```
close all
clear all

%Initial Condition:

xo=[0;0; 0;0];

%timespan:
dt=0.01;
ts=0:dt:10;


%desire path

Vx=30;
X=zeros();
Y=zeros();
X(1)=0;
Y(1)=-5;

 for step=1:10/dt+1
    if  ts(step)>=0 && ts(step)<3
        theta(step)=atan(5/90);
    else
        theta(step) =0;
    end
   if step>=2
        X(step)=X(step-1)+Vx*cos(theta(step))*dt;
        Y(step)=Y(step-1)+Vx*sin(theta(step))*dt;
   end

 end

[t,x]=ode45(@sys,ts,xo);

plot (t, x(:,1))
hold on
plot (t,x(:,3))
title ('Error state v.s. time')
legend('e1','e2')



for step= 1: 10/dt+1
   xr_e(step)=x(step,1)*sin(theta(step));
   yr_e(step)=x(step,1)*cos(theta(step));

end

figure
plot(X(1,:), Y(1,:))
hold on
```

```
plot (X(1,:)+xr_e(1,:), Y(1,:)-yr_e(1,:))
xlabel('X')
ylabel ('Y')

title ('Vehicle path in XY plane')


xlim([0 300])
ylim([-5 1])

function  dx = sys(t, x)

%Parameters:
Vx=30; %(m/s)
m=1573; %(kg)
Iz=2873; %(kg-m^2);
lf=1.1; %(m)
lr=1.58;  %(m)
Caf=80000; %(N/rad)
Car=80000;  %(N/rad)


A=[0 1 0 0; 0 -(2*Caf+2*Car)/(m*Vx) (2*Caf+2*Car)/m -
(2*Caf*lf-2*Car*lr)/(m*Vx); 0 0 0 1; 0 -(2*Caf*lf-2*Car*lr)/(Iz*Vx)
 (2*Caf*lf-2*Car*lr)/Iz -(2*Caf*lf*lf+2*Car*lr*lr)/(Iz*Vx)];
B1=[0; 2*Caf/m; 0; 2*Caf*lf/Iz];
B2=[0;-((2*Caf*lf-2*Car*lr)/(m*Vx))-Vx; 0; -(2*Caf*lf*lf+2*Car*lr*lr)/
(Iz*Vx)];


%R=1;
%Q=[1 0 0 0; 0 110 0 0; 0 0 1 0; 0 0 0 110];
%[K,S1,P1] = lqr(A,B1,Q,R);
p=[-25, -15, -20+i, -20-i];  % -25 -22 -20 -15
K=place(A,B1,p);

Ap=A-B1*K;     %Ap matrix after u=-Kx(t)
eig (Ap);


dt=0.8; %time for the turnning
dphi=atan(5/90);
dphi_des_val=dphi/dt;

dphi_des =  dphi_des_val*heaviside(t-0)-dphi_des_val*heaviside(t-dt)-
dphi_des_val*heaviside(t-3)+dphi_des_val*heaviside(t-3-dt);

dx = Ap*x+ B2*dphi_des;

end
```

Published with MATLAB® R2019a