

Modelling of Battrey Pack Design using PowerTrain Sizing Calculations

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About Project

- In this modelling project I modelled the different components of Powertrain like motor, transmission, wheel with breaking down them into subsystem in Simulink.
- Using powertrain sizing reverse calculation from drive cycle and velocity as main input to model's powertrain system by drive cycle, I calculated from the wheel/ chassis subsystem to motor subsystem to transmission and at the end lastly to Battery subsystem to design the whole car battery pack weight, volume, total how many numbers of battery cells are required to form the final battery pack system and also within that how many of them needed to be in series and parallel connections.
- Here I have taken the dimensions, weight and regarding specifications of hypothetical car.
- I have considered the LG Chem 18650 2500 mAh battery cell for car battery pack designation.
- In addition, I expect my car model with range of 300 km.
- According to this taken battery cell and range I am going to design the battery pack parameters.
- So, let's get Started...

Car Specifications & Model

The image shows the MATLAB Simulink environment. The top toolbar includes options like 'New Script', 'New Live Script', 'Find Files', 'Import Data', 'Clean Data', 'Variable', 'Save Workspace', and 'Clear Workspace'. The current folder is 'Modelling & Designing EV Battery using PowerTrain Sizing Calculations'. The 'Current Folder' pane shows a list of files including 'car_specifications.mat' and several '.png' files. The 'Command Window' shows the execution of the following commands:

```
>> load('car_specifications.mat')
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```

The 'Workspace' pane displays a table of variables and their values:

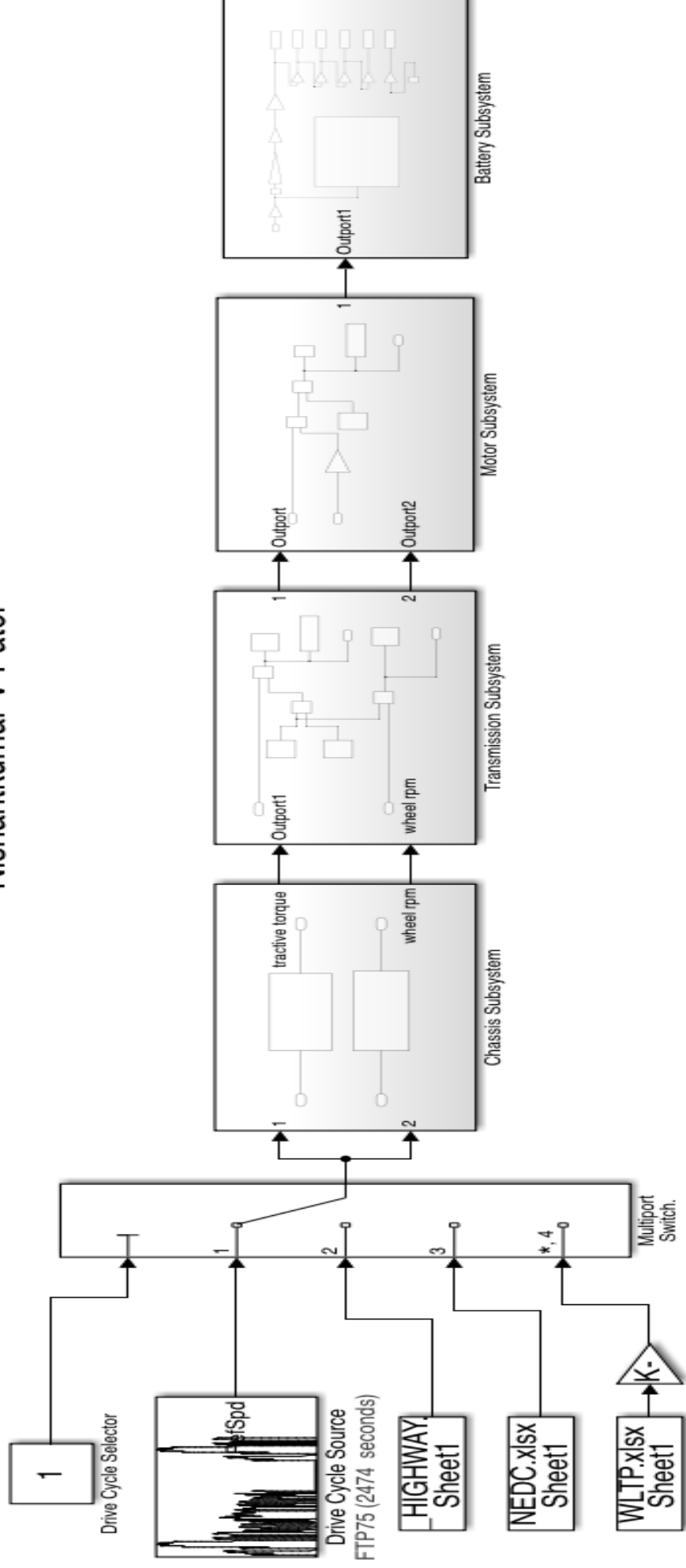
Name	Value
Air_Density	1.2000
Angle	0
Battery_Cell_Volume	1.6532e+04
Battery_Cell_Weight	0.0500
constant	0.1047
Drag_Coefficient	0.2000
Frontal_Area	2.6500
Gear_Ratio	9
Motor_Efficiency	0.9500
Nominal_Battery_Cell_Current_...	2.5000
Nominal_Battery_Cell_Voltage	3.6000
Nominal_Battery_Pack_Rating	175.5000
Nominal_Battery_Pack_Voltage	220
out	1x1 SimulationO...
Range	300
Rolling_Resistance_Coefficient	0.0200
Transmission_Efficiency	0.8000
Vehicle_Mass	1000
Wheel_Radius	0.3000

The 'Simulink_Model_by_NV...' pane shows the model version (1.26), saved in Simulink version (R2022a Update 2), last modified by (jamesbond), and a preview of the model.

- The workspace shows the different variables created for providing the specifications and parameters to simulink model.

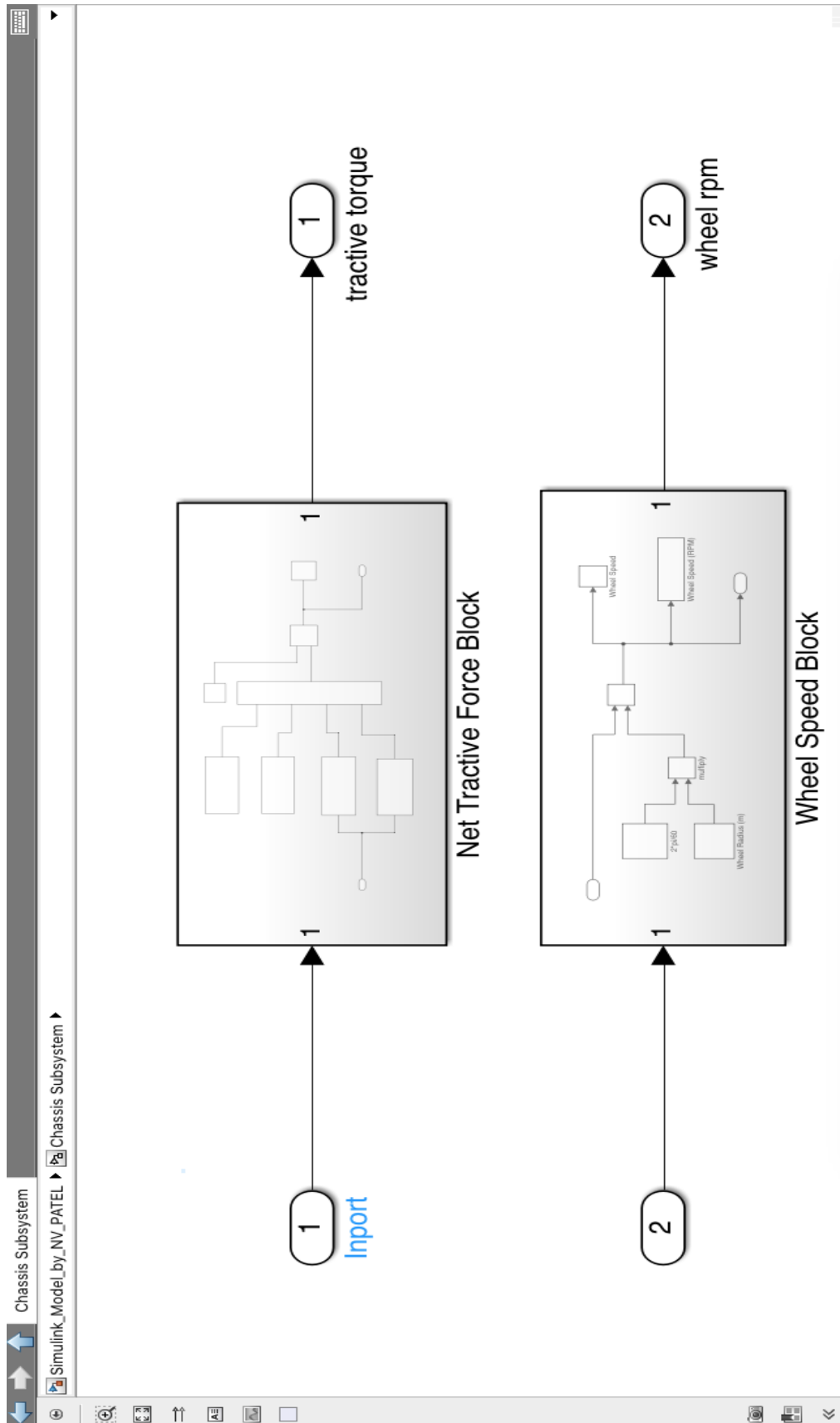
Design & Modelling of EV Battery using PowerTrain Sizing

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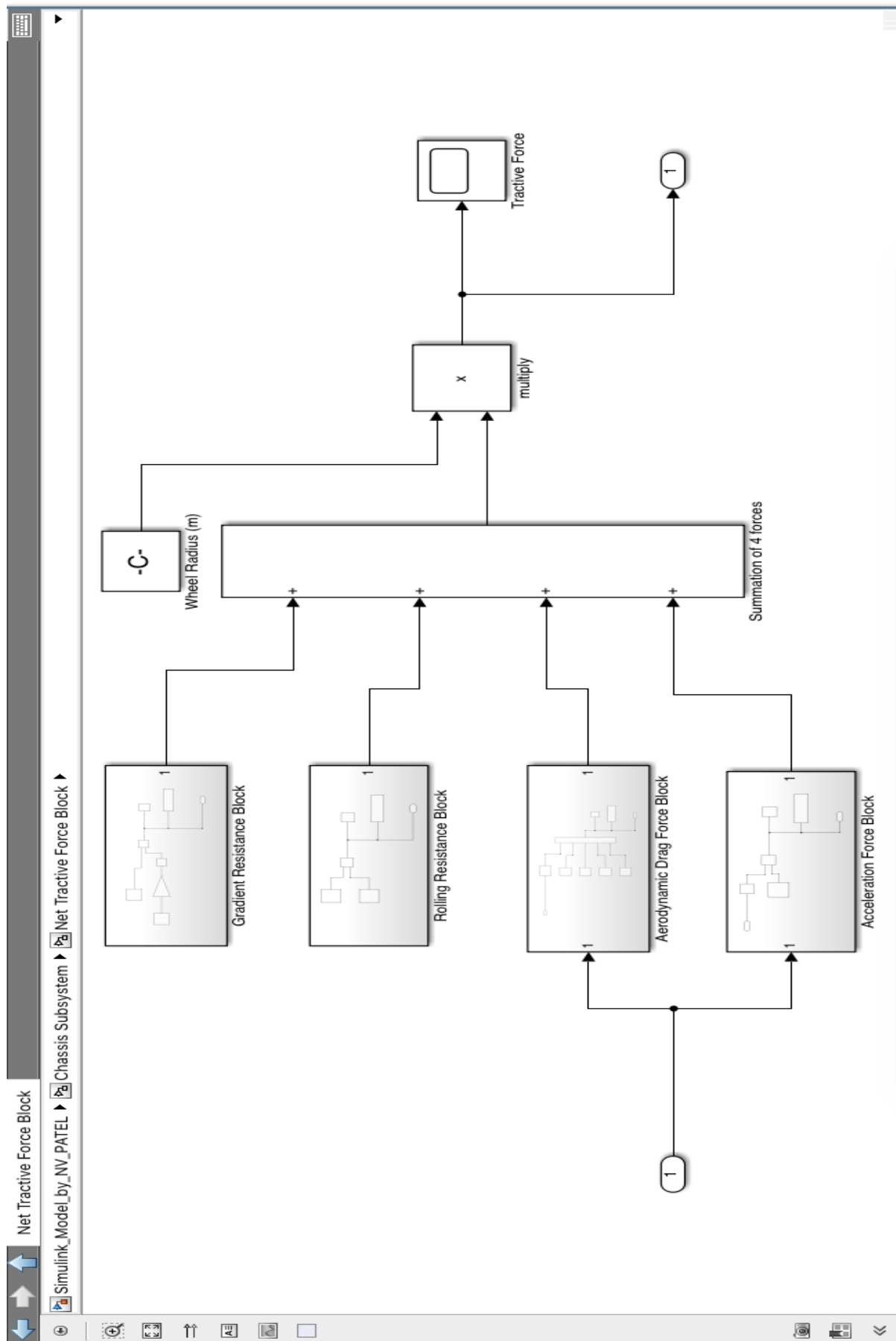


- I have 3 different drive cycle from spreadsheet files. One can switch to any drive cycle for simulation as I have provided the 'multiport switch block' to switch to any of three drive cycle. FTP 75 is standard drive cycle available in Simulink library browser. It has 2474 seconds simulation time and I have simulate the whole model based on this drive cycle with mentioned simulation time.
- I have divided the simulink model into 4-subsystems. And at last I have estimated the battery pack parameters.

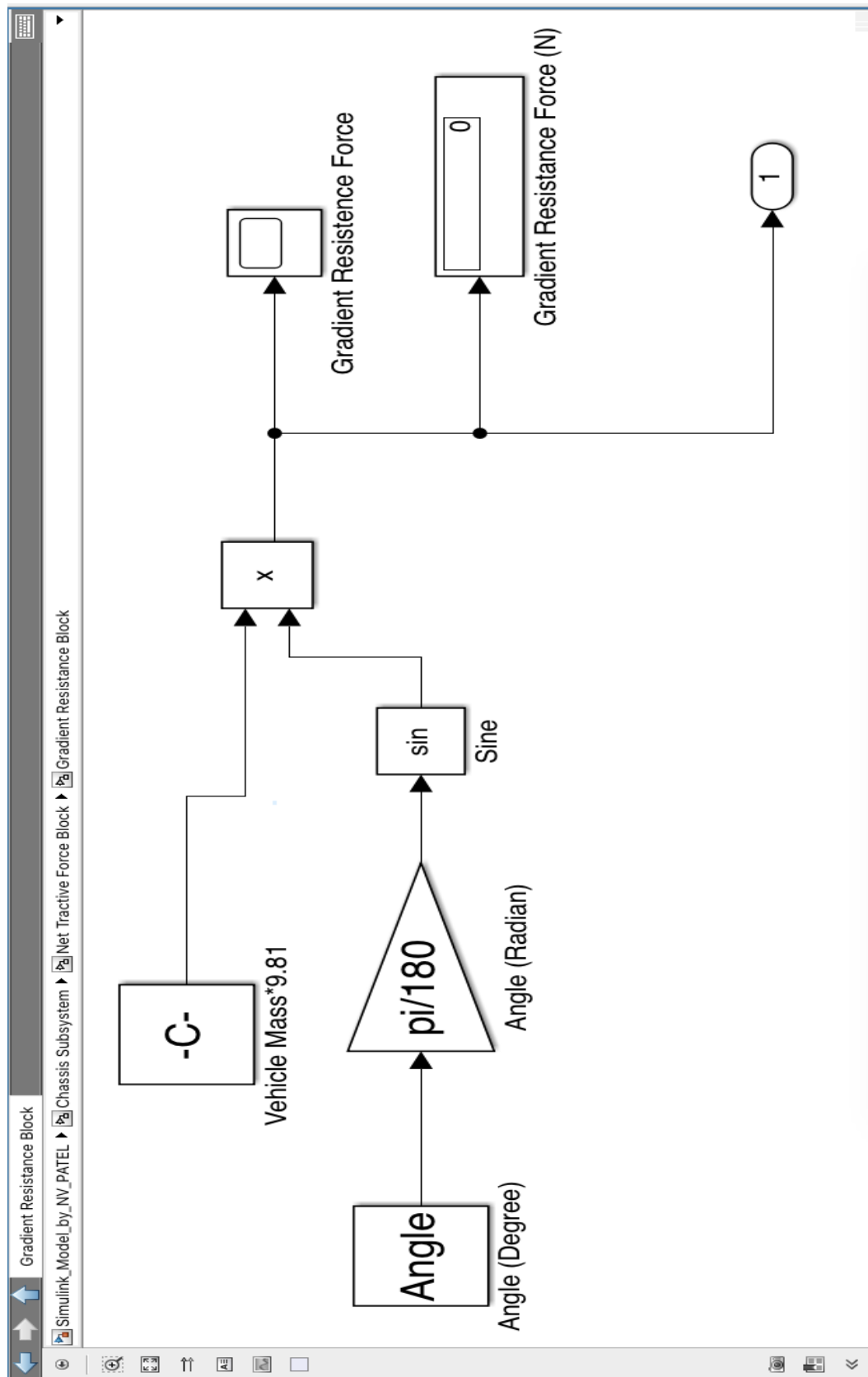
a.) Chassis Subsystem:



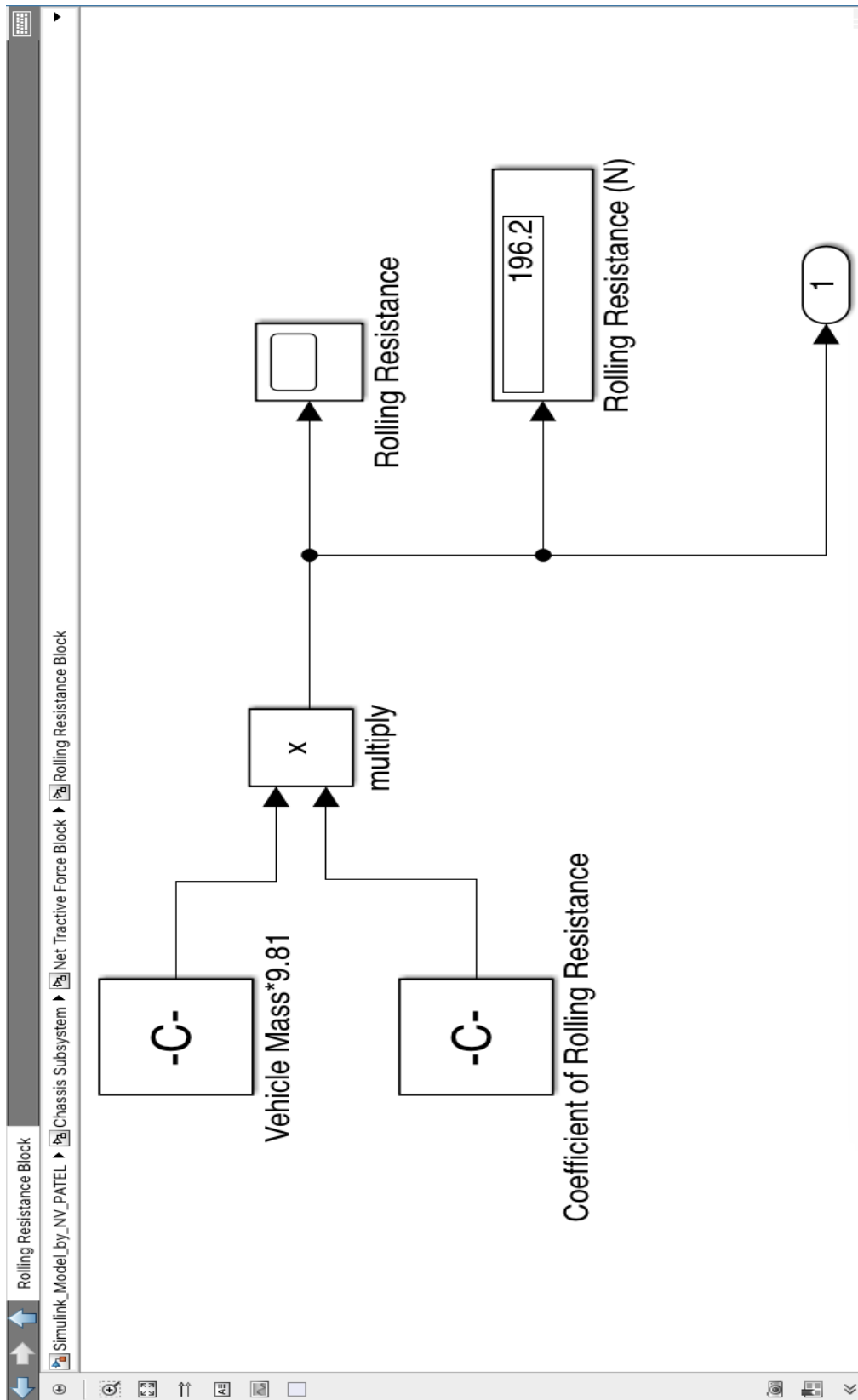
a.1) Net Tractive Force Block:



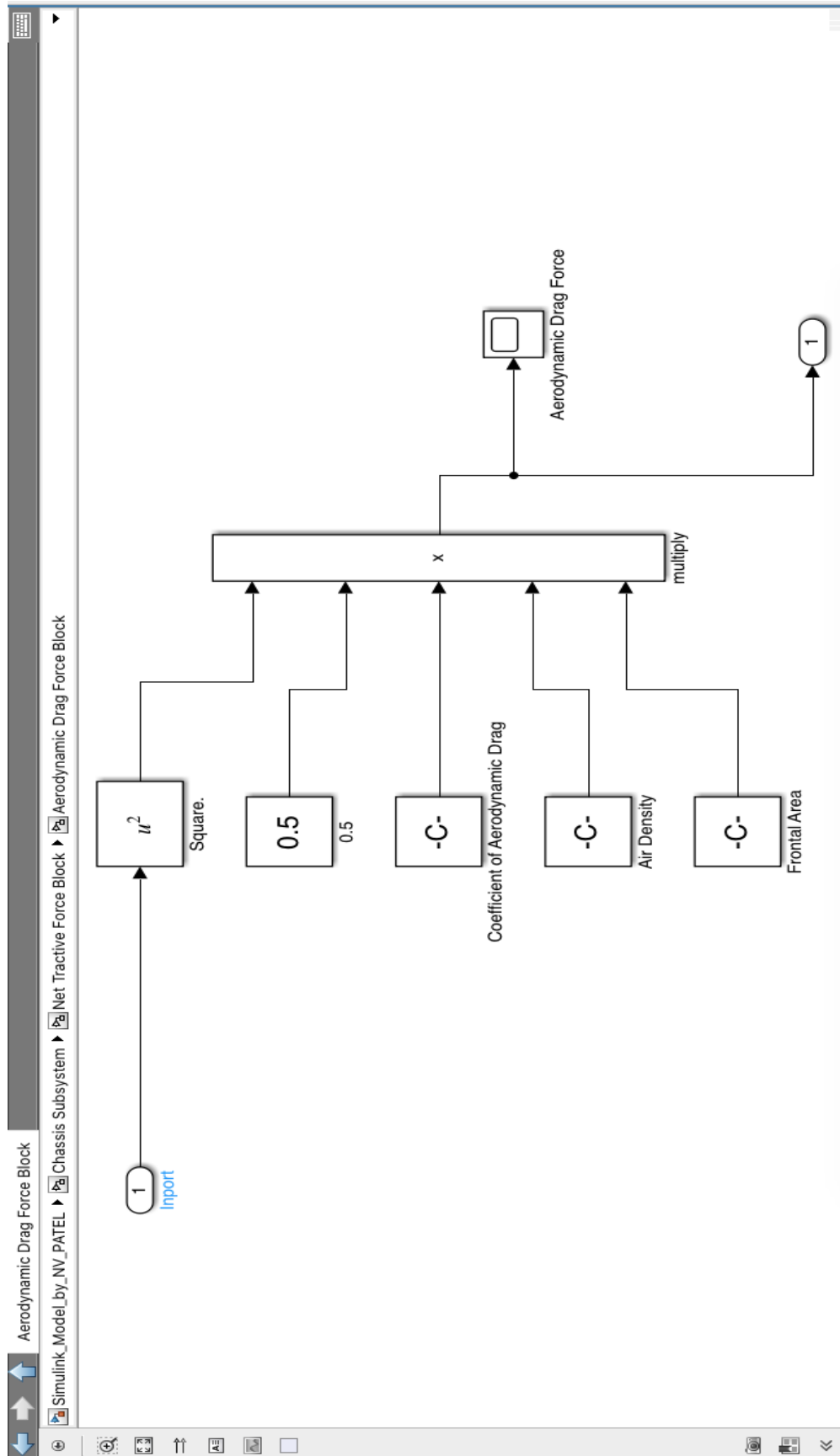
a.1.1) Gradient Resistance Force:



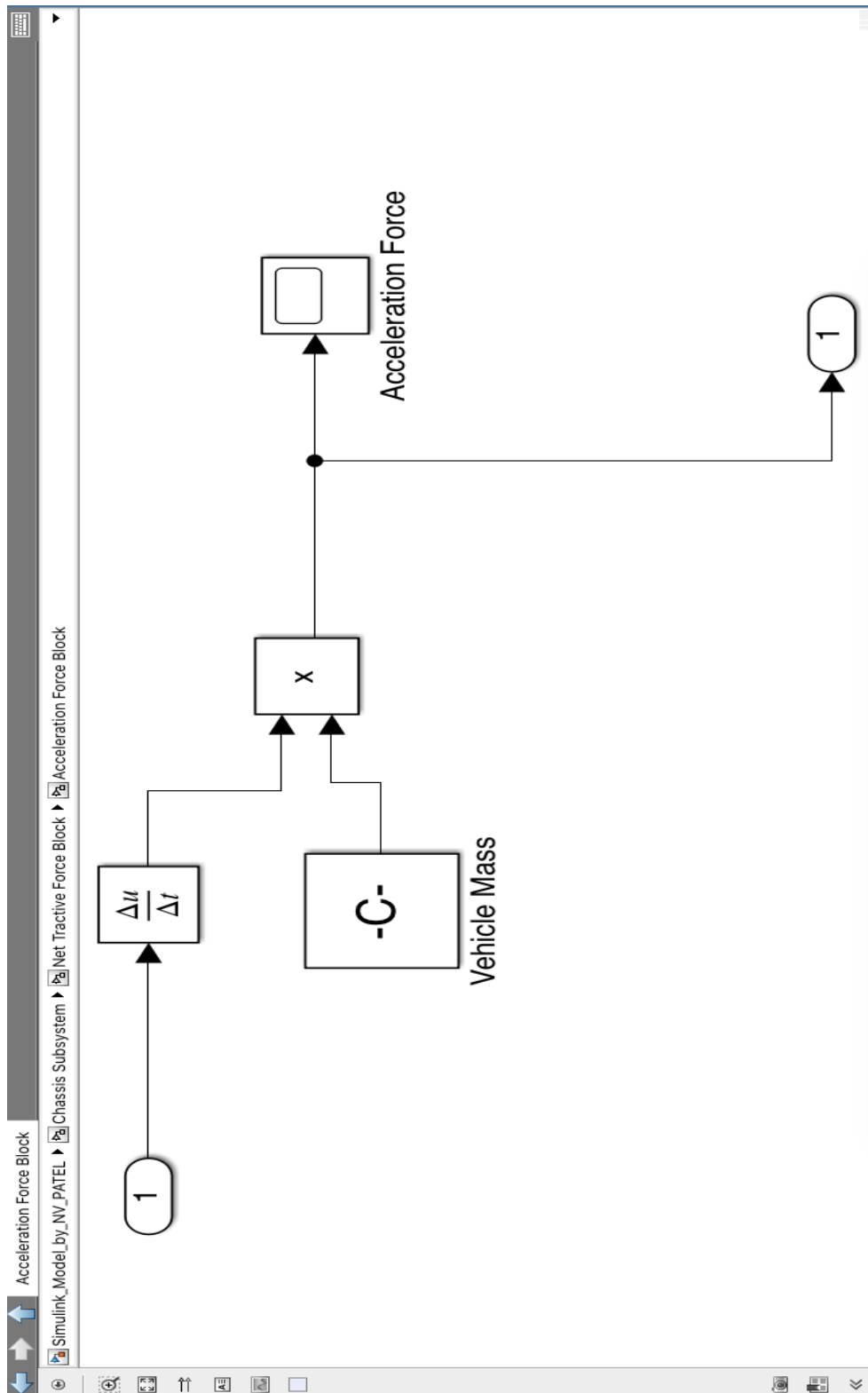
a.1.2) Rolling Resistance:



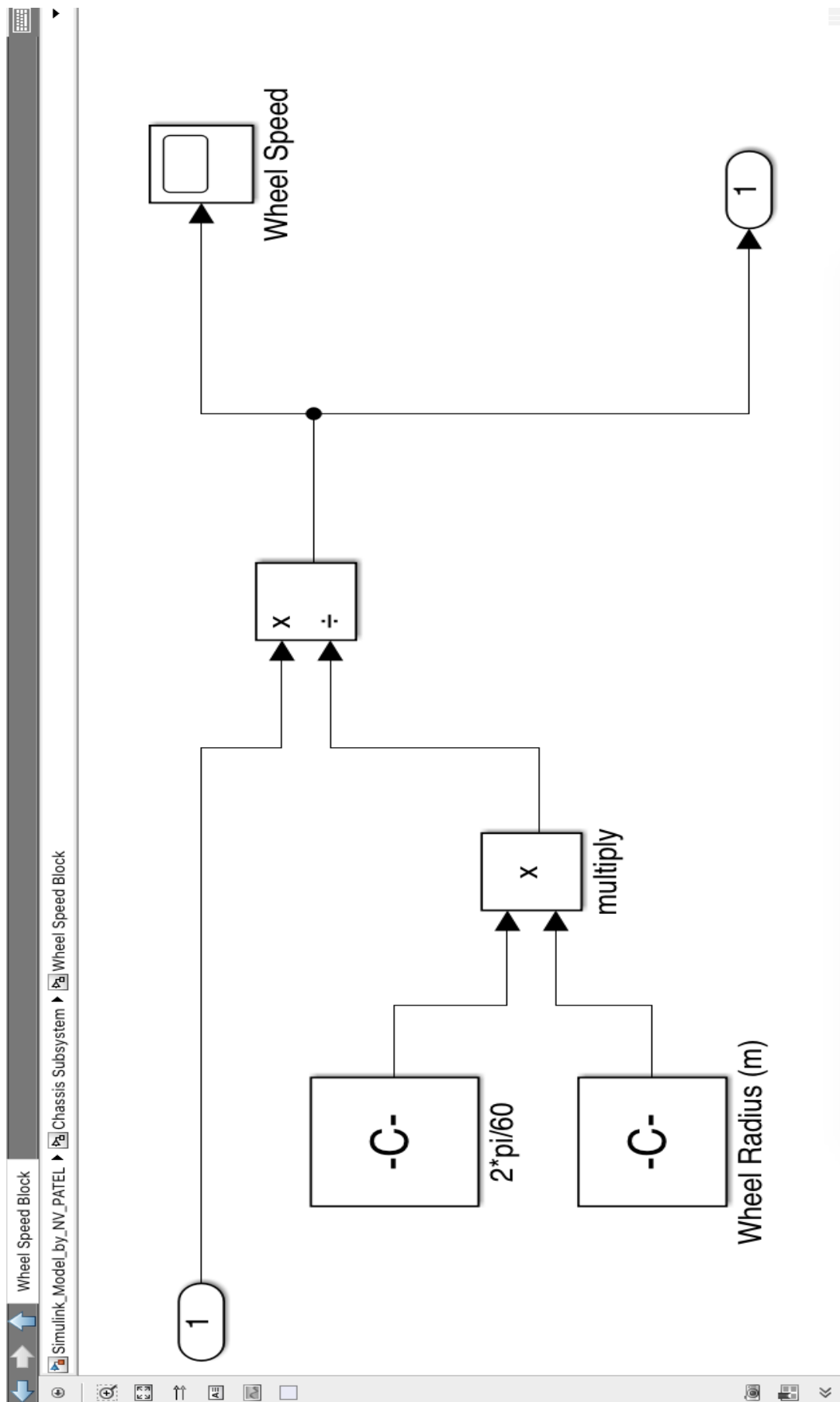
a.1.3) Aerodynamic Drag Force:



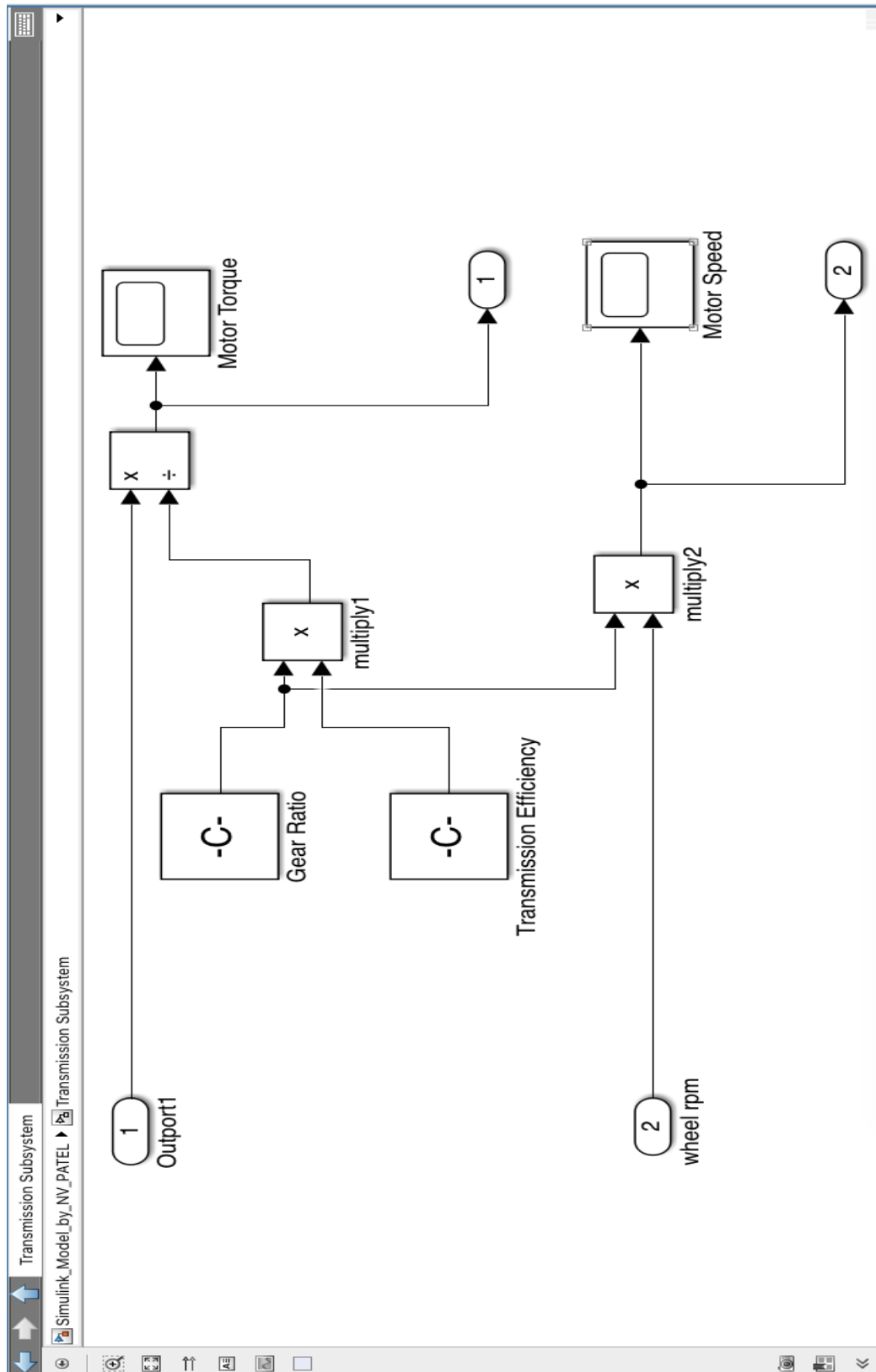
a.1.4) Acceleration Force:



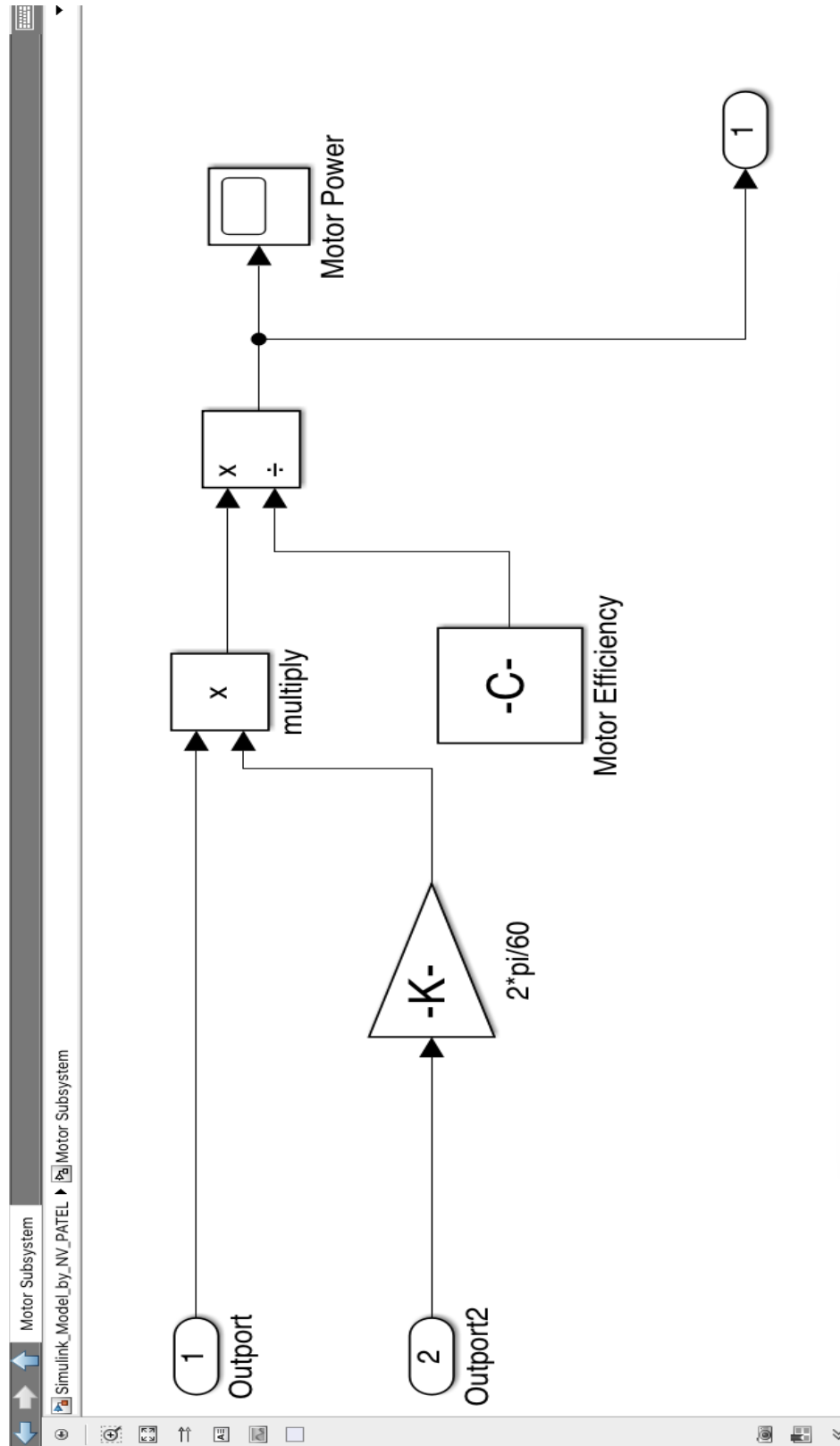
a.2) Wheel Speed Block:



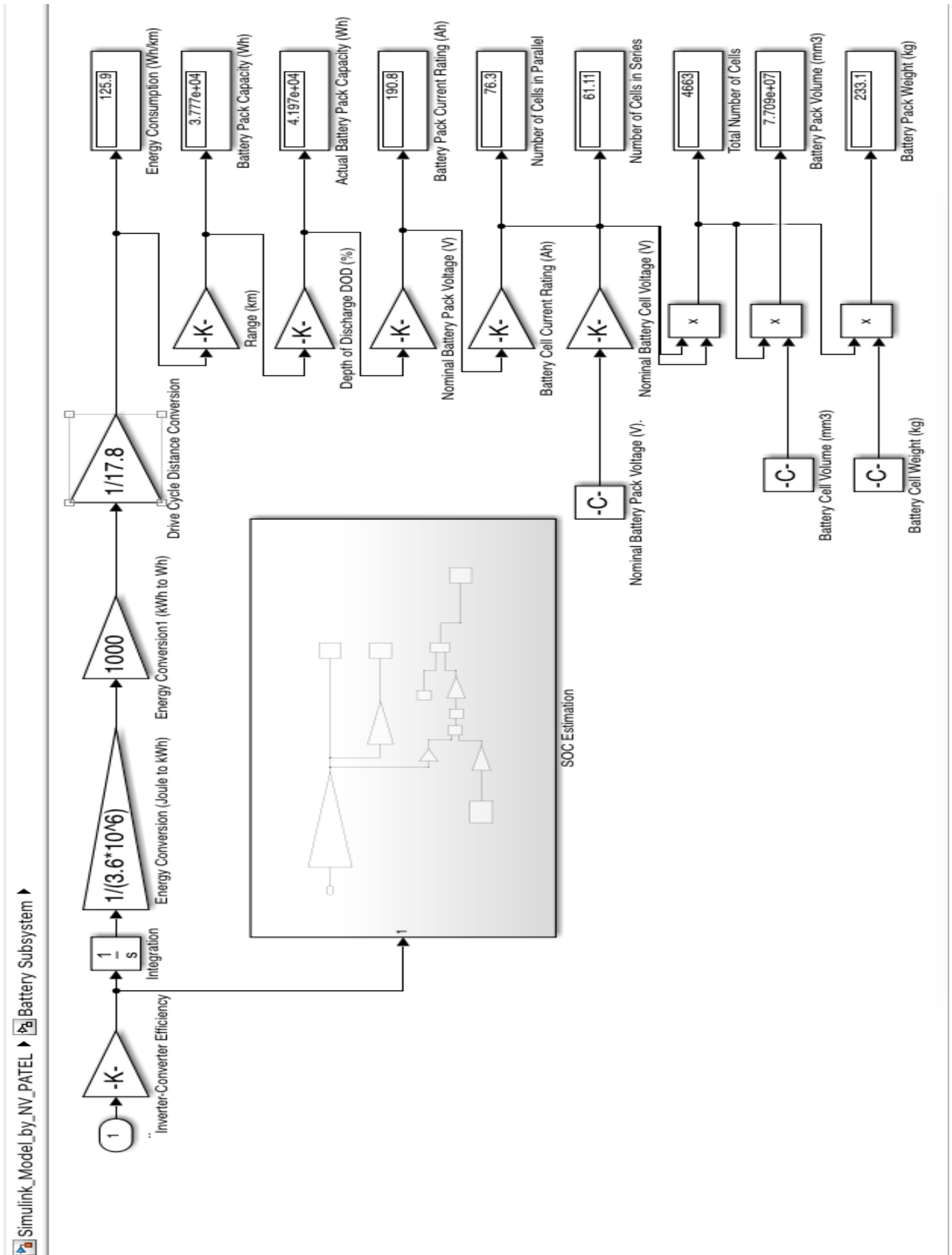
b.) Transmission Subsystem:



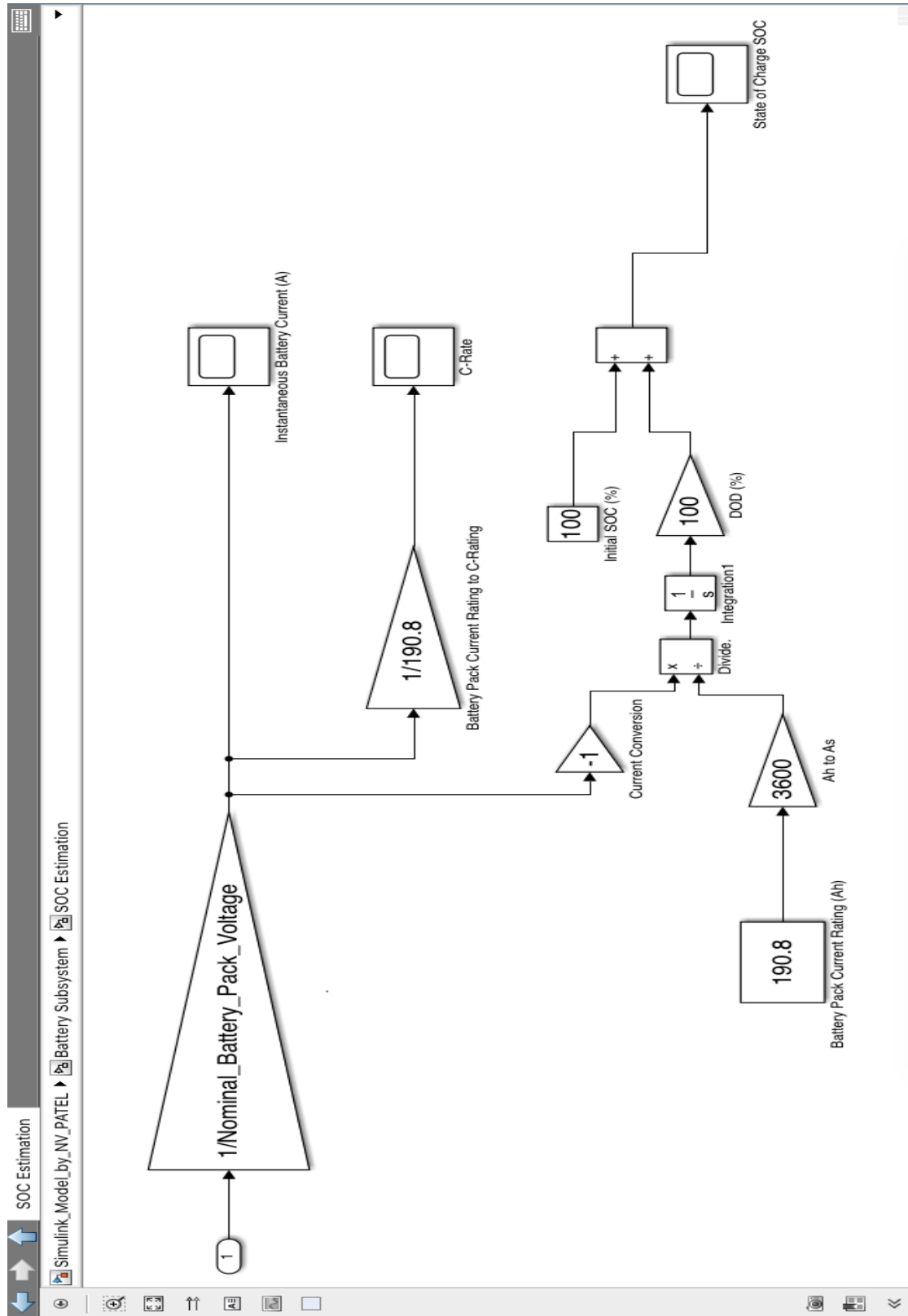
c.) Motor Subsystem:



d.) Battery Subsystem:



SOC Estimation:



Battery Pack Designation Parameters:

