Lab 8: Development of tracking filter of moving object when measurements and motion model are in different coordinate systems

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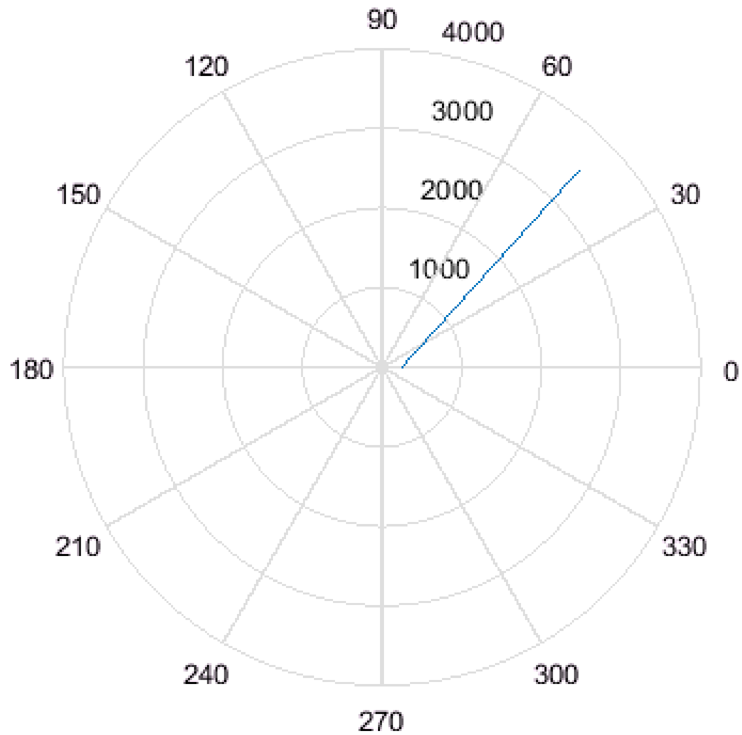
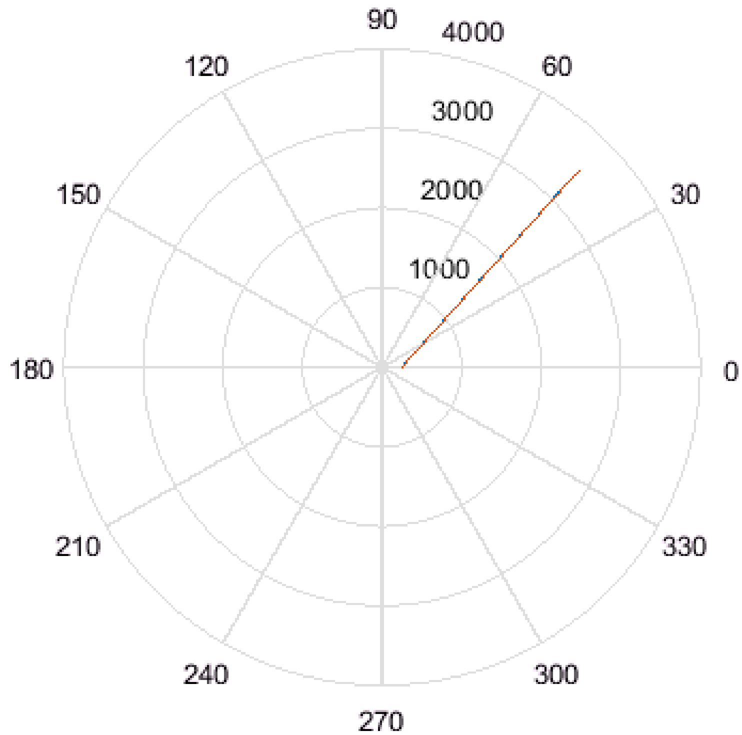
PART 19-21

```
clc; clear all; close all

n=26;
t=2;
%for part №1
% sigmaD=30;
% sigmaB=0.09;
%for part №3
sigmaD=50;
sigmaB=0.0015;
X(2,n)=zeros();
V(2,n)=zeros();
%for part №1
%  x0=13500/sqrt(2);
%  y0=13500/sqrt(2);
%for part №2, №3
x0=3500/sqrt(2);
y0=3500/sqrt(2);
X(:,1)=[x0;y0];
V(:,1)=[-50;-45];
ErrSumextrD=0;
ErrSumfiltrD=0;
ErrSumextrB=0;
ErrSumfiltrB=0;

for i=2:n
    X(:,i)=X(:,i-1)+V(:,i-1)*t;
    V(:,i)=V(:,i-1);
end

for i=1:n
    D(i)=sqrt(X(1,i)^2+X(2,i)^2);
    B(i)=atan(X(1,i)/X(2,i));
end

polar(B,D); %point 2
```

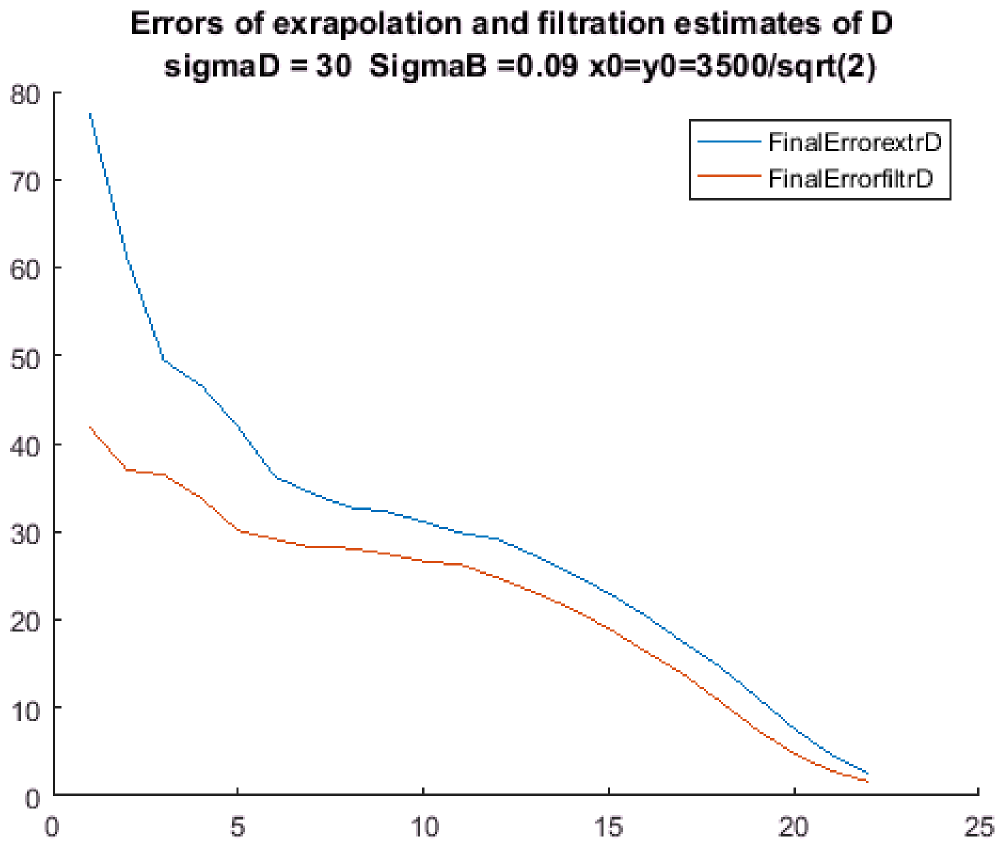



```
%for M=500 times
M=500;
for i=1:M
    etaB = normrnd(0,sigmaB,1,n);
    etaD = normrnd(0,sigmaD,1,n);
    Dm=D+etaD;
    Bm=B+etaB;
    for i=1:26;
        Xm(i)=Dm(i)*sin(Bm(i));
        Ym(i)=Dm(i)*cos(Bm(i));
    end

    for i=1:26
        Zc(1,i)=Xm(i);
        Zc(2,i)=Ym(i);
    end
    %polar(Bm,Dm);
    %F, G, H, P
    sigmaA=0;
    F=[1 t 0 0;
        0 1 0 0;
        0 0 1 t;
        0 0 0 1];
    H=[1 0 0 0;
        0 0 1 0];
    G=0;
    P=(10^10)*eye(4);

    bias=0;
```

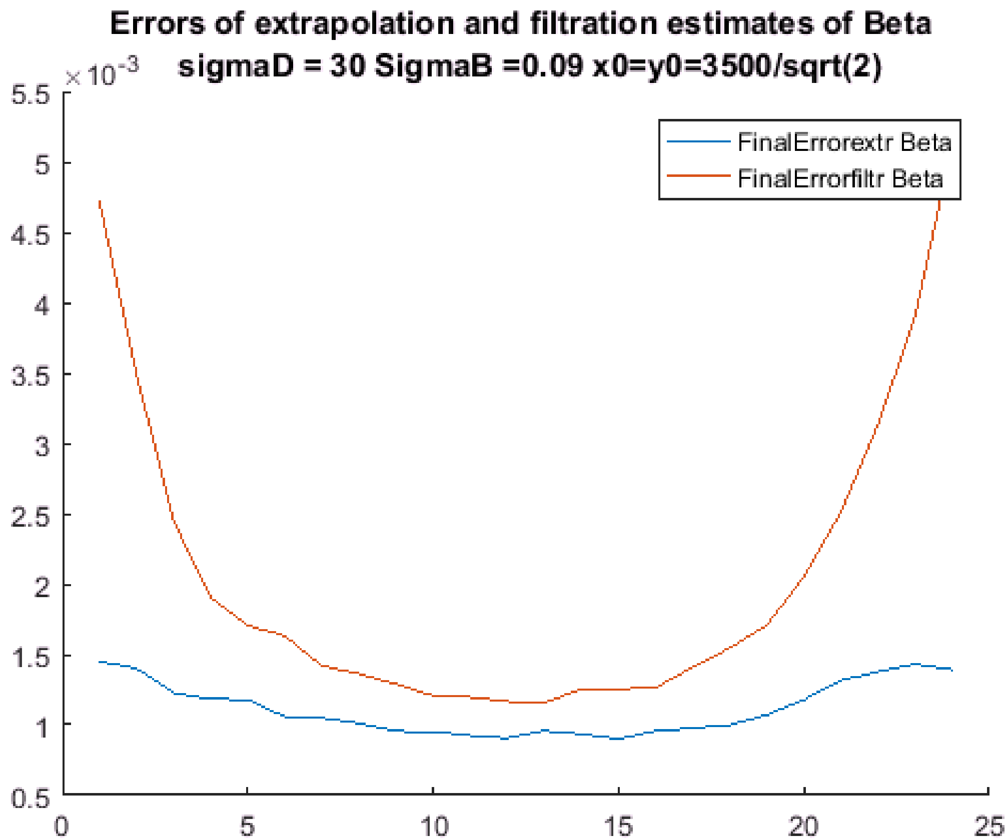
```
    [ Xk,Dmextr,Dmfiltr,Bmextr,Bmfiltr, R, CondNum, FilterGainK] = calcKalman4(Zc, sigmaA, sig

    Dk=(Xk(1,:).^2+Xk(3,:).^2).^0.5;
    Bk=atan(Xk(1,:)./Xk(3,:));

    ErrCurextrD = ( Dmextr - D).^2;
    ErrCurfiltrD = (Dmfiltr - D).^2;
    ErrCurextrB = ( Bmextr - B).^2;
    ErrCurfiltrB = (Bmfiltr - B).^2;


    ErrSumextrD = ErrSumextrD +  ErrCurextrD;
    ErrSumfiltrD = ErrSumfiltrD +  ErrCurfiltrD;
    ErrSumextrB = ErrSumextrB +  ErrCurextrB;
    ErrSumfiltrB = ErrSumfiltrB +  ErrCurfiltrB;


%     polar(Bk(2:end),Dk(2:end));
%     hold on
%     polar(B,D)
    % figure
    % hold on
    % plot(D)
    % plot(Dk)
    % figure
    % hold on
    % plot(B)
    % plot(Bk)

end
FinalErrorextrD = (  ErrSumextrD(3:end)./(M-1) ).^0.5;
FinalErrorfiltrD = (  ErrSumfiltrD(3:end)./(M-1) ).^0.5;
FinalErrorextrB = (  ErrSumextrB(3:end)./(M-1) ).^0.5;
FinalErrorfiltrB = (  ErrSumfiltrB(3:end)./(M-1) ).^0.5;

    % plot for last realization (M=500) as an examole
    polar(Bk(2:end),Dk(2:end));
    hold on
    polar(B,D)
```



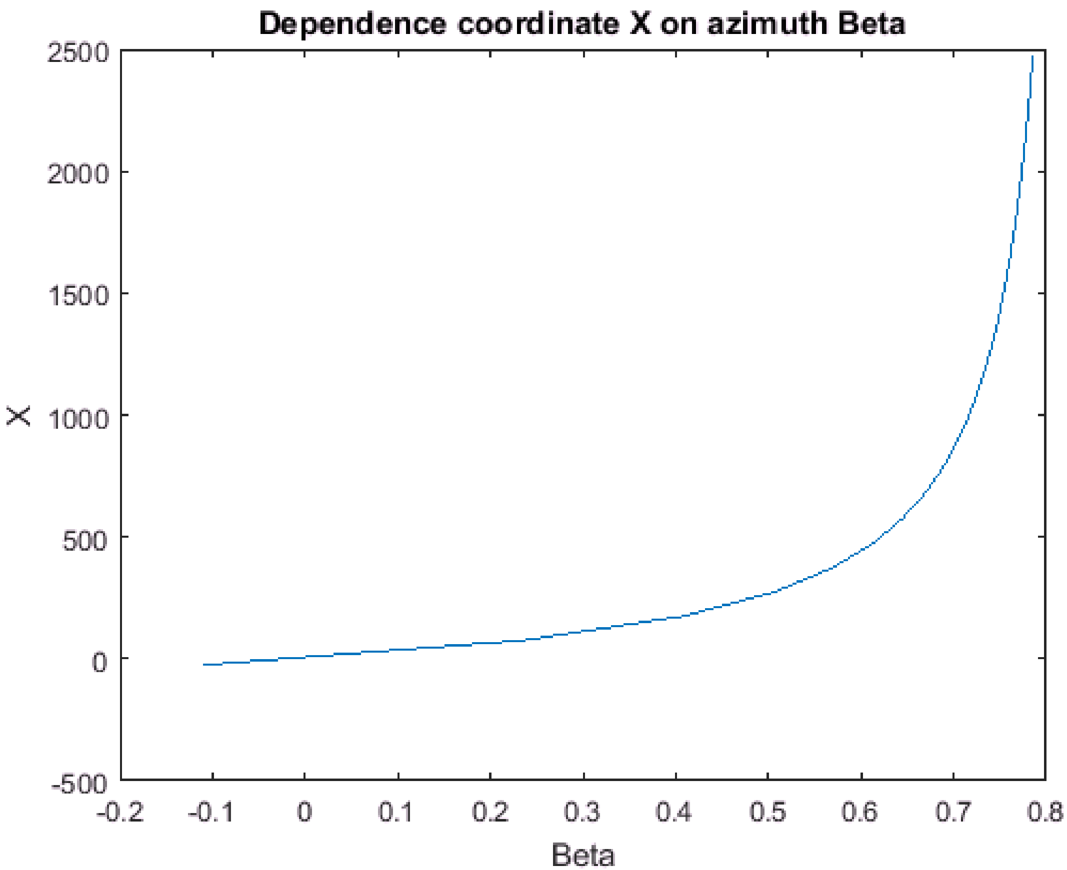

```
 figure
 hold on
plot(FinalErrorextrD(3:end))
plot(FinalErrorfiltrD(3:end))
 title( sprintf ('Errors of exrapolation and filtration estimates of D \n sigmaD = 30  SigmaB
 legend('FinalErrorextrD', 'FinalErrorfiltrD');
```




```
figure
hold on
plot(FinalErrorfiltrB)
plot(FinalErrorextrB)
 title(sprintf('Errors of extrapolation and filtration estimates of Beta \n sigmaD = 30 SigmaB
 legend('FinalErrorextr Beta', 'FinalErrorfiltr Beta');
```

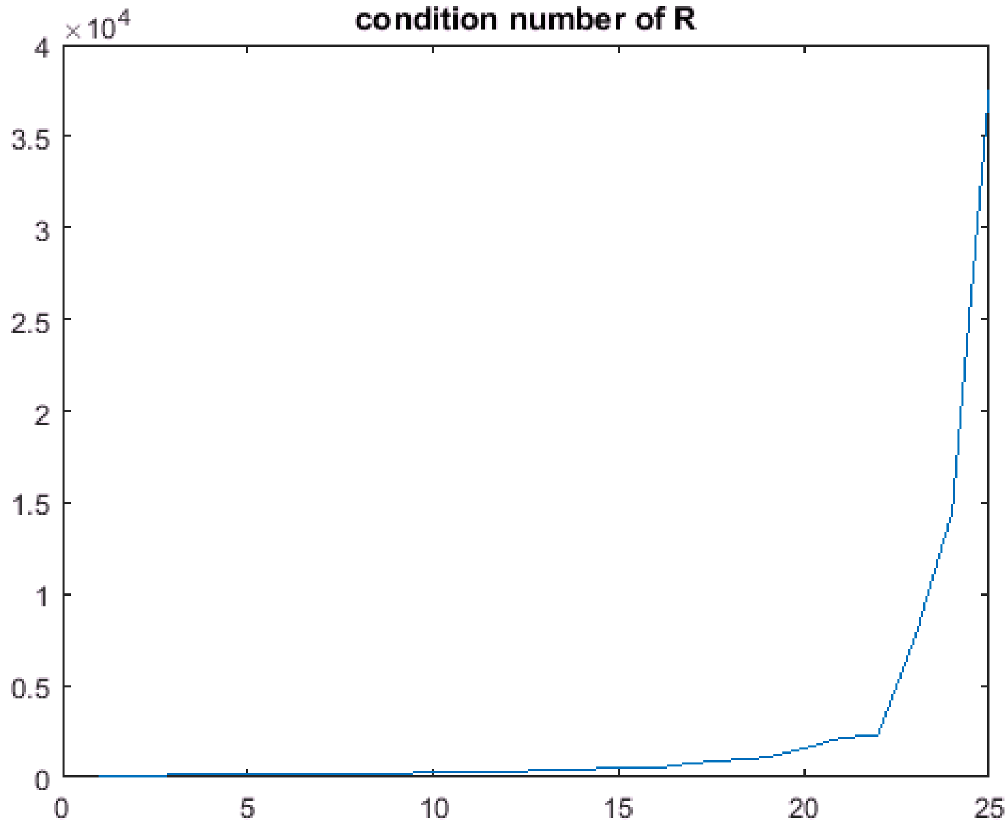



```
% hold on
% polar(B,D);
% polar(Bmextr,Dmextr);
% polar(Bmfiltr,Dmfiltr);

%point 11
for i=1:n
Xx(i)=D(i)*sin(B(i));
end
figure
plot(B,Xx);
ylabel('X');
xlabel('Beta');
title('Dependence coordinate X on azimuth Beta');
```



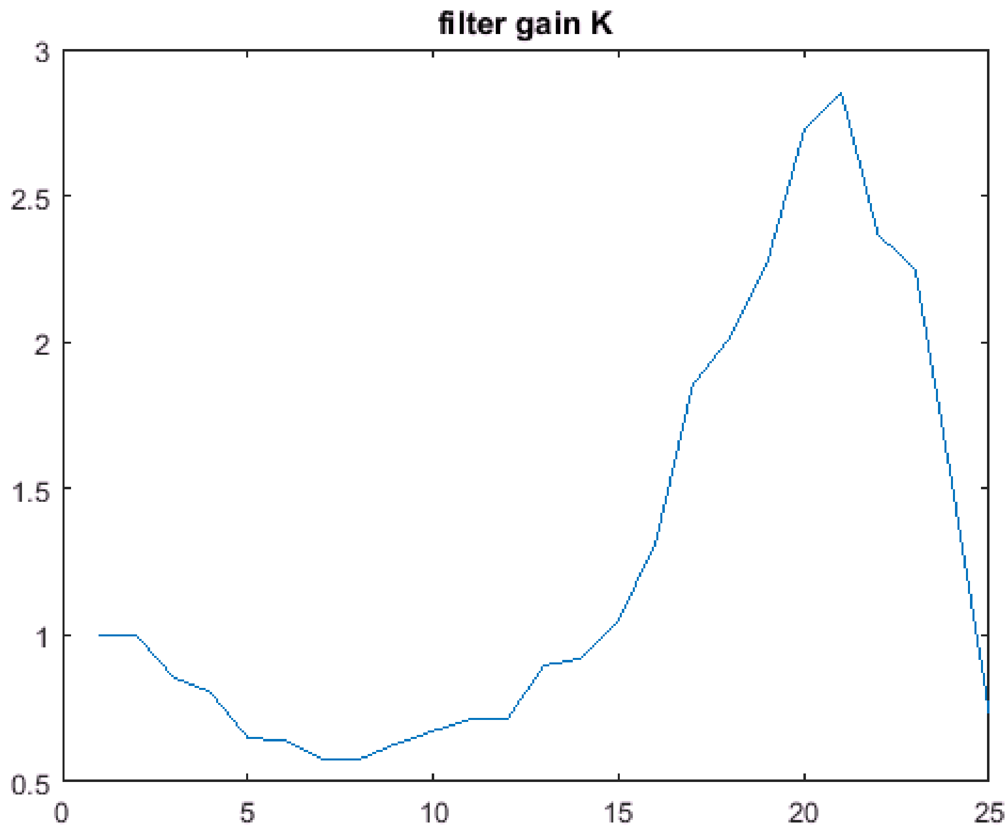
Dependence coordinare X on azimuth Beta is nonlinear

```
%point 13
plot(CondNum(2:end));
title('condition number of R')
```



Condition number increase in time

```
%point 14
plot(FilterGainK(2:end));
title('filter gain K')
```



Conclusion: Navigation system may become blind if object is close to us and we have ill-conditions. Ill-conditions affected more than linearization errors