clc

clear

close all

sigx2=0.01;

sigy2=0.01;

sigphi2=0.0001;

sigv2=0.1;

sigw2=0.1;

sigmag2=0.01;

T=1;

b=1;

vk=0;Vk=[];

xk=0;Xk=[];

yk=0;Yk=[];

Xest=[];

Yest=[];

xest=0;

yest=0;

Phiest=[];

phiest=0;

phik=0;Phik=[];

wk=0;Wk=[];

zk=zeros(3,1);Zk=[];

True\_pos=[];

Gk=[];

Phat=eye(2)\*10;

zhat=zeros(2,1);

Zhat =[];

H =T\*[1 b/2; 1 -b/2];

%Discrete system parameters

A= [0 0 1;0 0 0;0 0 0];

B=[0 0;1 0;0 1];

Bt=B.'; %Transpose of matrix B

syms t

F=expm(A\*t) %exponent of matrix

Ft=F.';

cov=[sigv2 0 ;0 sigw2;]; %covarience of noise

k=F\*B\*cov\*Bt\*Ft;

Q=double(int(k,0,T));

U=chol(Q)';

F = double(subs(F,t,T));

R=[sigmag2 0;0 sigmag2/10];

V=chol(R)';

Aest= [0 0;0 0];

Best=[1 0;0 1];

Bestt=Best.'; %Transpose of matrix B

Fest=expm(Aest\*t) %exponent of matrix

Festt=Fest.';

cov=[sigv2 0 ;0 sigw2;]; %covarience of noise

kest=Fest\*Best\*cov\*Bestt\*Festt;

Qest=double(int(kest,0,T));

Fest =double(Fest);

for k=1:100

% Drive / system model

nx=randn\*sqrt(sigx2);

ny=randn\*sqrt(sigy2);

nz = U\*randn(3,1);

zk = F\*zk + nz;

phik=zk(1);

vk=zk(2);

wk=zk(3);

xk=xk+T\*vk\*cos(phik+T\*wk/2)+nx;

yk=yk+T\*vk\*sin(phik+T\*wk/2)+ny;

%saving values

Xk=[Xk xk];

Yk=[Yk yk];

Phik=[Phik phik];

Vk=[Vk vk];

Wk=[Wk wk];

% measurement model

ng = V\*randn(2,1);

gk = H\*zk(2:3) + ng;

Gk=[Gk gk];

% Kalman Prediction

ztemp = Fest\*zhat;

Ptemp=Fest\*Phat\*Fest'+Qest;

gtemp = H\*ztemp;

S=H\*Ptemp\*H'+R;

K=Ptemp\*H'/S;

zhat=ztemp+K\*(gk-gtemp);

Phat=Ptemp-K\*H\*Ptemp;

Zhat = [Zhat zhat];

vest = zhat(1);

west = zhat(2);

phiest=phiest+T\*west;

xest=xest+T\*vest\*cos(phiest+T\*west/2);

yest=yest+T\*vest\*sin(phiest+T\*west/2);

Xest=[Xest xest];

Yest=[Yest yest];

Phiest=[Phiest phiest];

end

Vobs = (Gk(1,:)+Gk(2,:))/2/T;

Wobs = (Gk(1,:)-Gk(2,:))/b/T;

Vest = Zhat(1,:);

West = Zhat(2,:);

figure; subplot 221

plot(Vk,'k-'); hold on

plot(Vobs,'bo','markerfacecolor','b'); hold on

plot(Vest,'g-','linewidth',2);

%

subplot 222

plot(Wk,'k-'); hold on

plot(Wobs,'bo','markerfacecolor','b'); hold on

plot(West,'g-','linewidth',2);

%

subplot 223

plot(Xk,Yk,'k-'); hold on

plot(Xest,Yest,'g-','linewidth',2);

subplot 224

plot(Phik,'k-'); hold on

plot(Phiest,'g-','linewidth',2);