Hybrid Electric Vehicles (HEV)

Automatic Control Systems

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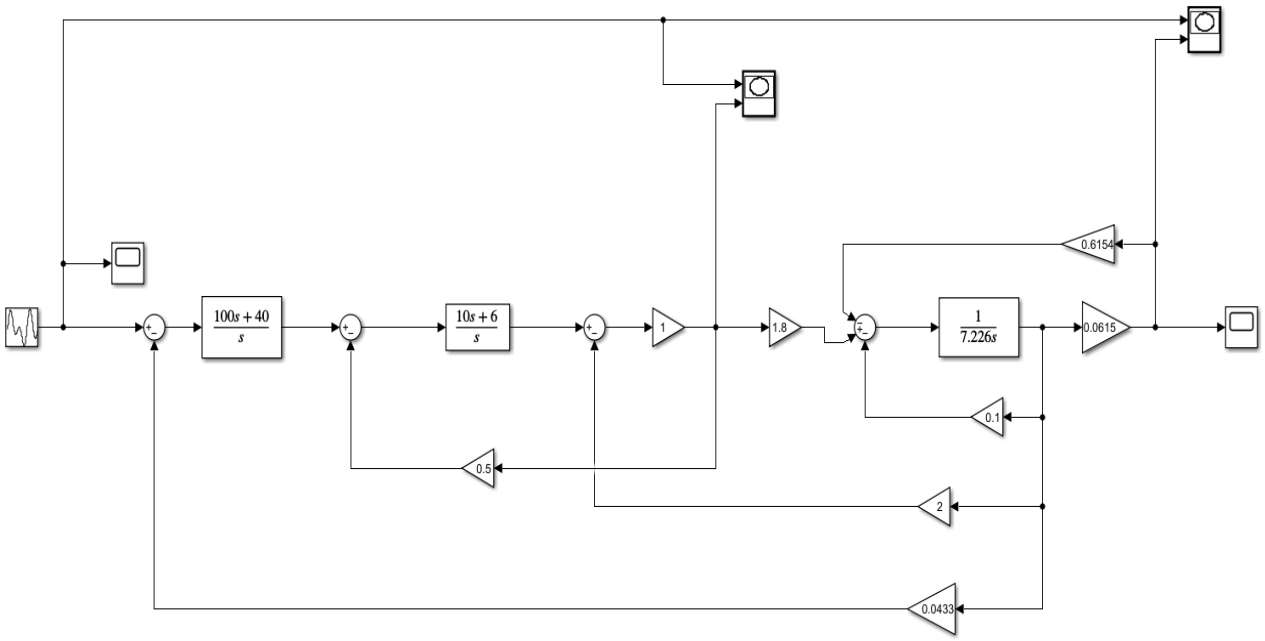
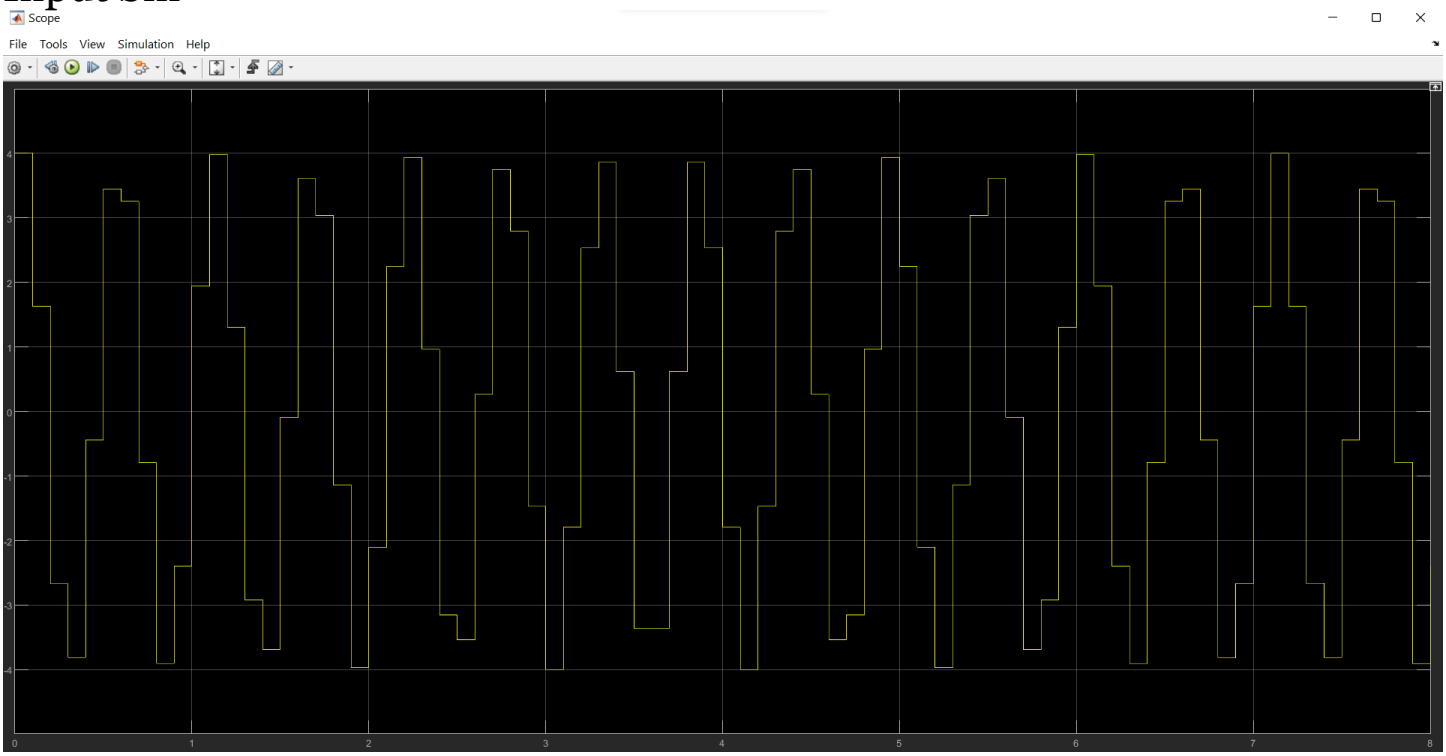
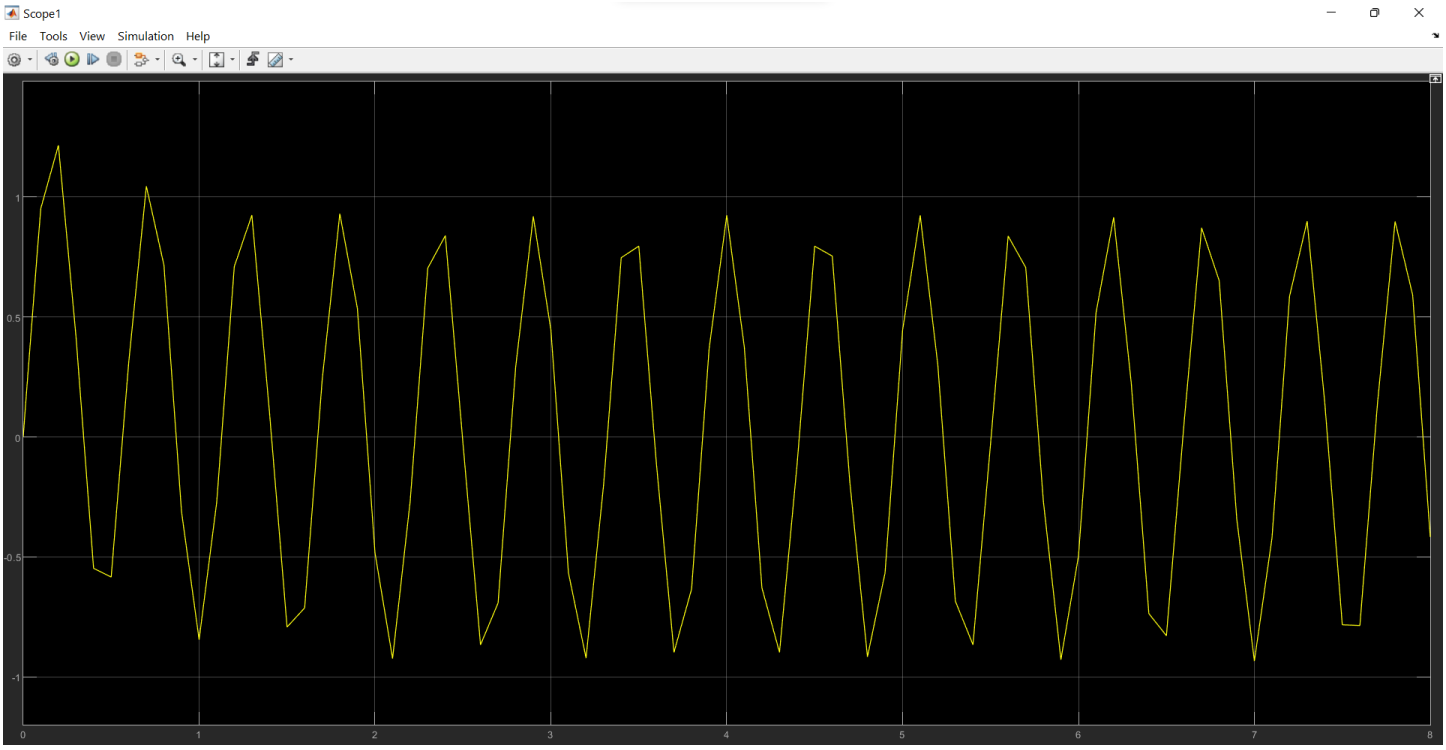
Simulink Model For the original System



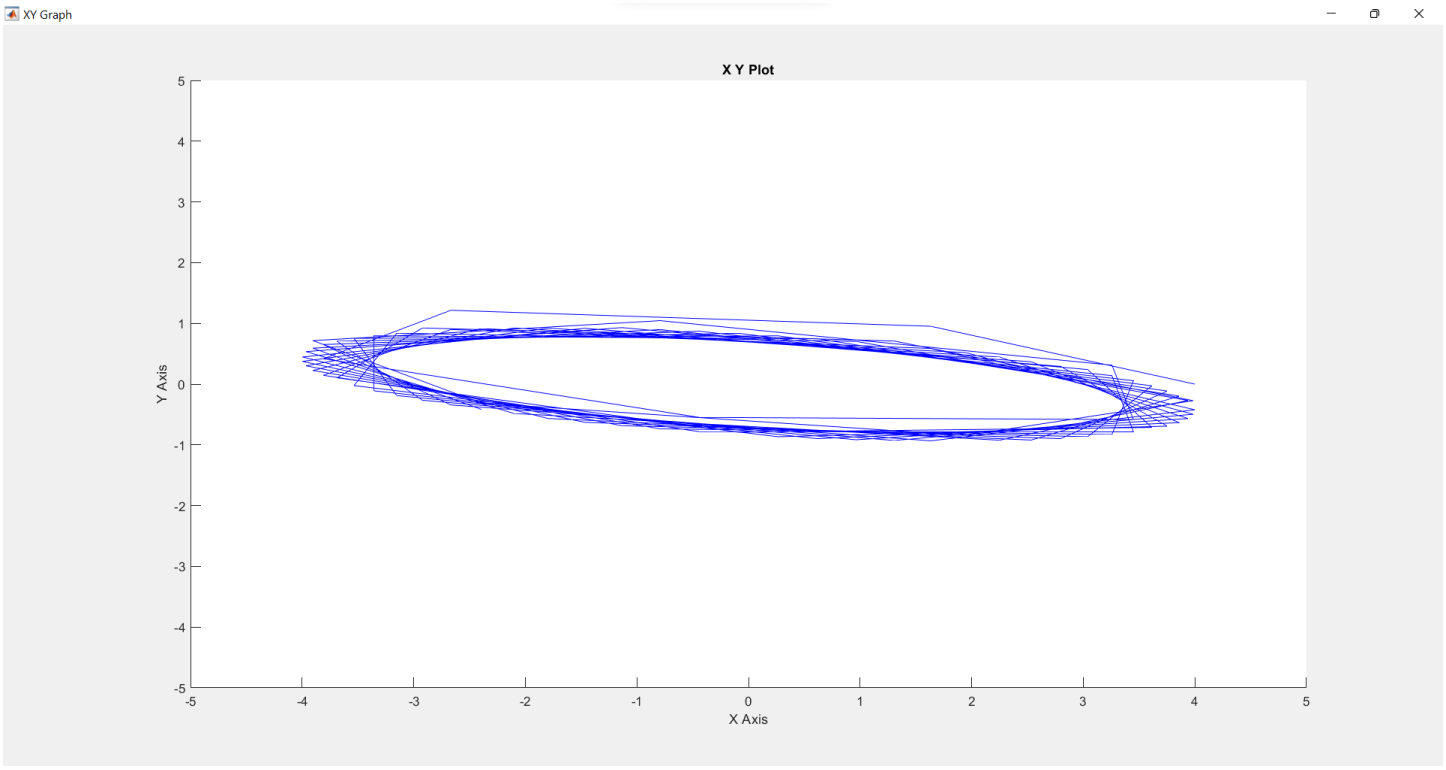
Input Sin



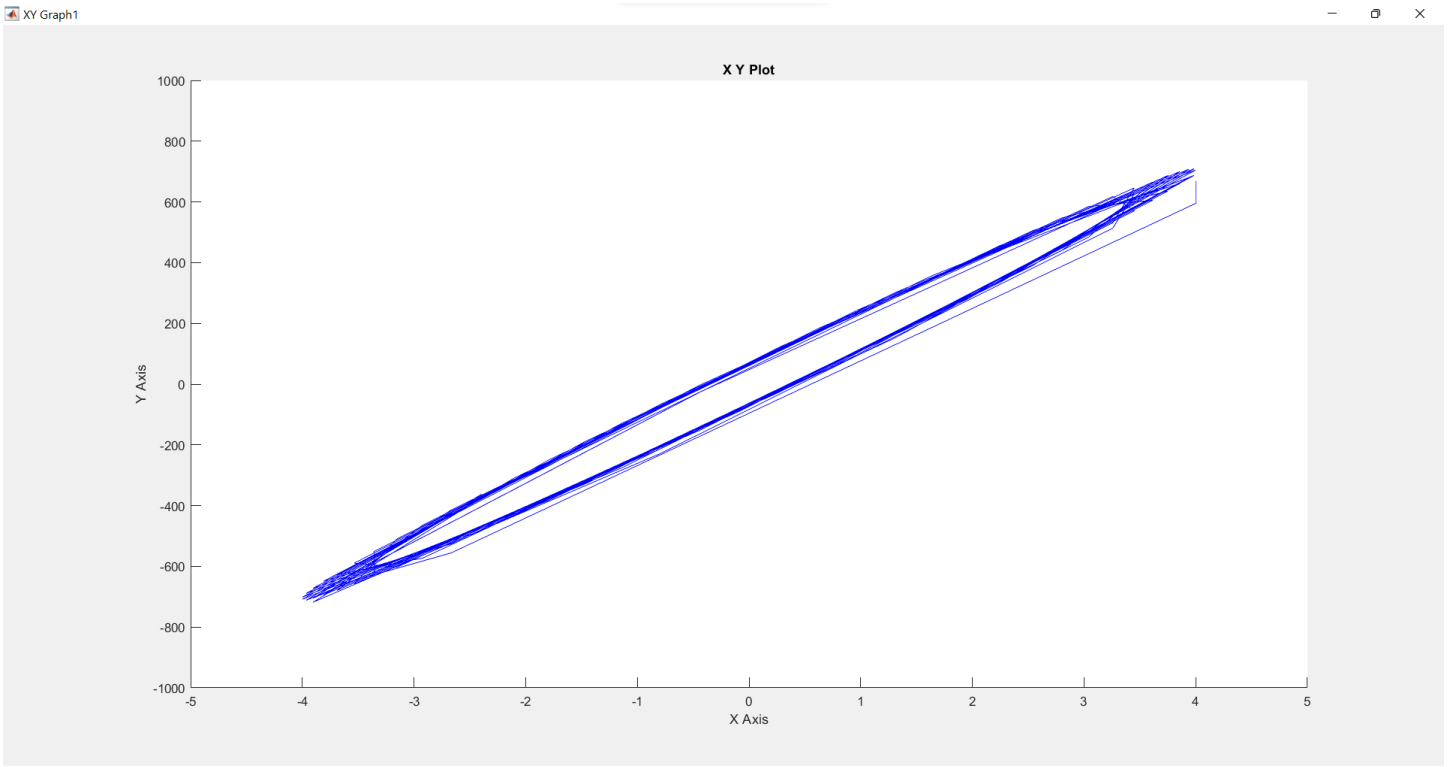
Output Signal (Step Response)



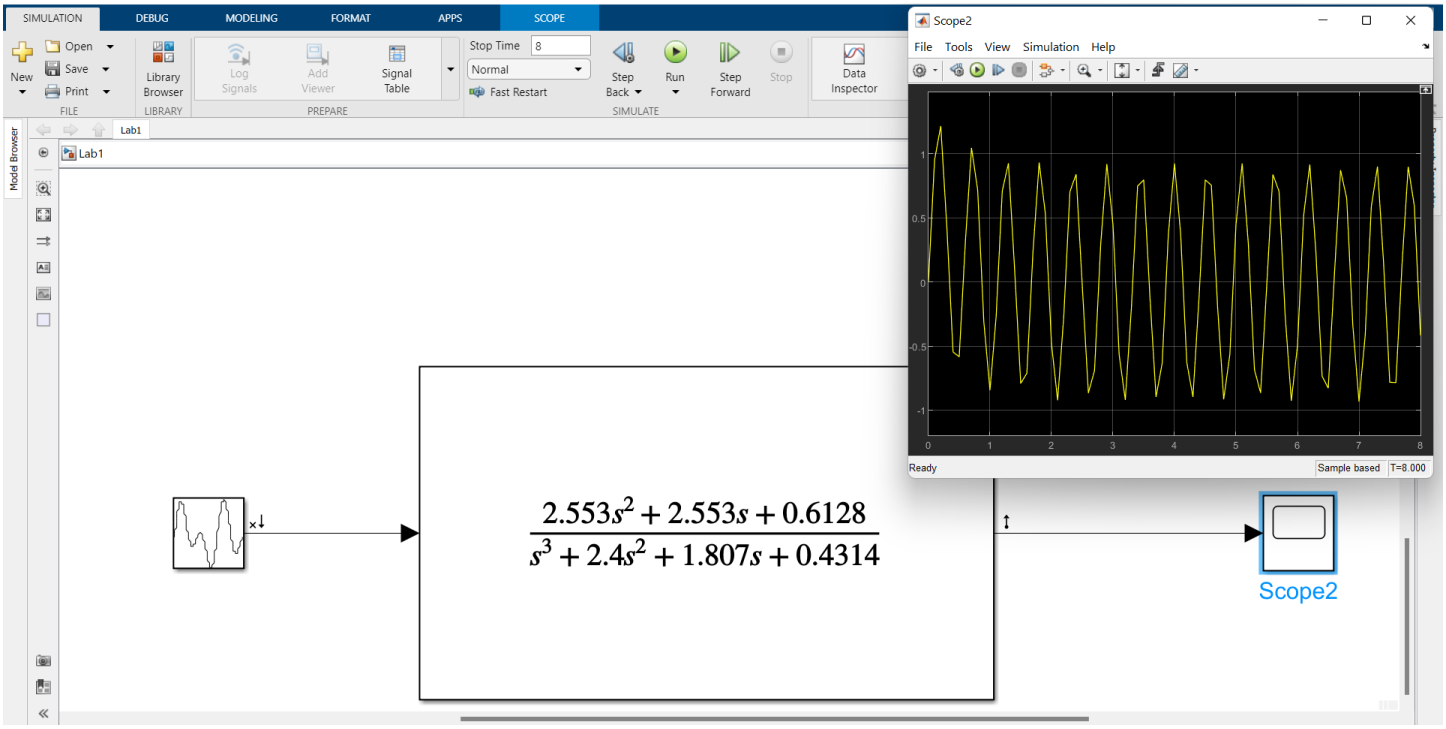
The Response of the Car Speed to the input



The Response of the motor armature current to the input



Obtaining the transfer function from Simulink



```
ans =

  From input "Waveform Generator" to output "Gain2":
    2.553 s^2 + 2.553 s + 0.6128
  --------------------------------
  s^3 + 2.4 s^2 + 1.807 s + 0.4314

Name: Linearization at model initial condition
Continuous-time transfer function.
```

Obtaining the transfer function using MATLAB

```
%Constants // Static gains
Kcs = 0.5;
Kss = 0.0433;
Jtot = 7.226;
Ra = 1;
Kf = 0.1;
Kb = 2;
R = 0.0615;  %Ratio betwn r/itot
PRE = 0.6154;
Last = 1.8;

D = tf(Kf*1/R);
K_b = tf(Kb*1/R);
K_ss = tf(Kss*1/R);

G1 = tf(R, [Jtot,0]);
G2 = tf(PRE);

GD_2 = parallel(D,G2);

G3 = feedback(G1,GD_2);

G_Last = tf(Last);

G4 = series(G_Last,G3);

K_CS = Kcs/G4;

G5 = feedback(G4,K_b);
Ka_GTC = tf([10 6],[1 0]);
G6 = series(G5,Ka_GTC);

G7 = feedback(G6,K_CS);

Gsc = tf([100 40],[1 0]);
G8 = series(G7,Gsc);

system = feedback(G8,K_ss);

%Total System transfere function
SYSTEM_TF = tf(system)
```

```
>> lab1_matlab_code

SYSTEM_TF =

        12.25 s^2 + 12.25 s + 2.941
  -------------------------------------
  4.8 s^3 + 11.52 s^2 + 8.674 s + 2.071

Continuous-time transfer function.

fx >>
```

The transfer function would be the same if we normalized it dividing the numerator and denominator by 4.8.