EKF design

The plant dyns are given by

The observer dyns are given by

The linearization is given by

There are some parameter matrices that are necessary to design EKF.

The following ARE is used to construct EKF dynamics

Where this is a matrix differential equation.

The Kalman-gain term is obtained by

And finally,

Example:

Step-1 compute

Step-2 decide

Step-3 explicitly write down the dynamics

Text

Description automatically generated

Step-4 compute

Step-5 explicitly write down dynamics

Text

Description automatically generated with medium confidence

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| Matlab code for simulation |
| fig1=figure(1);fig1.Color=[1,1,1];  ax1=axes('Parent',fig1);  set(0,'CurrentFigure',fig1);  set(fig1,'currentaxes',ax1);  for ii=1:1:10  tspan=[0:0.01:10]; x0=randn(7,1)\*1; x0(5)=1;x0(6)=0;x0(7)=1;  wt=tspan;  % f=randi([1,20],1,1); w=sin(2\*pi\*f\*tspan);  w=square(tspan);  [t,x]=ode45(@(t,x) odefcn(t,x,wt,w),tspan,x0);  x1\_vec=x(:,1);x2\_vec=x(:,2);  x1hat\_vec=x(:,3);x2hat\_vec=x(:,4);  plot(t,x2\_vec,'r-','LineWidth',[2],"Parent",ax1);hold on;  plot(t,x2hat\_vec,'g-','LineWidth',[2],"Parent",ax1);hold on;  hold on;yline(1);yline(-1);  end  function xdot=odefcn(t,x,wt,w)  w=interp1(wt,w,t);  xdot=zeros(7,1);  x1=x(1);x2=x(2);  x1hat=x(3);x2hat=x(4);  p11=x(5);p12=x(6);p22=x(7);  f1=x2;  f2=-x1-2\*x2+0.25\*(x1)^2\*(x2)+0.2\*sin(2\*t);  x1dot=f1;  x2dot=f2;  y=x1;  x1hat\_dot=x2hat + p11\*(x1 - x1hat);  x2hat\_dot=p12\*(x1 - x1hat) - 2\*x2hat - x1hat + (x1hat^2\*x2hat)/4+0.2\*sin(2\*t);  %  p11dot=- p11^2 + 2\*p12 + 1;  p12dot=p22 - p11\*p12 + p12\*(x1hat^2/4 - 2) + p11\*((x1hat\*x2hat)/2 - 1);  p22dot=2\*p22\*(x1hat^2/4 - 2) + 2\*p12\*((x1hat\*x2hat)/2 - 1) - p12^2 + 1;  xdot(1)=f1;  xdot(2)=f2;  xdot(3)=x1hat\_dot;  xdot(4)=x2hat\_dot;  xdot(5)=p11dot;  xdot(6)=p12dot;  xdot(7)=p22dot;  end |