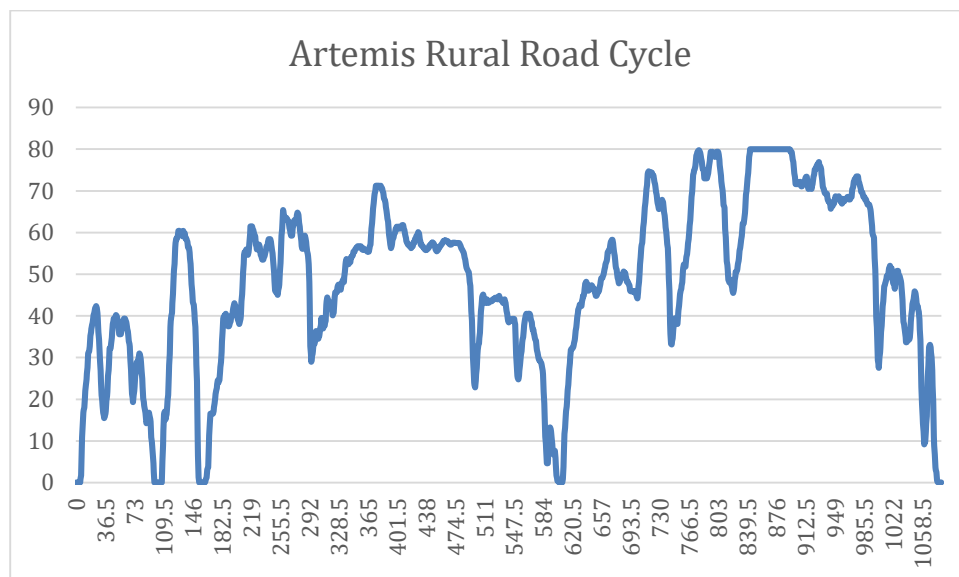


Course name	Numerical Modeling & Simulation in MATLAB-Simulink
Lesson name	Numerical Modelling of Ather 450 using Artemis Rural Drive Cycle data in MATLAB-Simulink
Lesson objective	Practice blocks & acquaint to use GUI of MATLAB-Simulink
Created by	Vivek Rathod

Problem statement: Model Ather 450 for Artemis Rural 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:



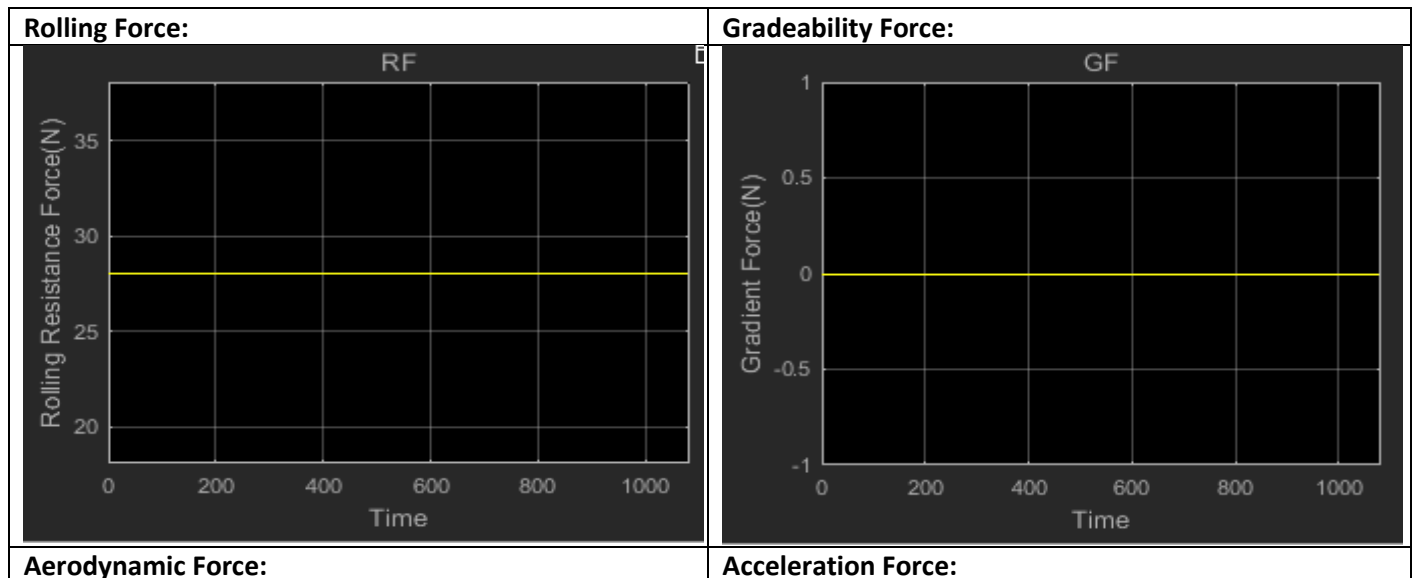
Model Inputs:

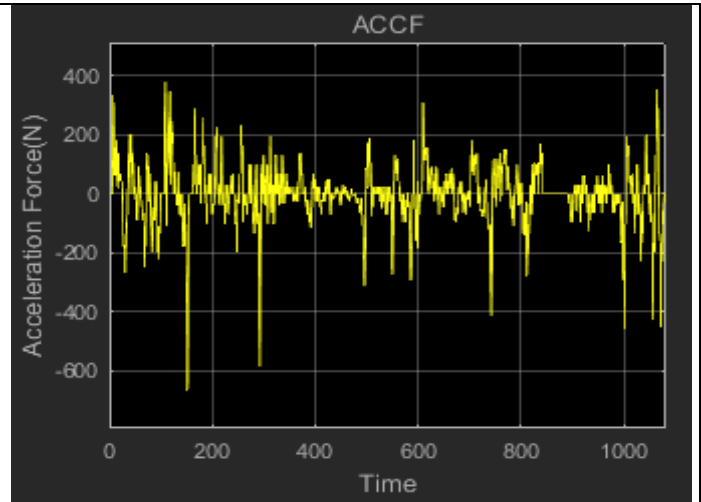
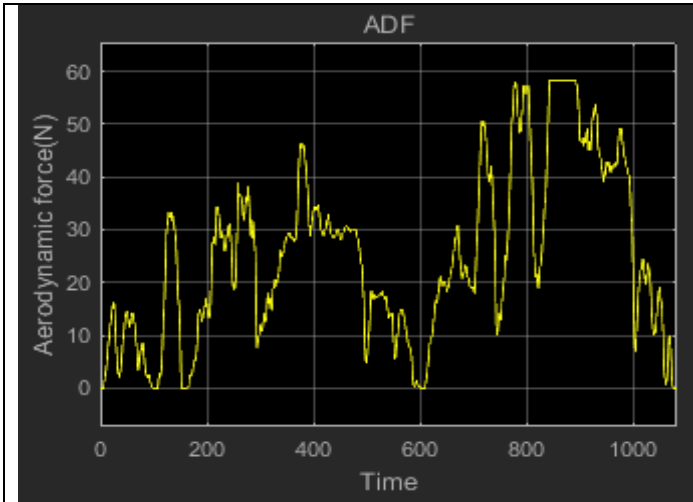
SI No	Parameter	Value	Units
1.	Chassis		
2.	I. Coefficient of rolling resistance	0.015	
3.	II. Mass of Vehicle	111	Kg
4.	III. Mass of Driver	80	Kg
5.	IV. Gravity constant	9.81	m/s
6.	V. Grade Angle	0	degree
7.	VI. Velocity	From the artemis rural drive cycle data	Kmph
8.	VII. Area	0.875	m ²
9.	VIII. Air 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 Rural drive cycle distance	14.561	Km
19.	IV. Battery Initial SOC	100	%
20.	V. Drive Cycle time or Simulation time	1082	s
21.	Cell		
22.	I. Cell Voltage	3.6	V
23.	II. Cell Capacity	2.7	Ah

Program:

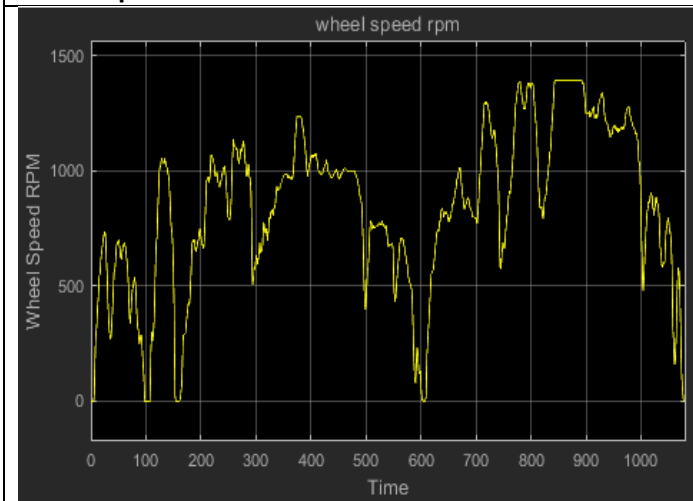
```
M=111; %Mass of vehicle (kg)
Md=80; %Mass of driver (kg)
GVM=M+Md; %Gross vehicle mass (kg)
g=9.81; %Gravity constant (m/s^2)
GVW=GVM*g; %Gross vehicle weight
A=0.875; % frontal area (m^2)
rho=1.2250; %Air Density (kg/m^3)
Rw=0.1524; %Radius of wheel (m)
cd=0.22; %coefficient of drag
crf=0.015; %coefficient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

Results:

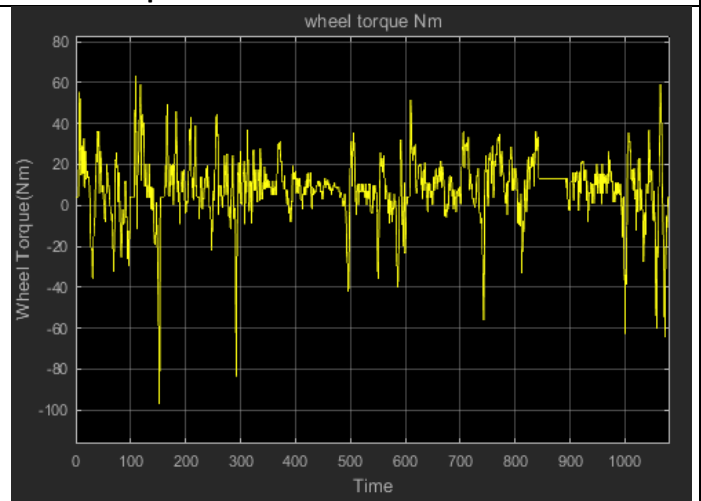




Wheel Speed:



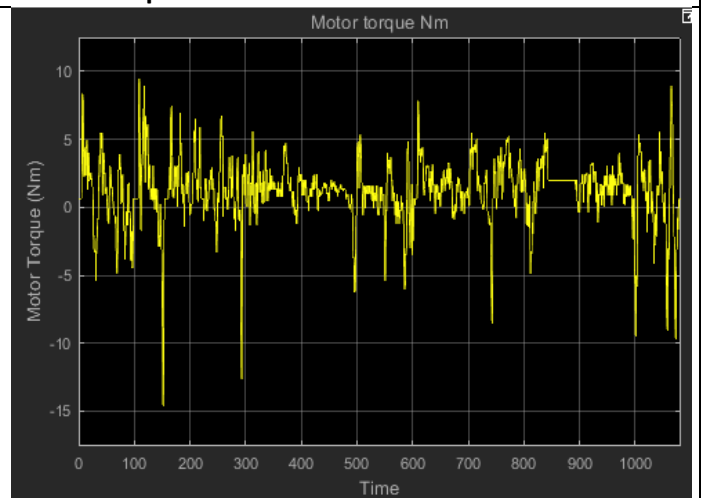
Wheel Torque:



Motor Speed:

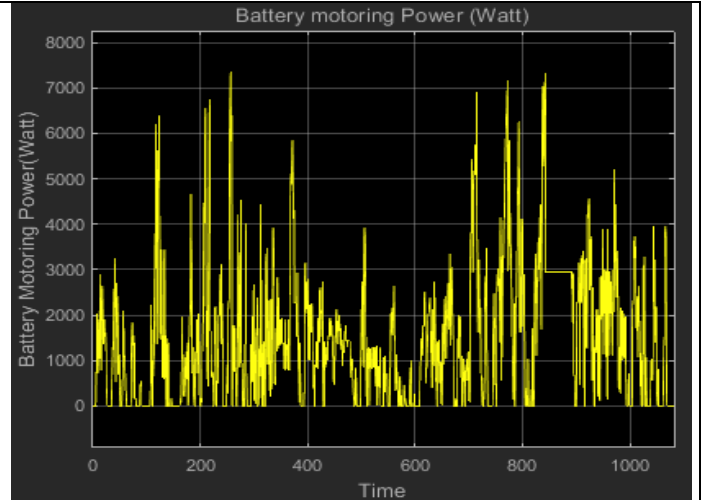
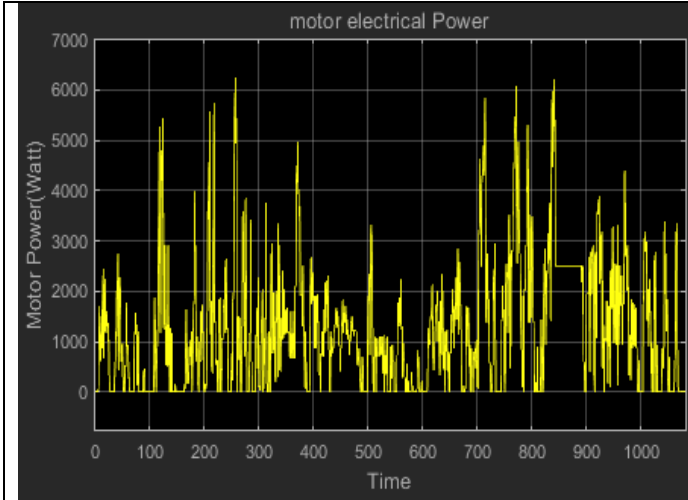


Motor Torque:

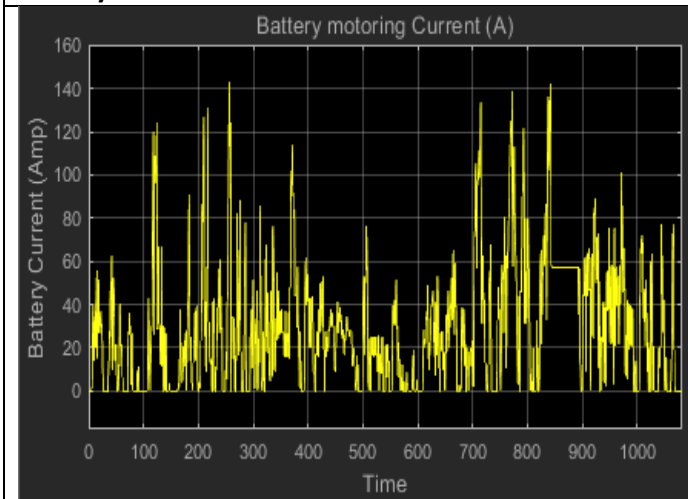


Motor Power:

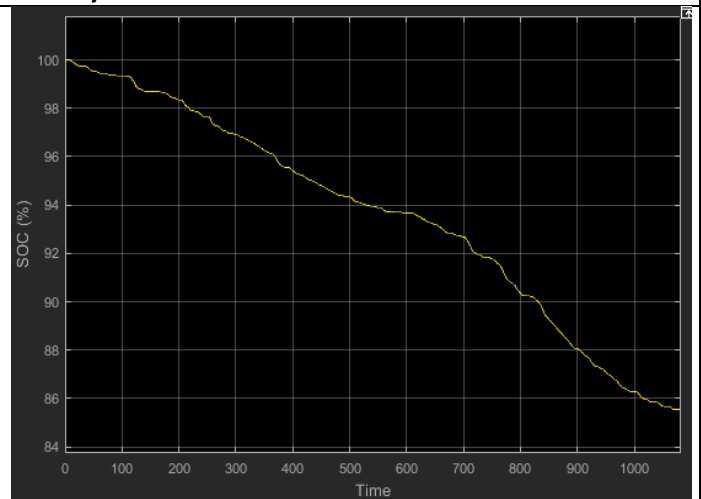
Battery Power:



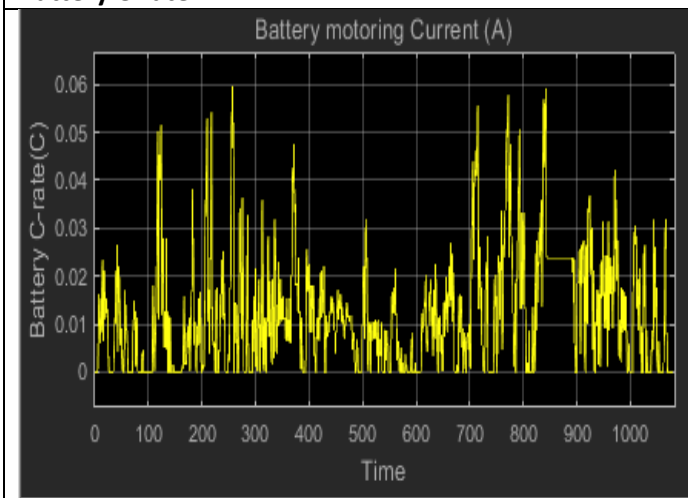
Battery Current:



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	58.2253	N
5.	• Maximum Acceleration Force	383.3264	N
6.	• Maximum Wheel Speed	1392.4	Rpm
7.	• Maximum Wheel Torque	62.9187	Nm
8.	Motor		
9.	• Maximum Motor Speed	10861	Rpm
10.	Motor Torque		
11.	• Nominal Motor Torque	1.2214	Nm
12.	Motor Power		
13.	• Nominal Motor Power	1143.6	W
14.	Battery		
15.	• Power per Km	30.72	Wh/Km
16.	• Vehicle Range	78.13	Km
17.	• Battery Capacity in Ah	60.11	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	1494.4	W
24.	Battery Current		
25.	• Nominal Battery Current	29.026	A
26.	Battery C-rate		
27.	• Nominal Battery Discharge C-rate	0.0121	C
28.	• State of Charge	85.5510	%
29.	Regenerative		
30.	Battery Power		
31.	• Nominal Battery Power	-140.3829	W
32.	Battery Current		
33.	• Nominal Battery Current	-2.7472	A
34.	Battery C-rate		
35.	• Nominal Battery Discharge C-rate	-0.0011	C
36.	• State of Charge	85.586	%