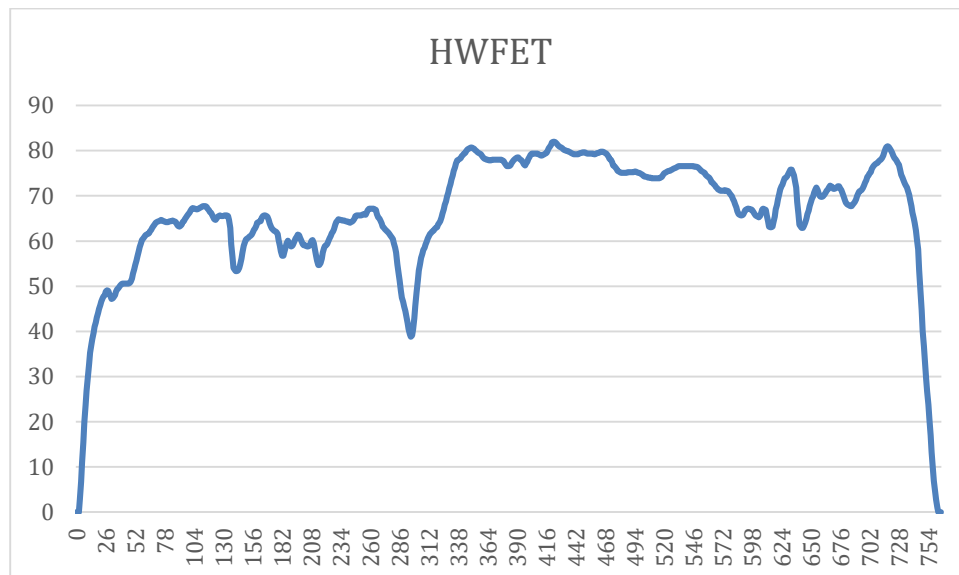


Course name	Numerical Modeling & Simulation in MATLAB-Simulink
Lesson name	Numerical Modelling of Ather450 using Artemis HWFET Drive Cycle data in MATLAB-Simulink
Lesson objective	Practice blocks & acquaint to use GUI of MATLAB-Simulink
Created by	Vivek Rathod

Problem statement: Model Ather450 for Artemis HWFET Drive Cycle 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:



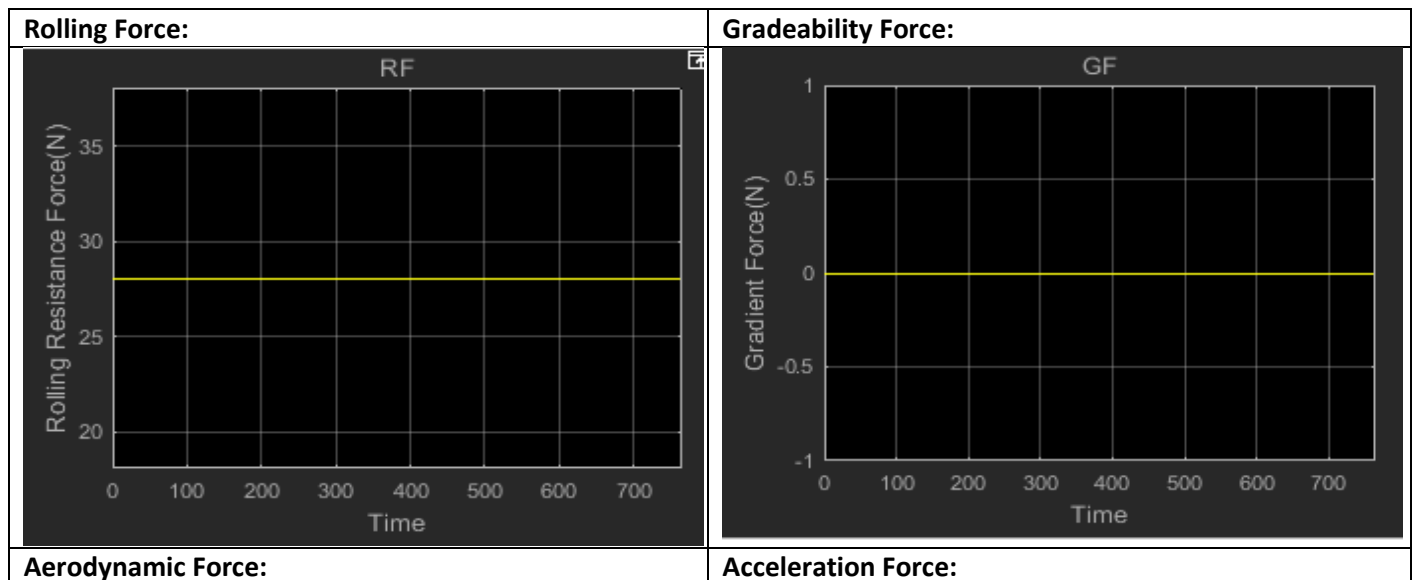
Model Inputs:

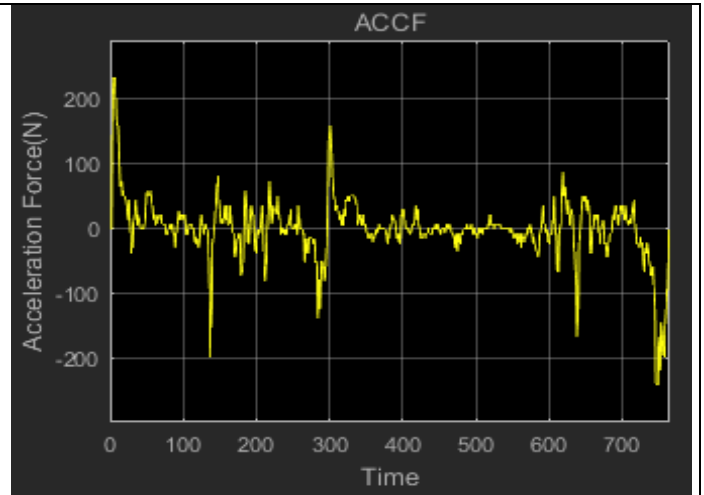
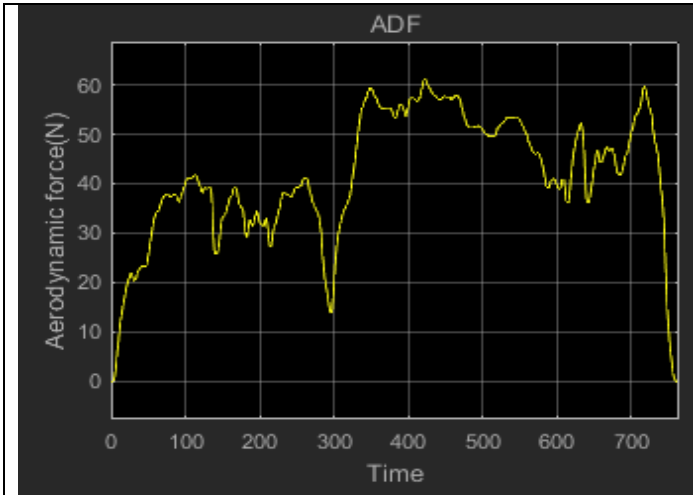
SI No	Parameter	Value	Units
1.	Chassis		
2.	I. Coefficient of rolling resistance	0.015	
3.	II. Mass of Vehicle	111	Kg
4.	III. Mass of Driver	80	Kg
5.	IV. Gravity constant	9.81	m/s
6.	V. Grade Angle	0	degree
7.	VI. Velocity	From the HWFET Drive Cycle data	Kmph
8.	VII. Area	0.875	m ²
9.	VIII. Air Density	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. Artemis Urban drive cycle distance	14.03	Km
19.	IV. Battery Initial SOC	100	%
20.	V. Drive Cycle time or Simulation time	765	s
21.	Cell		
22.	I. Cell Voltage	3.6	V
23.	II. Cell Capacity	2.7	Ah

Program:

```
M=111; %Mass of vehicle (kg)
Md=80; %Mass of driver (kg)
GVM=M+Md; %Gross vehicle mass (kg)
g=9.81; %Gravity constant (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 =HWFET;
```

Results:

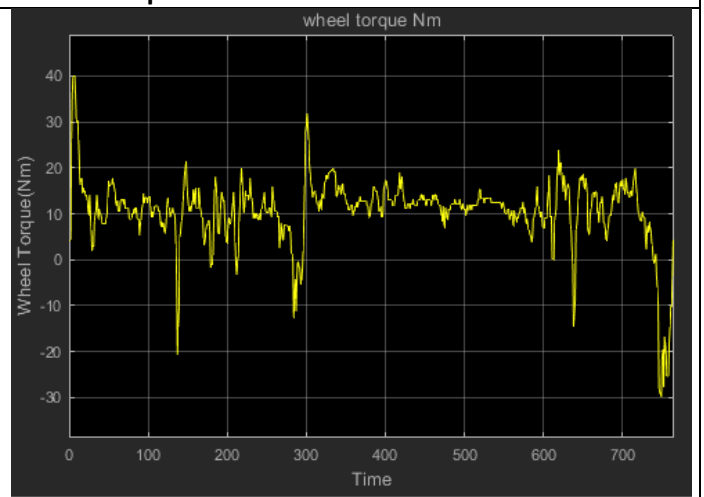




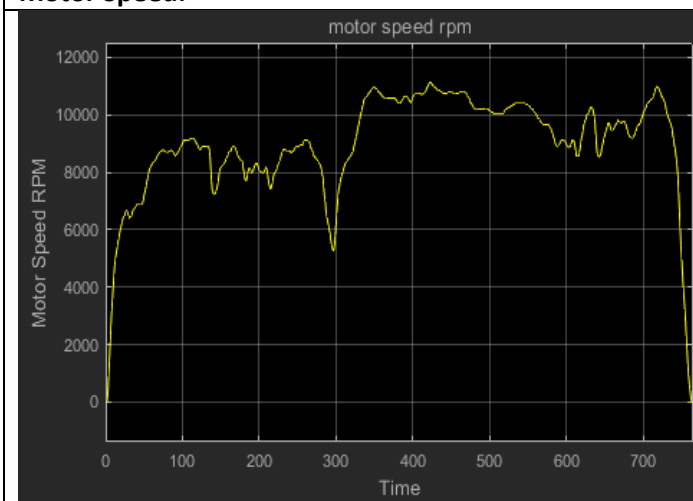
Wheel Speed:



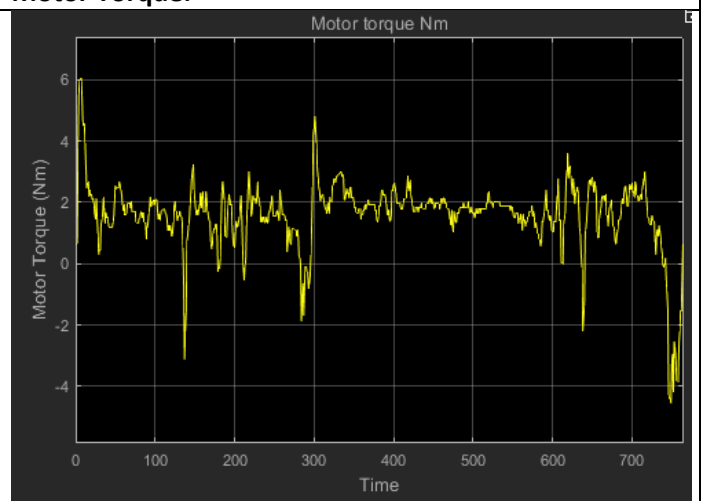
Wheel Torque:



Motor Speed:

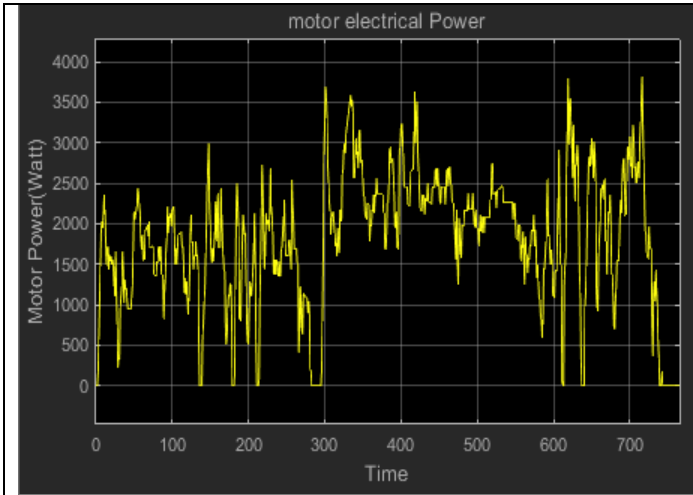


Motor Torque:

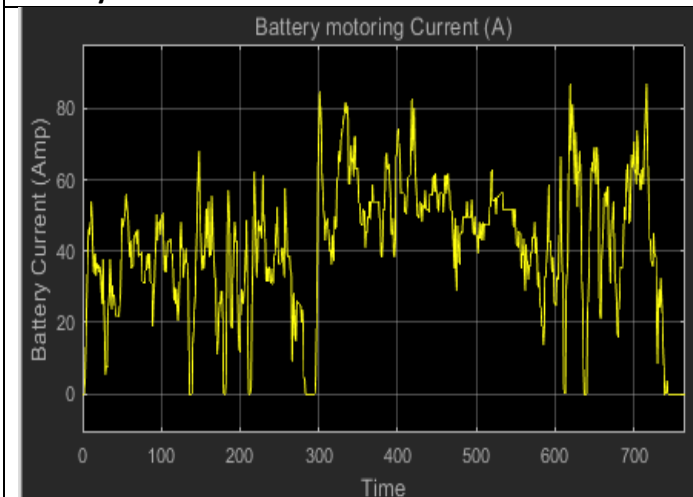


Motor Power:

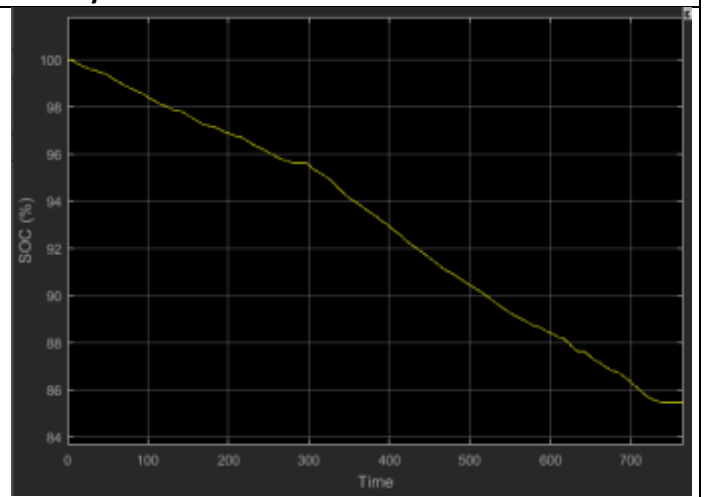
Battery Power:



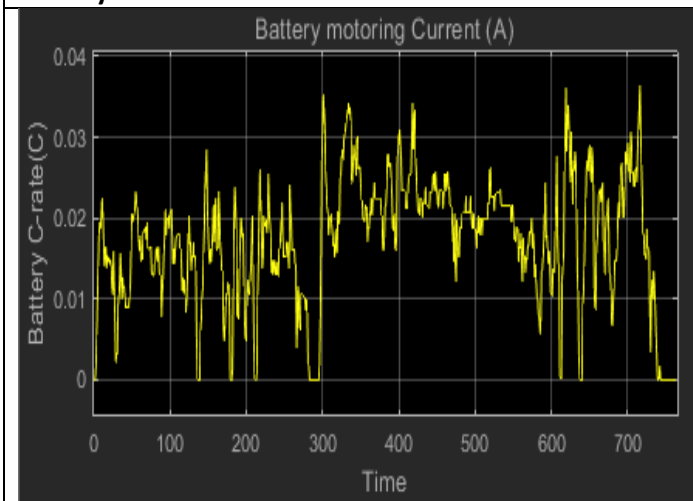
Battery Current:



Battery SOC:



Battery C-rate:



Conclusion:

SI No	Parameters	Values	Units
1.	Chassis		
2.	• Rolling Force	28.1057	N
3.	• Gradeability Force	0	N
4.	• Maximum Aerodynamic Force	61.0828	N
5.	• Maximum Acceleration Force	232.2456	N
6.	• Maximum Wheel Speed	1426.2	Rpm
7.	• Maximum Wheel Torque	40.2230	Nm
8.	Motor		
9.	• Maximum Motor Speed	11124	Rpm
10.	Motor Torque		
11.	• Nominal Motor Torque	1.5963	Nm
12.	Motor Power		
13.	• Nominal Motor Power	1619	W
14.	Battery		
15.	• Power per Km	32.03	Wh/Km
16.	• Vehicle Range	74.93	Km
17.	• Battery Capacity in Ah	62.66	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	2116.3	W
24.	Battery Current		
25.	• Nominal Battery Current	41.0935	A
26.	Battery C-rate		
27.	• Nominal Battery Discharge C-rate	0.0171	C
28.	• State of Charge	85.4830	%
29.	Regenerative		
30.	Battery Power		
31.	• Nominal Battery Power	-43.0983	W
32.	Battery Current		
33.	• Nominal Battery Current	-0.8434	A
34.	Battery C-rate		
35.	• Nominal Battery Discharge C-rate	-0.000351	C
36.	• State of Charge	85.4906	%