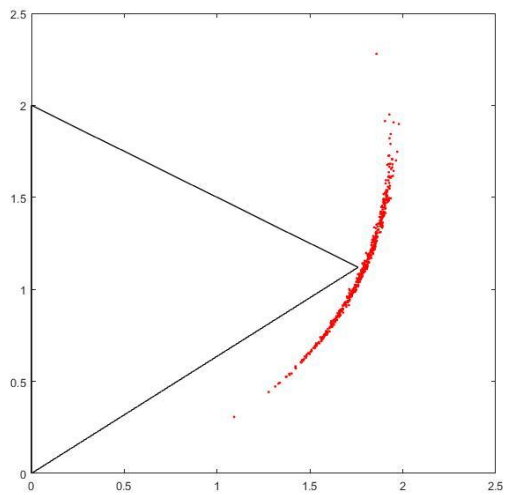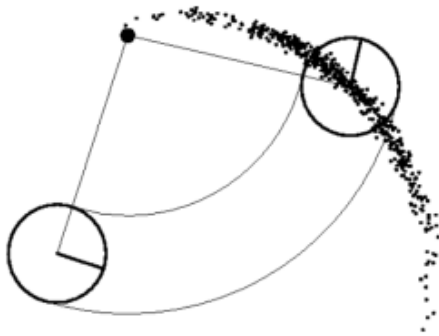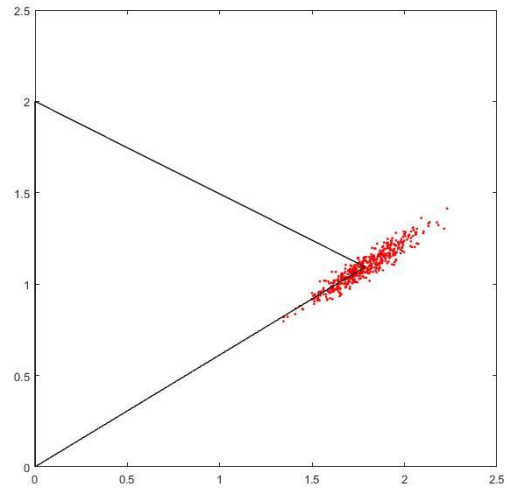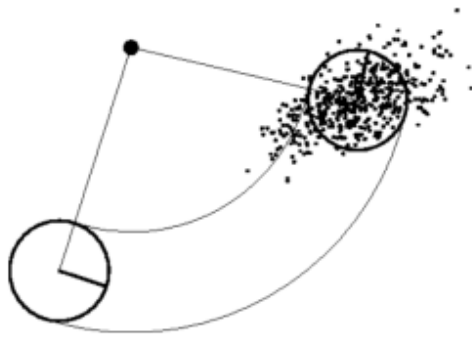
Task 2 Please generate samples of the velocity-based motion model for following cases (N=500).

实验结果的截图如下：

My code: (matlab)

Velocity-based Motion Model 代码实现如下：

```matlab
function [ newX,newY,newTheta] =
sample_from_Velocity_Model( X,v,w,aT,t )
    new_v=v+sample(aT(1)*abs(v)+aT(2)*abs(w));
    new_w=w+sample(aT(3)*abs(v)+aT(4)*abs(w));
    new_yj=sample(aT(5)*abs(v)+aT(6)*abs(w));

    newX=X(1)-(new_v/new_w)*sin(X(3))+(new_v/new_w)*sin(X(3)+new_w*t);
    newY=X(2)+(new_v/new_w)*cos(X(3))-(new_v/new_w)*cos(X(3)+new_w*t);
    newTheta=X(3)+new_w*t+new_yj*t;
end
```

主程序的 code 如下：

```matlab
xs=zeros(500,1);
ys=zeros(500,1);
thetas = zeros(500,1);
xT = [0,0,0];
aT = [.04;.006;.006;.4;0.4;.2];
v=1;
```

```
w=0.5;%v=w*r
t=0.6*pi;%8.7
for i=1:500
    [xs(i),ys(i),thetas(i)]=sample_from_Velocity_Model(xT,v,w,aT,t);
end
plot(xs,ys,'r.');
axis([0 2.5 0 2.5])
hold on;

plot([0;0],[0;v/w],'k','LineWidth',1)
plot([0;mean(xs)],[v/w;mean(ys)],'k','LineWidth',1)
plot([0;mean(xs)],[0;mean(ys)],'k','LineWidth',1)
%line(xT_array(1,1:3),xT_array(4,1:3))

hold off;
```
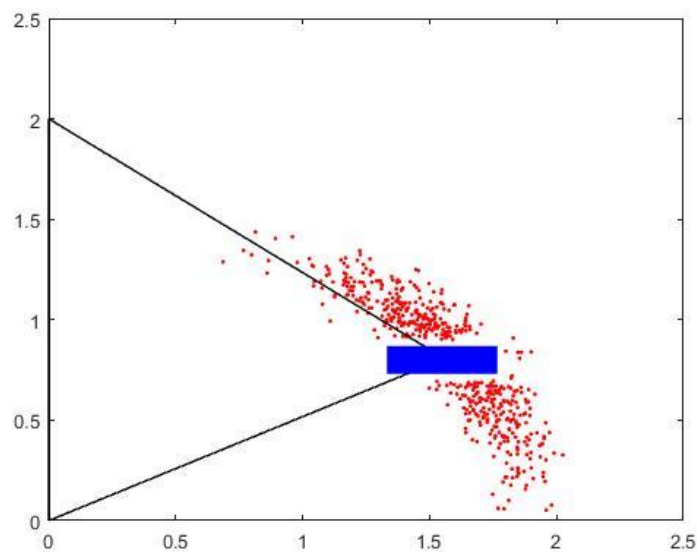
Task 3 Please generate the map-consistent probability model in the following situation.

$$p(x|u,x') \qquad \neq \qquad p(x|u,x',m)$$

Approximation: $p(x|u,x',m) = \eta \; p(x|m) \; p(x|u,x')$

通过修改 Task2 的代码，得到如下的实验结果：

My code: (matlab)

Map-Consistent Motion Model 代码实现如下：

```
function[ newX,newY,newTheta] =
Map_Consistent_Motion_Model( X,v,w,aT,t )
    [ newX,newY,newTheta] =sample_from_Velocity_Model(X,v,w,aT,t);
    while (newX>=1.3&&newX<=1.8)&&(newY>=0.7&&newY<=0.9)
        [ newX,newY,newTheta] =sample_from_Velocity_Model(X,v,w,aT,t);
    end
end
```

主程序的源码如下：

```
xs=zeros(500,1);
ys=zeros(500,1);
thetas = zeros(500,1);
xT = [0,0,0];
aT = [.04;.006;.006;.4;0.4;.2];
v=1;
w=0.5;
t=0.6*pi;

for i=1:500
    [xs(i),ys(i),thetas(i)]=Map_Consistent_Motion_Model(xT,v,w,aT,t);
end
plot(xs,ys,'r.');
axis([0 2.5 0 2.5])
hold on;

plot([0;0],[0;v/w],'k','LineWidth',1)
plot([0;mean(xs)],[v/w;mean(ys)],'k','LineWidth',1)
plot([0;mean(xs)],[0;mean(ys)],'k','LineWidth',1)
rectangle('Position',[1.34,0.74,0.42,0.12],'FaceColor','b','EdgeColor',
'b','LineWidth',2,'LineStyle','-');

hold off;
```