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| Course name | Numerical Modeling & Simulation in MATLAB-Simulink |
| **Lesson name** | **Numerical Modelling of Ather 450 using HWFET Drive Cycle data in** MATLAB-Simulink |
| **Lesson objective** | **Practice blocks &** **acquaint to use GUI of MATLAB-Simulink** |
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**Problem statement:** Model Ather 450 for HWFET Drive Cycle in MATLAB Simulink to plot the Wheel Torque, Wheel Speed, Motor Torque, Motor Speed and Battery Current in Scilab-Xcos.

**HWFET Drive Cycle Graph:**

**Model Inputs:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl No** | **Parameter** | **Value** | **Units** |
|  | **Chassis** |  |  |
|  | 1. Coefficient of rolling resistance | 0.015 |  |
|  | 1. Mass of Vehicle | 111 | Kg |
|  | 1. Mass of Driver | 80 | Kg |
|  | 1. Gravity constant | 9.81 | m/s |
|  | 1. Grade Angle | 0 | degree |
|  | 1. Velocity | 81.9395 | Kmph |
|  | 1. Area | 0.875 | m^2 |
|  | 1. Air Density | 1.225 | Kg/m^3 |
|  | 1. Drag Coefficient | 0.22 |  |
|  | 1. Radius of wheel | 0.1524 | m |
|  | **Transmission** |  |  |
|  | 1. Gear Ratio | 7.8 |  |
|  | 1. Transmission Efficiency | 85 | % |
|  | **Motor** |  |  |
|  | Motor Efficiency | 90 | % |
|  | **Battery** |  |  |
|  | 1. Motor Controller Efficiency | 85 | % |
|  | 1. Battery Capacity | 2400 | Wh |
|  | 1. Battery Voltage | 51.1 | V |
|  | 1. Artemis Urban drive cycle distance | 14.03 | Km |
|  | 1. Battery Initial SOC | 100 | % |
|  | 1. Drive Cycle time or Simulation time | 765 | s |
|  | **Cell** |  |  |
|  | 1. Cell Voltage | 3.6 | V |
|  | 1. Cell Capacity | 2.7 | Ah |

**Results:**

|  |  |
| --- | --- |
| **Rolling Force:** | **Gradeability Force:** |
|  |  |
| **Aerodynamic Force:** | **Acceleration Force:** |
|  |  |
| **Wheel Speed:** | **Wheel Torque:** |
|  |  |
| **Motor Speed:** | **Motor Torque:** |
|  |  |
| **Motor Power:** | **Battery Power:** |
|  |  |
| **Battery Current:** | **Battery SOC:** |
|  |  |
| **Battery C-rate:** |  |
|  |  |

**Conclusion:**

|  |  |  |  |
| --- | --- | --- | --- |
| **SR. No** | **Parameters** | **Values** | **Units** |
|  | **Chassis** |  |  |
|  | * Rolling Force | 28.1057 | N |
|  | * Gradeability Force | 0 | N |
|  | * Maximum Aerodynamic Force | 61.0828 | N |
|  | * Maximum Acceleration Force | 232.2456 | N |
|  | * Maximum Wheel Speed | 1462 | Rpm |
|  | * Maximum Wheel Torque | 40.2230 | Nm |
|  | **Motor** |  |  |
|  | * Maximum Motor Speed | 11124 | Rpm |
|  | **Motor Torque** |  |  |
|  | * Nominal Motor Torque | 6.0668 | Nm |
|  | **Motor Power** |  |  |
|  | * Nominal Motor Power | 3800 | W |
|  | **Battery** |  |  |
|  | * Power per Km | 32.01 | Wh/Km |
|  | * Vehicle Range | 65.56 | Km |
|  | * Battery Capacity in Ah | 46.97 | Ah |
|  | **Cell** |  |  |
|  | * Cell Voltage | 3.6 | V |
|  | * Cell Capacity | 2.7 | Ah |
|  | **No of cells** |  |  |
|  | **Battery Power** |  |  |
|  | * Nominal Battery Power | 4484 | W |
|  | **Battery Current** |  |  |
|  | * Nominal Battery Current | 87.75 | A |
|  | **Battery C-rate** |  |  |
|  | * Nominal Battery Discharge C-rate | 1.8 | C |
|  | * State of Charge | 81 | % |