Table of Contents

Velocity

```
clear all;
close all;
clc;
format shortg;

L=2.77; %m
Ae=-.0547;
Vref=31.1; %m/s 70mph
s=tf('s');
E=119/Vref;%m/s^2

A=[ Ae];
B=[E];
C=eye(1);
D=0*B;

G=C*(s*eye(1)-A)^-1*B;

n=.15;

Kp=0.5;
Ki=0.5;
Kd=0.05;

tend=20;
dt=.001;
X0=[Vref+4.4];
Xr=[Vref];

MaxCMD=[1];
MinCMD=[0];

SimOut = sim('controlsprojectsimulinkupdated');
```

GM and PM Calculation

```
K=(s^2*(Kp+Kd*n)+s*(Kp*n+Ki)+Ki*n)/(s^2+s*n);

L=G*K;
```

```
[Gm,Pm,Wcg,Wcp] = margin(L)
```

```
Gm =

   Inf


Pm =

        66.76


Wcg =

   NaN


Wcp =

       2.1367
```

NS and NP Calculations

```
T=(eye(1)+L)^-1*L;
Tmin=minreal(T); %minimal realization of T

NScondition=pole(Tmin)

S=(eye(1)+L)^-1;
wb=1;
M=2.7;
A=0.01;
wp=(s/M+wb)/(s+wb*A);
NPcondition=norm(wp*S,inf)
```

```
NScondition =

     -0.99809 +    0.95497i
     -0.99809 -    0.95497i
      -0.1504 +          0i


NPcondition =

       0.5709
```

RS Calculations

```
tau=.2;
```

```
r0=.2;
rinf=10;

wi=(tau*s+r0)/((tau/rinf)*s+1);

RScondition=norm(wi*T,inf)

RPcondition=NPcondition+RScondition
```

```
RScondition =

      0.42759


RPcondition =

       0.9985
```

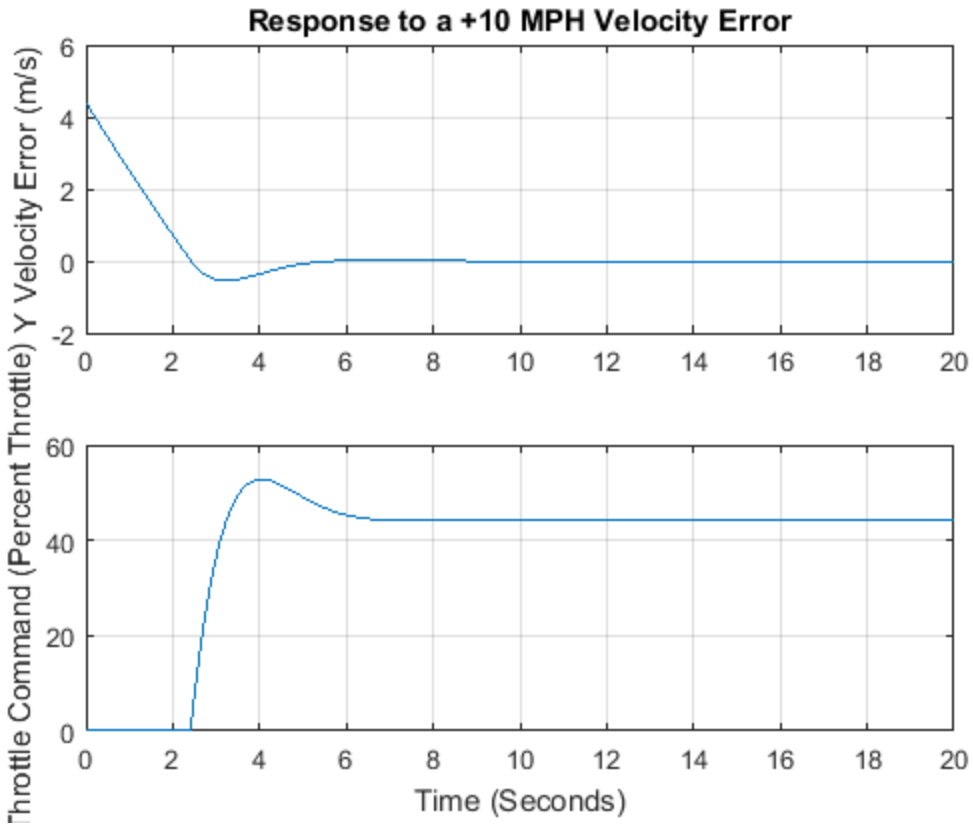
Time Response Plots

```
solution=Statehistory;
t=solution.time;

figure(gcf)

subplot(211)
plot(t,solution.data(:,1)-Vref);
grid on;
ylabel('Y Velocity Error (m/s)');
title('Response to a +10 MPH Velocity Error')
t=Commandhistory.time;

subplot(212)
plot(t,Commandhistory.data(:,1)*100);
grid on;
ylabel('Throttle Command (Percent Throttle)');
xlabel('Time (Seconds)')
```



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