Decibels Lab Private Limited
#2362, 24th main road
1st sector, HSR layout
Bangalore, Karnataka, 560102
CIN: U80904KA2019PTC126675
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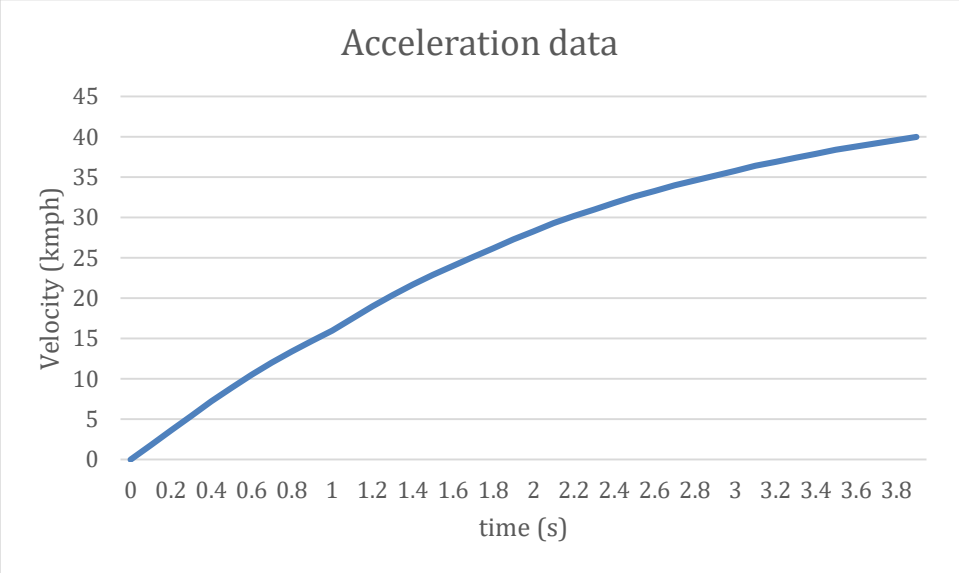
Course name	Numerical Modeling & Simulation in MATLAB-Simulink
Lesson name	**Numerical Modelling of Ather 450 using Acceleration data in** MATLAB-Simulink
Lesson objective	**Practice blocks & acquaint to use GUI of MATLAB-Simulink**
Created by	Vivek Rathod

Problem statement: Model Ather 450 for Acceleration Data in MATLAB Simulink to plot the Wheel Torque, Wheel Speed, Motor Torque, Motor Speed and Battery Current in Scilab-Xcos.

Artemis Urban Drive Cycle Graph:



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Model Inputs:

Sl No	Parameter	Value	Units
1.	**Chassis**		
2.	I. Coefficient of rolling resistance	0.015	
3.	II. Mass of Vehicle	111	Kg
4.	III. Mass of Driver	80	Kg
5.	IV. Gravity constant	9.81	m/s
6.	V. Grade Angle	0	degree
7.	VI. Velocity	From the Acceleration Drive Cycle data	Kmph
8.	VII. Area	0.875	m^2
9.	VIII. Air Density	1.225	Kg/m^3
10.	IX. Drag Coefficient	0.22	
11.	X. Radius of wheel	0.1524	m
12.	**Transmission**		
13.	I. Gear Ratio	7.8	
14.	II. Transmission Efficiency	85	%
15.	**Battery**		
16.	I. Battery Capacity	2400	Wh
17.	II. Battery Voltage	51.1	V
18.	III. Drive cycle distance	Acceleration Test	Km
19.	IV. Battery Initial SOC	100	%
20.	V. Drive Cycle time or Simulation time	3.9	s
21.	**Cell**		
22.	I. Cell Voltage	3.6	V
23.	II. Cell Capacity	2.7	Ah

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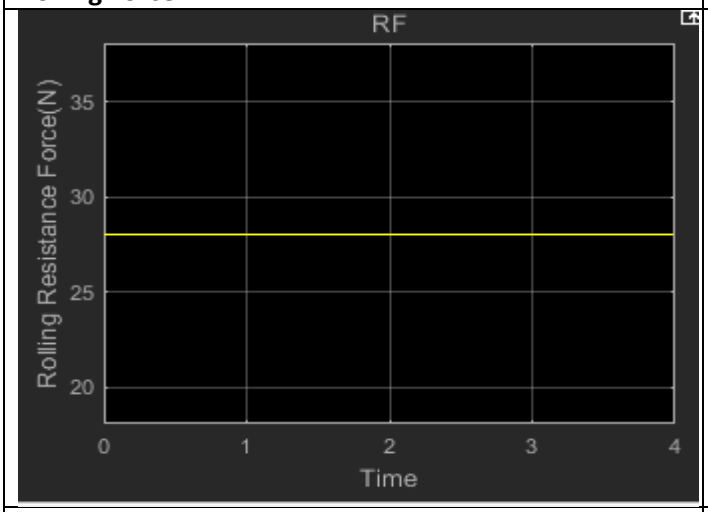
Program:

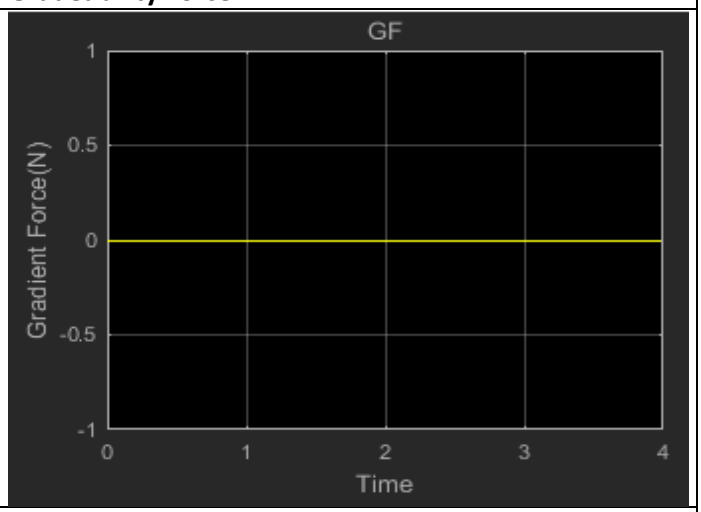
```
M=111;       %Mass of vehicle       (kg)
Md=80;       %Mass of driver        (kg)
GVM=M+Md;    %Gross vehicle mass    (kg)
g=9.81;      %Gravity cnstant       (m/s^2)
GVW=GVM*g;   %Gross vehicle weight
A=0.875;     %frontal area         (m^2)
rho=1.2250;  %Air Density           (kg/m^3)
Rw=0.1524;   %Radius of wheel       (m)
cd=0.22;     %coefficient of drag
crf=0.015;   %coefficient of rolling resistance
GR=7.8;      %Gear Ratio
Teff=0.85;   %transmission efficiency
Drive_cycle =AtherAcceleration;
```

Results:

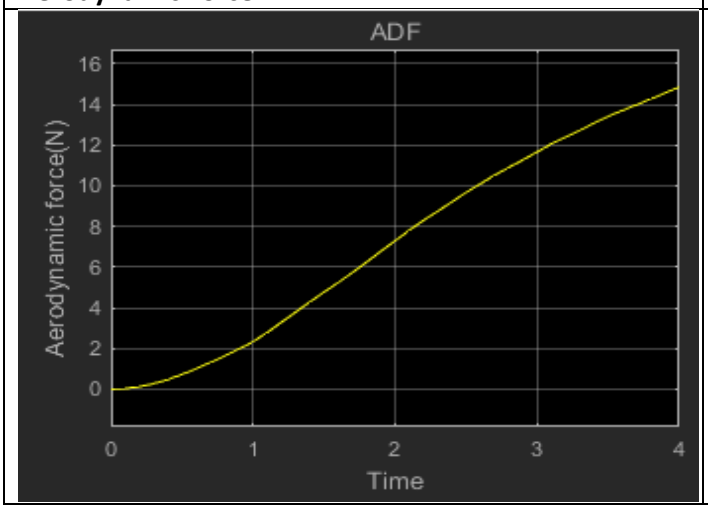
Rolling Force:



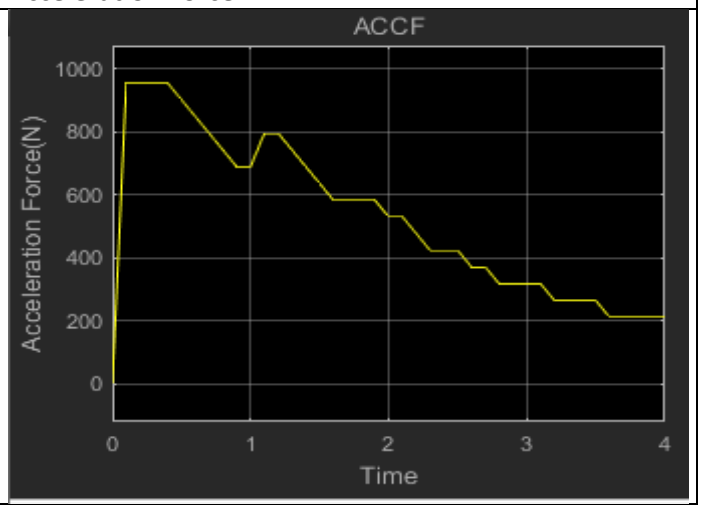
Gradeability Force:



Aerodynamic Force:



Acceleration Force:



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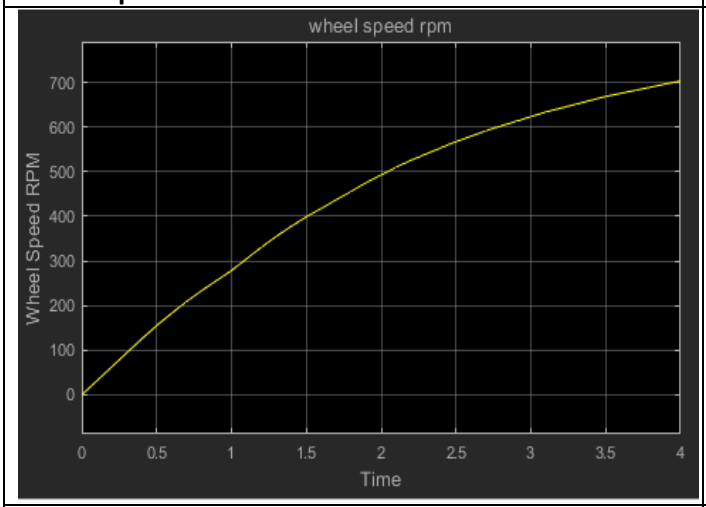
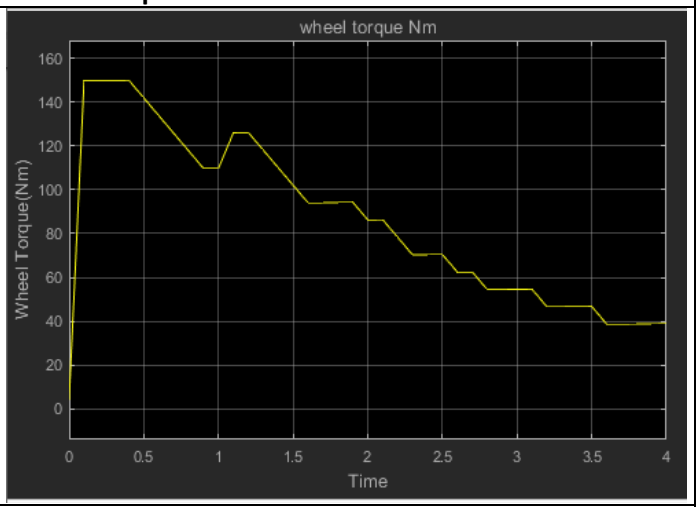
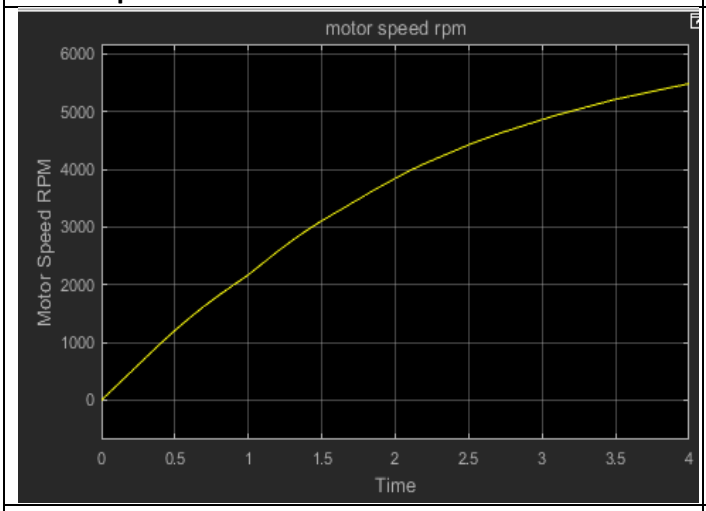
Wheel Speed:



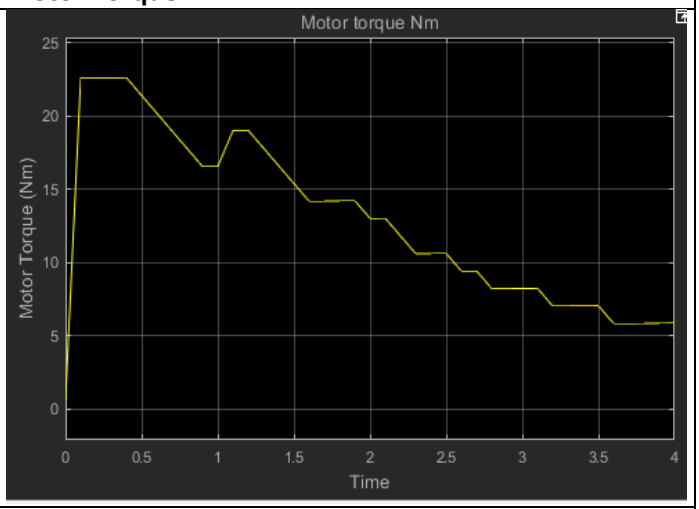
Wheel Torque:



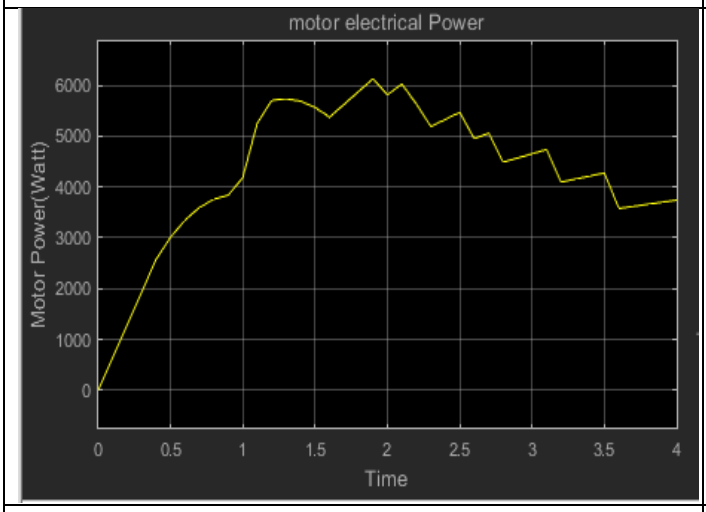
Motor Speed:



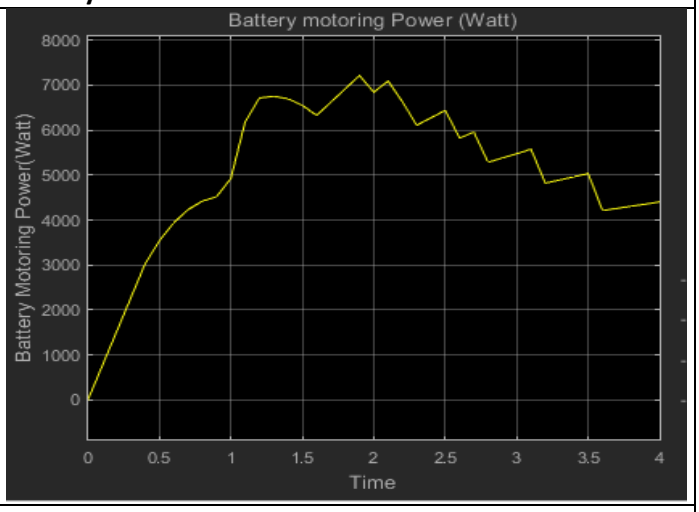
Motor Torque:



Motor Power:

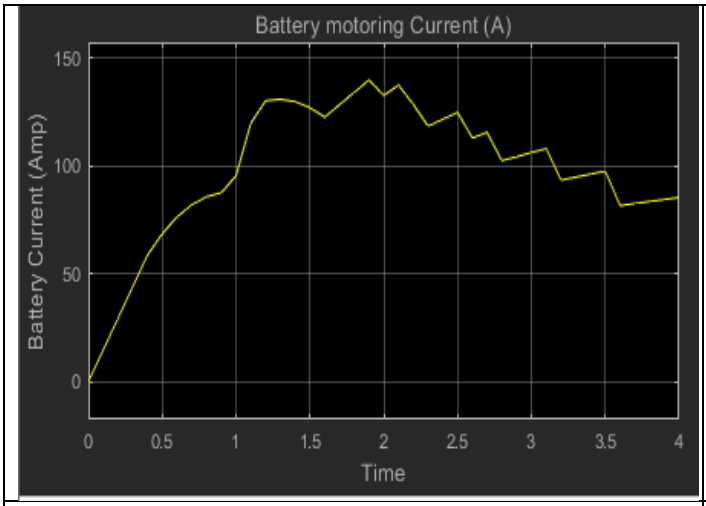


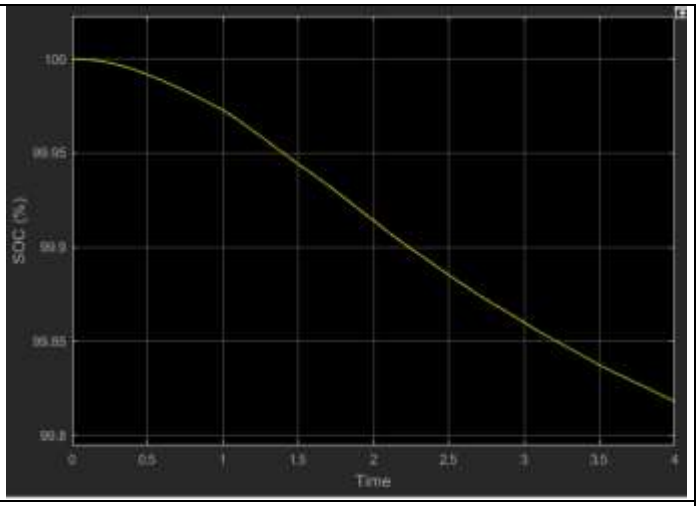
Battery Power:



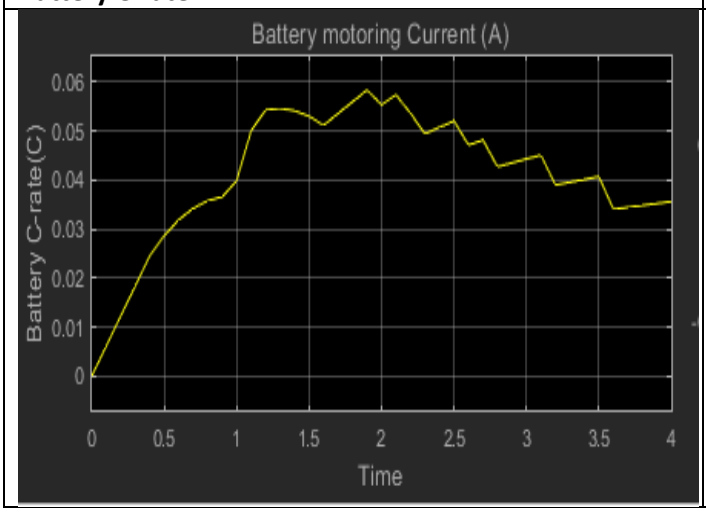
Battery Current:

Battery SOC:





Battery C-rate:



Conclusion:

Sl No	Parameters	Values	Units
1.	**Chassis**		
2.	• Rolling Force	28.1057	N
3.	• Gradeability Force	0	N
4.	• Maximum Aerodynamic Force	14.8489	N
5.	• Maximum Acceleration Force	955	N
6.	• Maximum Wheel Speed	703.1780	Rpm
7.	• Maximum Wheel Torque	149.8972	Nm

8.	**Motor**		
9.	• Maximum Motor Speed	5484.8	Rpm
10.	**Motor Torque**		
11.	• Nominal Motor Torque	12.8275	Nm
12.	**Motor Power**		
13.	• Nominal Motor Power	3866.3	W
14.	**Battery**		
15.	• Power per Km	199.2	Wh/Km
16.	• Vehicle Range	12.05	Km
17.	• Battery Capacity in Ah	389.9	Ah
18.	**Cell**		
19.	• Cell Voltage	3.6	V
20.	• Cell Capacity	2.7	Ah
21.	**No of cells**		
22.	**Battery Power**		
23.	• Nominal Battery Power	5053.9	W
24.	**Battery Current**		
25.	• Nominal Battery Current	98.1347	A
26.	**Battery C-rate**		
27.	• Nominal Battery Discharge C-rate	0.0409	C
28.	• State of Charge	99.8179	%
29.	**Regenerative**		
30.	**Battery Power**		
31.	• Nominal Battery Power	0	W
32.	**Battery Current**		
33.	• Nominal Battery Current	0	A
34.	**Battery C-rate**		
35.	• Nominal Battery Discharge C-rate	0	C
36.	• State of Charge	99.8179	%