Modelling & Simulation of EV Hyundai i10 Car

Presented by

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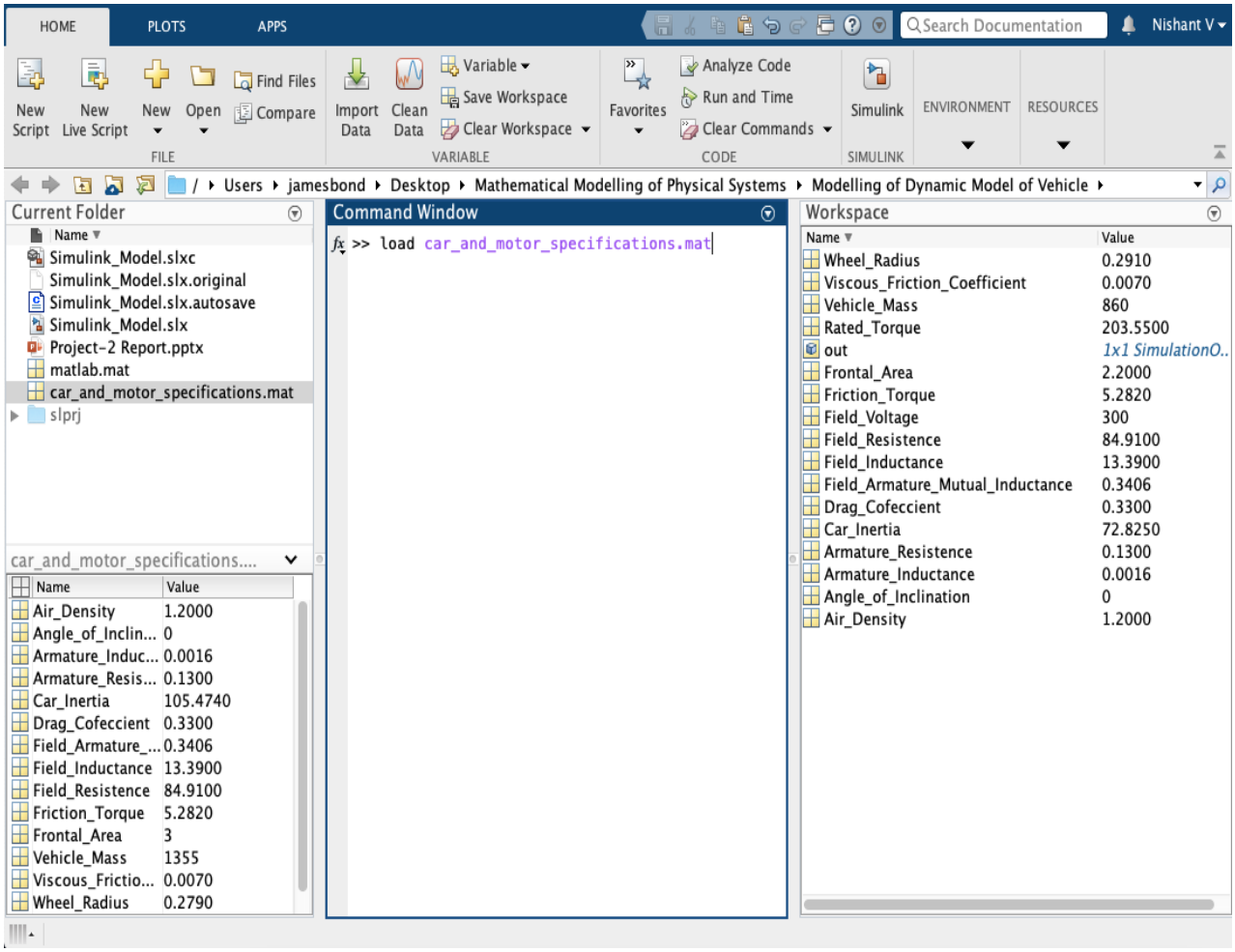
About Project

- Inside this project I have simulated the Hyundai i10 car model connected with DC motor to look out different possibilities of results of vehicle speed and appiled current to motor.
- I have taken the parameters of Hyundai i10 IC engine car but connected to motor to make it Ev car model. I have collected the data of motor from online sources and then decide to take 50 hp, 240V DC motor.
- In this model I breakdowned the car model into 2 subsystems. One is ‘Vehicle body Dynamics model’ and seconds one is ‘Hyundai i10 Whole Dynamics model’.
- The vehicle dynamics car model then shifted to the whole car model by converting it into 1-D Look-up Table.

Vehicle body & Motor Parameters:



The data provided in this .mat file is collected through the internet sources. These specification variables are used in putting the values for different blocks in model.

Modelling & Simulation of Dynamic Model of Hyundai i20 Car

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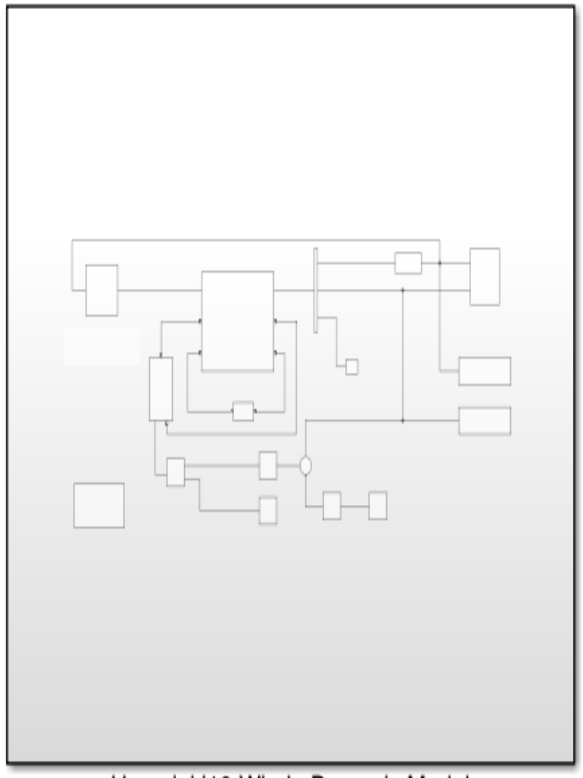
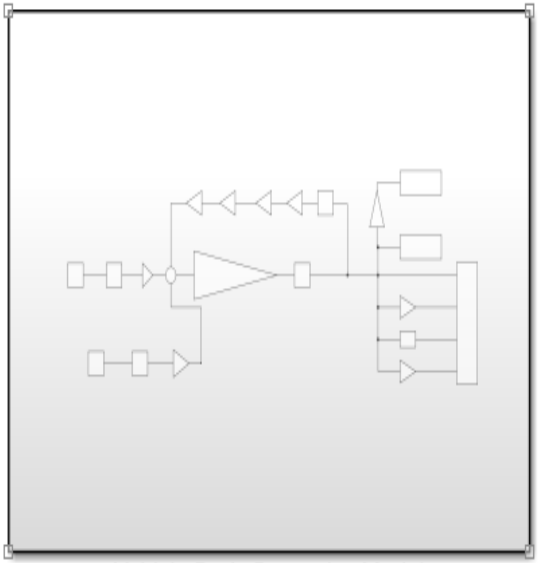
Simulink Model

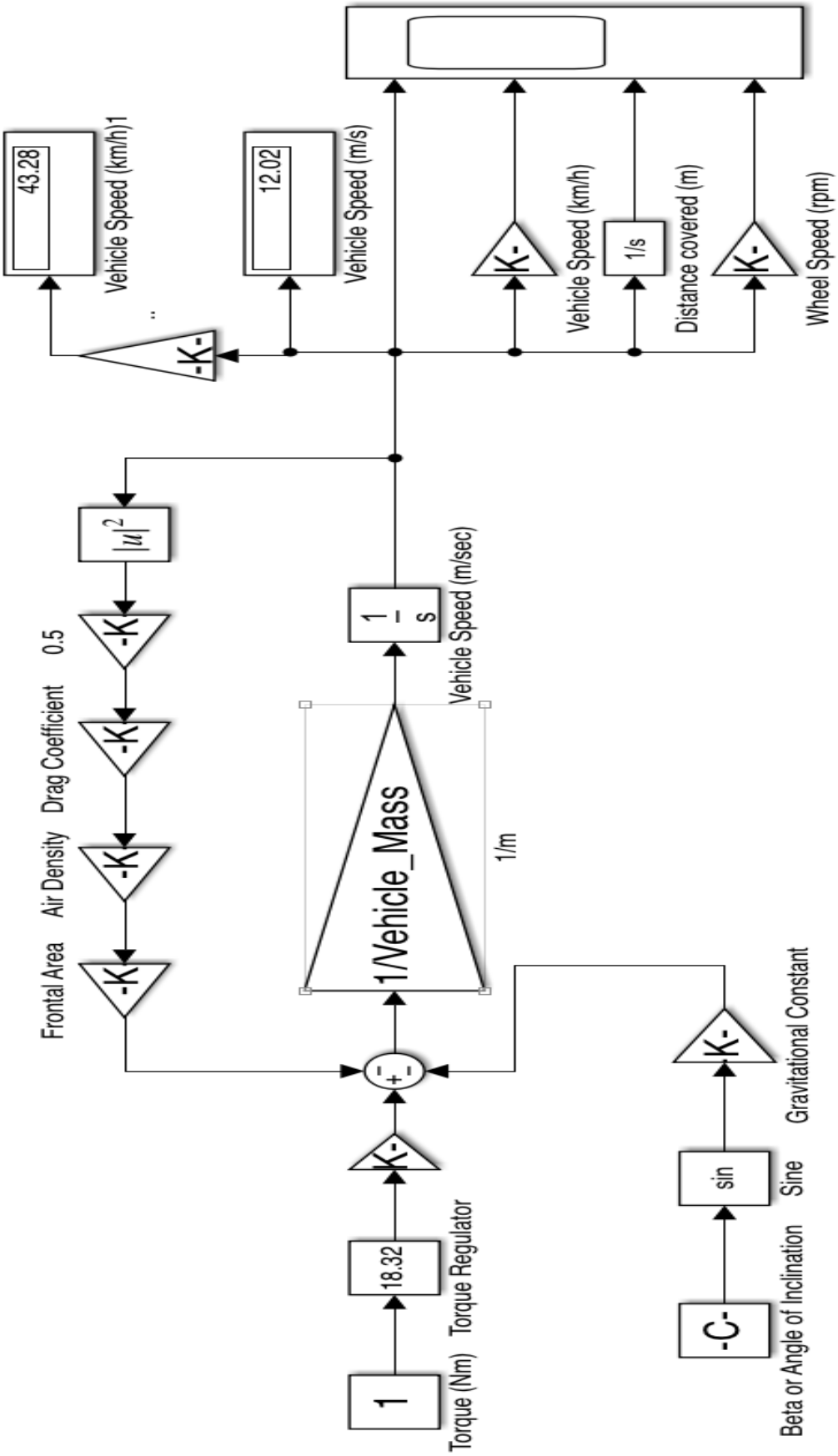


Hyundai i10 Whole Dynamic Model



Vehicle Body Dynamics Model

Vehicle Body Dynamics Model

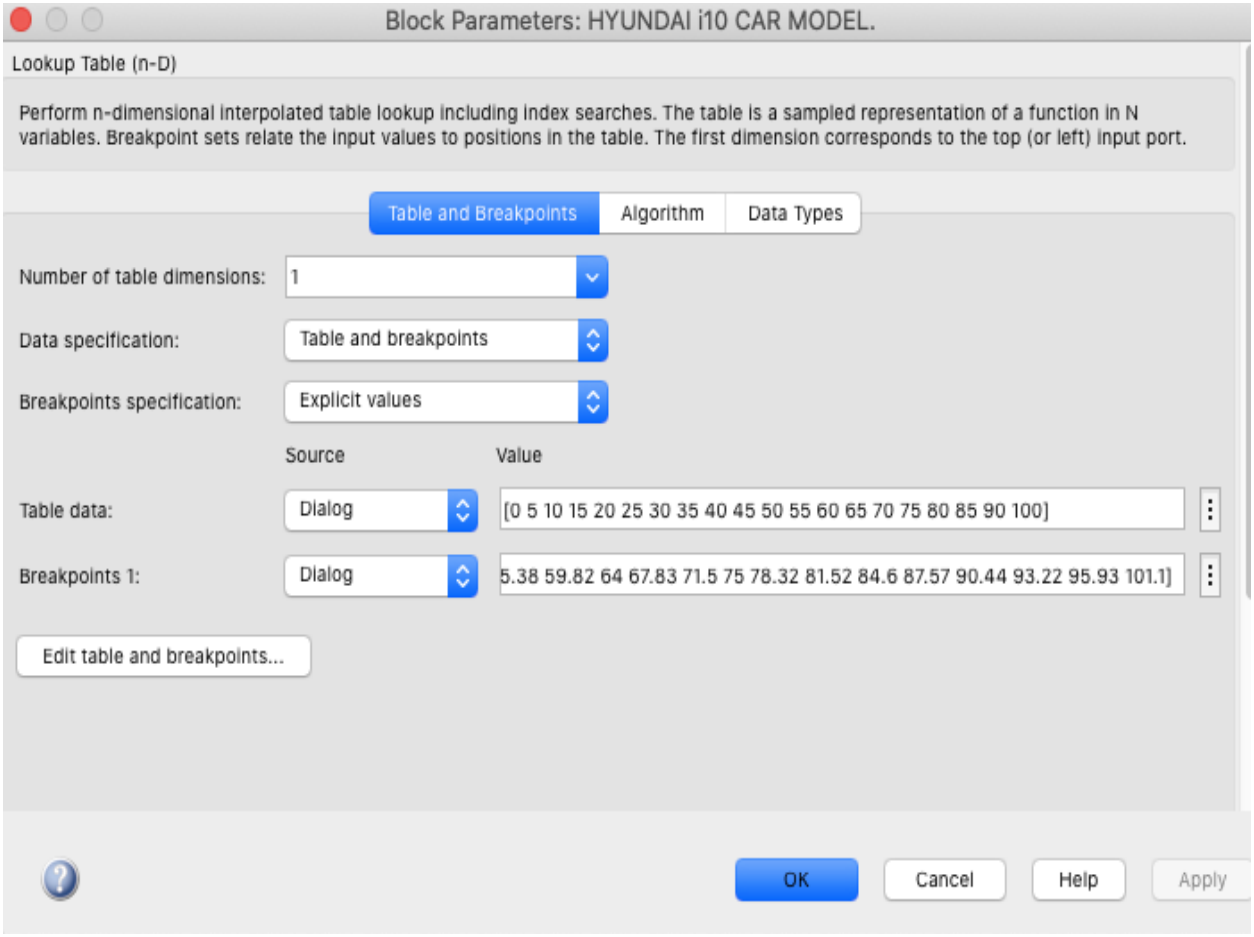


- The basic vehicle body dynamic equations or the one can say the forces like aerodynamics drag, acceleration force which are acting on the vehicle body and considered them and with the help of doing mathematical modelling in the simulink software so in such way this subsystem had been created.

- With the help of these model I derived the Speed-Torque characteristic table which will be later on fed into to making the 1D Look-up table.

- ‘Slider gain’ is used to change the torque values to look out the different vehicle speed outputs.

Creating Look-up Table

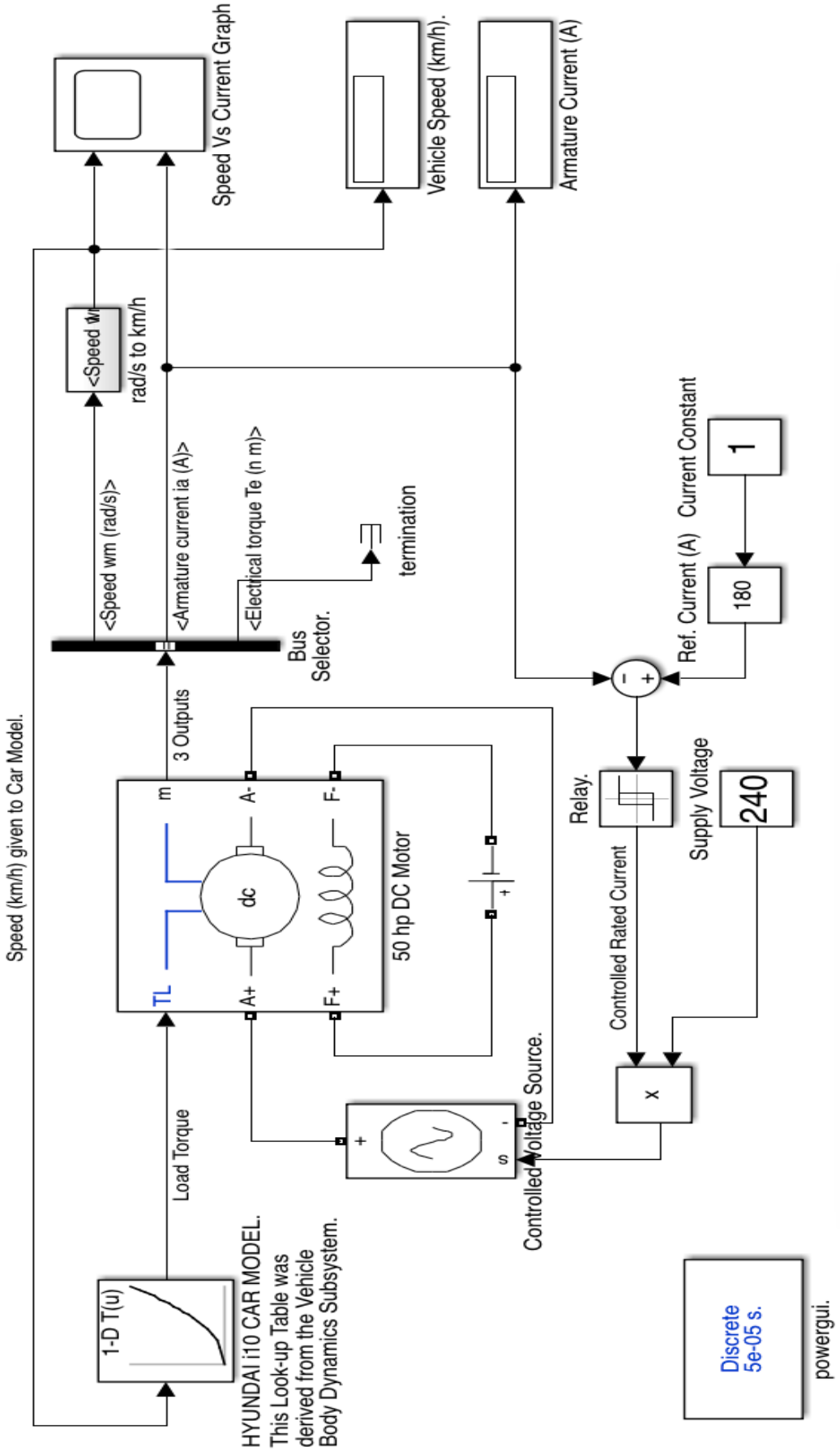


As you can observe in the above picture which is showing Look-up Table Block Parameters. By simulating my 'Vehicle Body Dynamics Model' at different torque values I got the diverse speed in km/h at its corresponding torque value. Then making the speed-torque relation table.

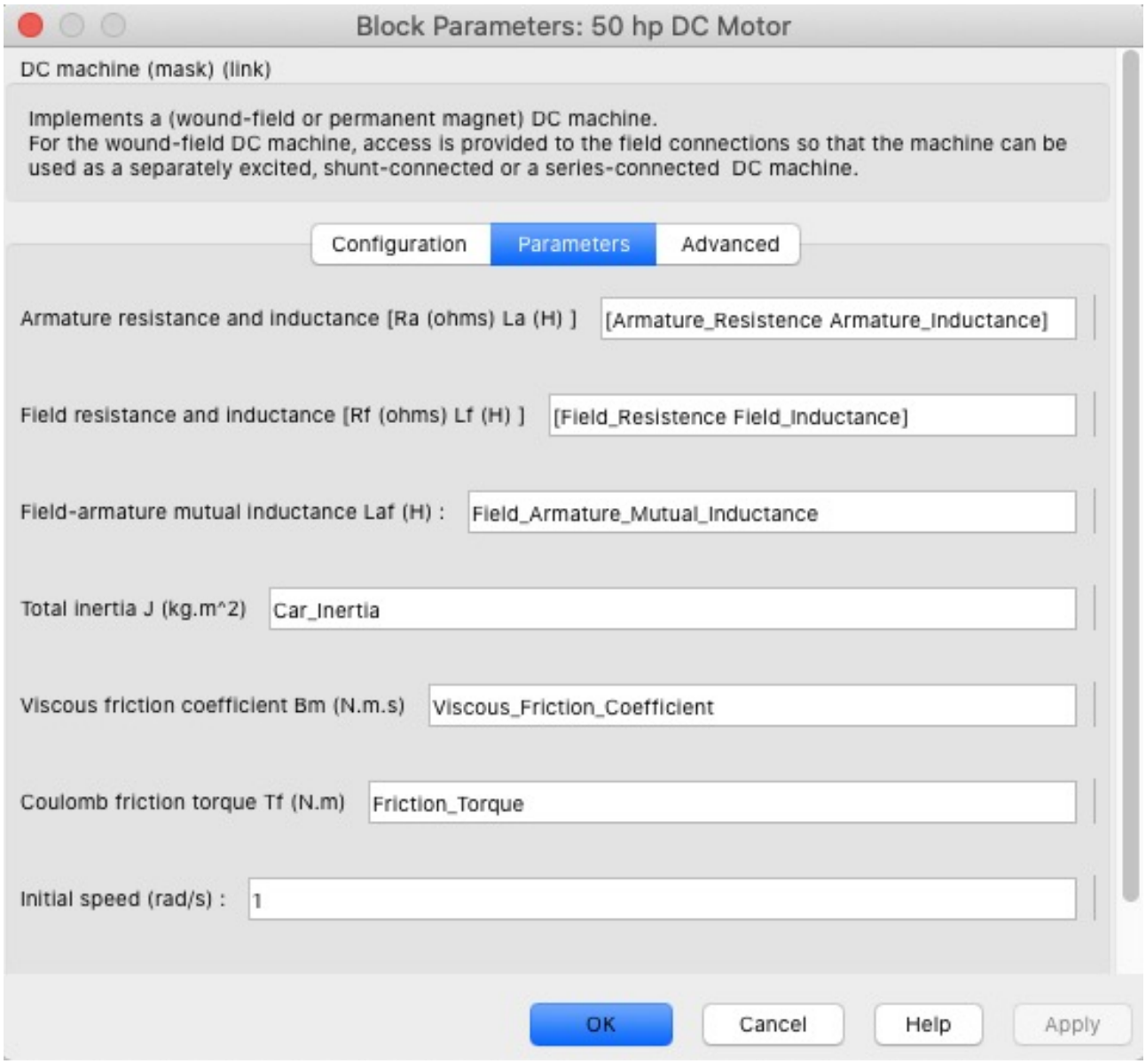
To make it possible in Simulink software one need the look-up table. The look-up table parameters contains X and Y values. Table-data indicates torque values whereas Breakpoints depicts speed values. Here for the look-up table block the Table-data is going to act as Output while Breakpoints remains as Input to this block.

In such a methodology the when I put this table block in whole dynamics model then this block wil intaking speed and outputing the load torque to DC motor which will producethe required torque to acjieve the predescribed speed which was as already fed to look-up table block as input.

Hyundai i10 Whole Dynamic Car Model



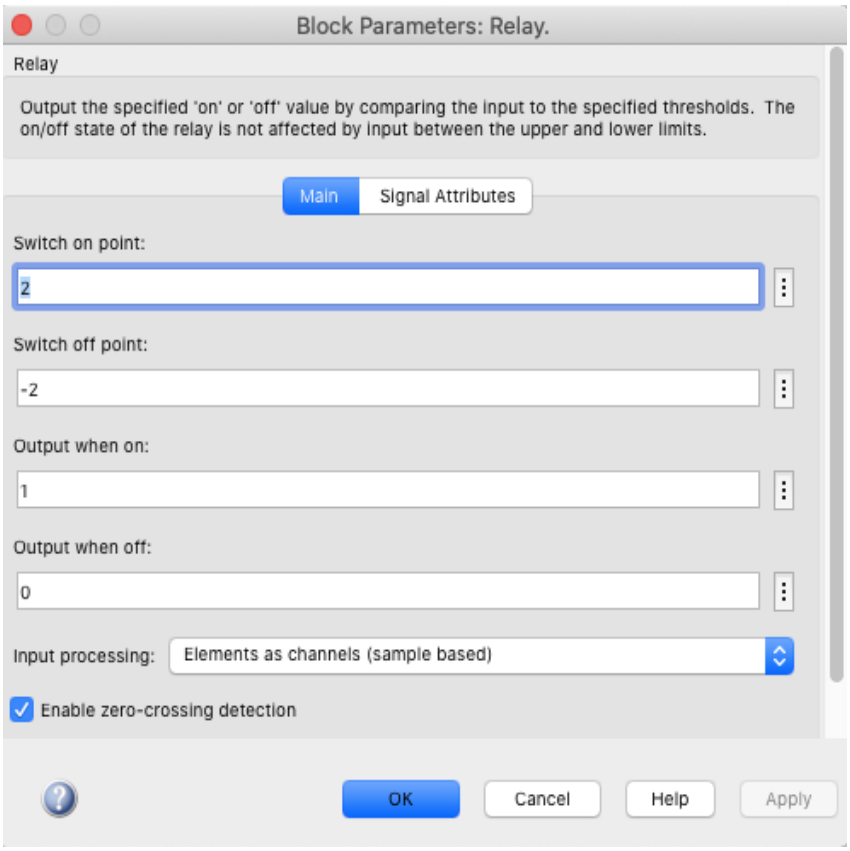
DC Machine Block Parameters



- The different motor variables are imported from the work-space. I have selected the DC Machine blocks as it allows user to feeding the value as he/she defined or also provides the different power standardized motor models. Here I have inputted the data for motor manually from the internet sources and by doing some research.

Limiting the Current as per Rated Current of Motor

- It is important to restrict the current value for required torque and desired speed from user less than rated current rating of 50 hp DC motor.
- So, in order to have done it, ‘Relay switch block’ is

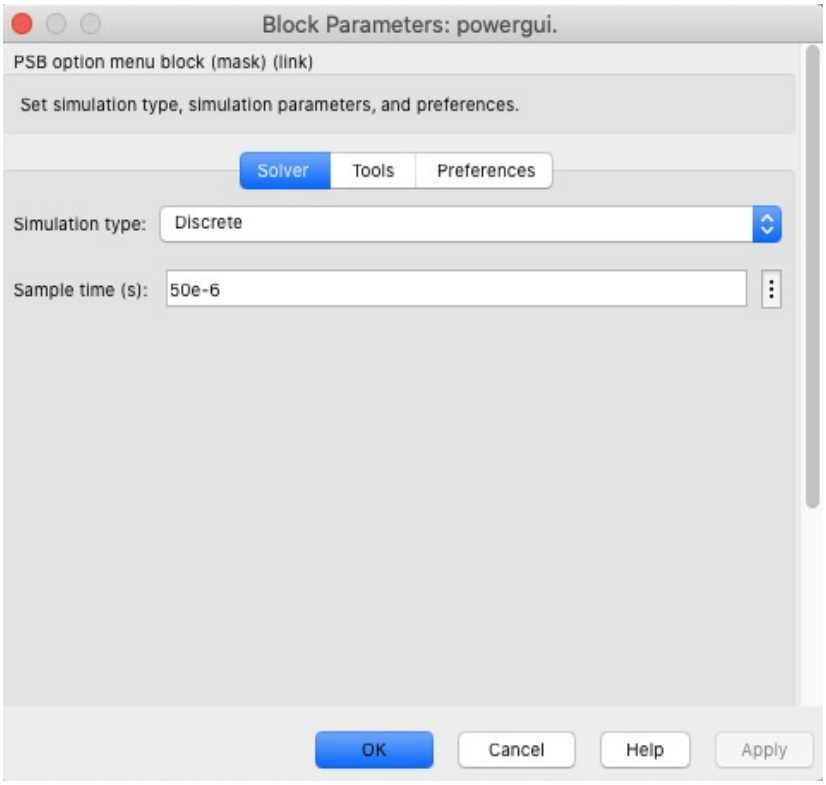


used to attach in model between armature current which is output of motor and input to motor connection.
Here, as you can see the in parameters settings values between 2 to -2

switch on point and switch off points are set. For higher values of current it is necessary to set the value always >= 2. Values below 2 are not compatible to run the model.

other Electrical Blocks Setup

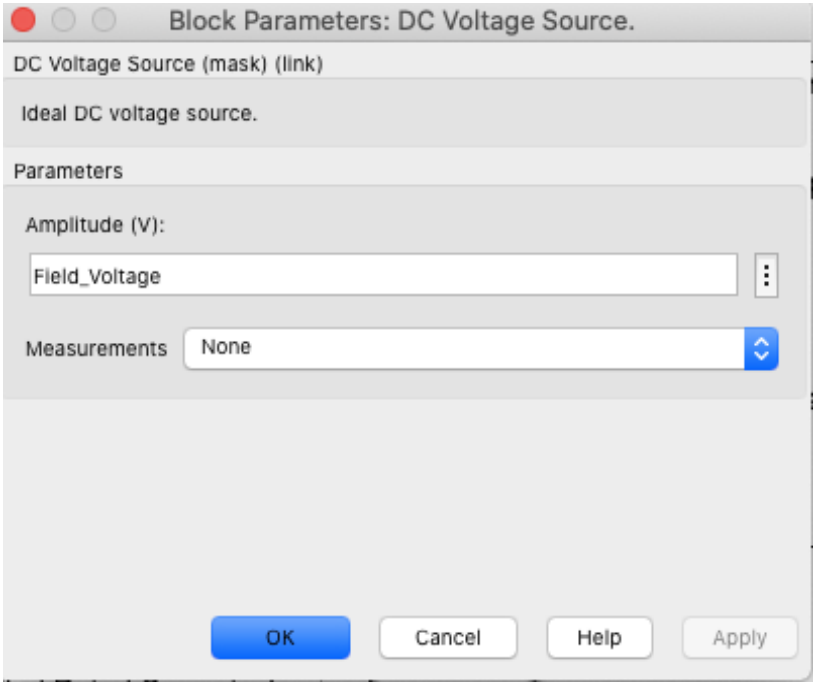
a.) Powergui Block



The 'powergui block' is must when one is dealing with electrical component blocks like here I used 'DC Machine block', 'Controlled voltage source'. So, without this block one can not run the model.

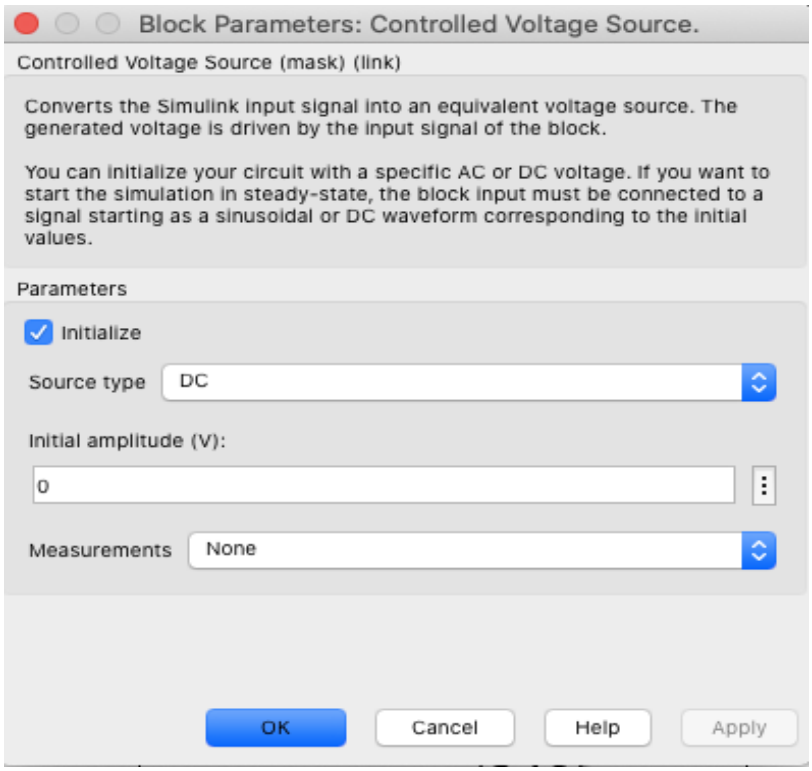
I kept the simulation type to be discrete.

b.) DC Voltage Source Block



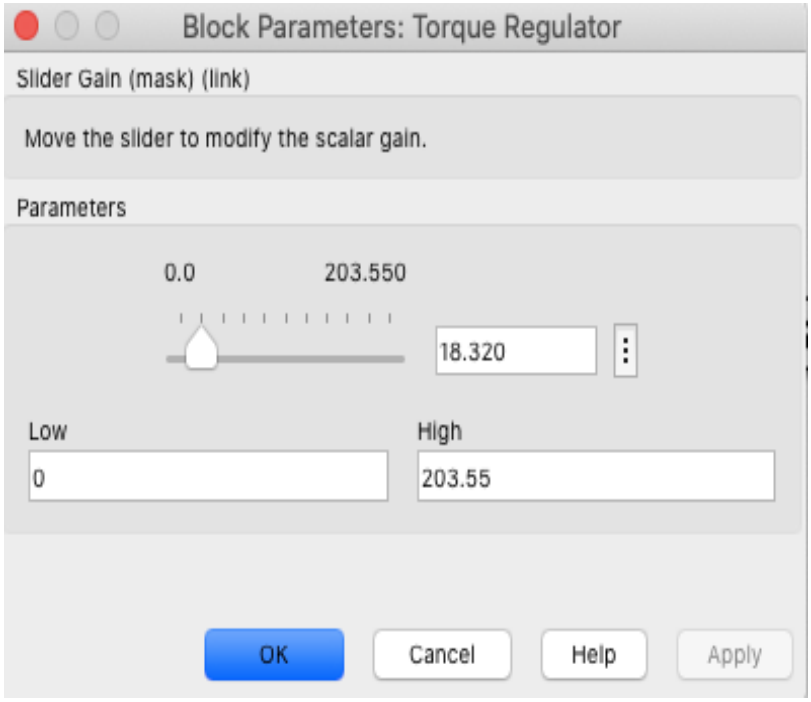
This block is used to provide the field voltage in the DC motor.

c.) Controlled Voltage Source Block



This electrical block is used to provide the main voltage supply input to DC motor. This block has ability to delivered the volatage within its control range. Source-type has to be DC as it is connected to DC motor.

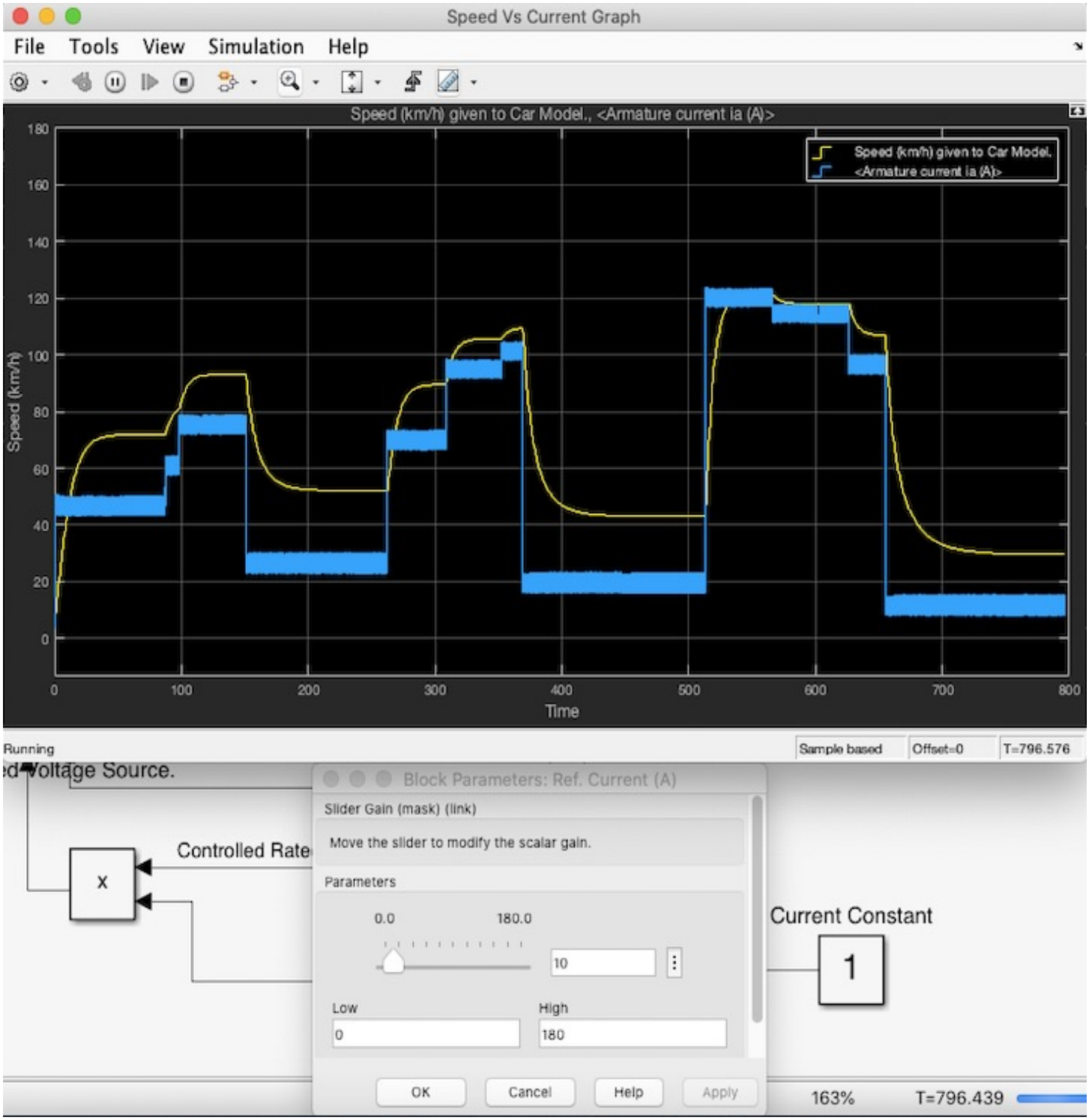
d.) Slider Gain Block



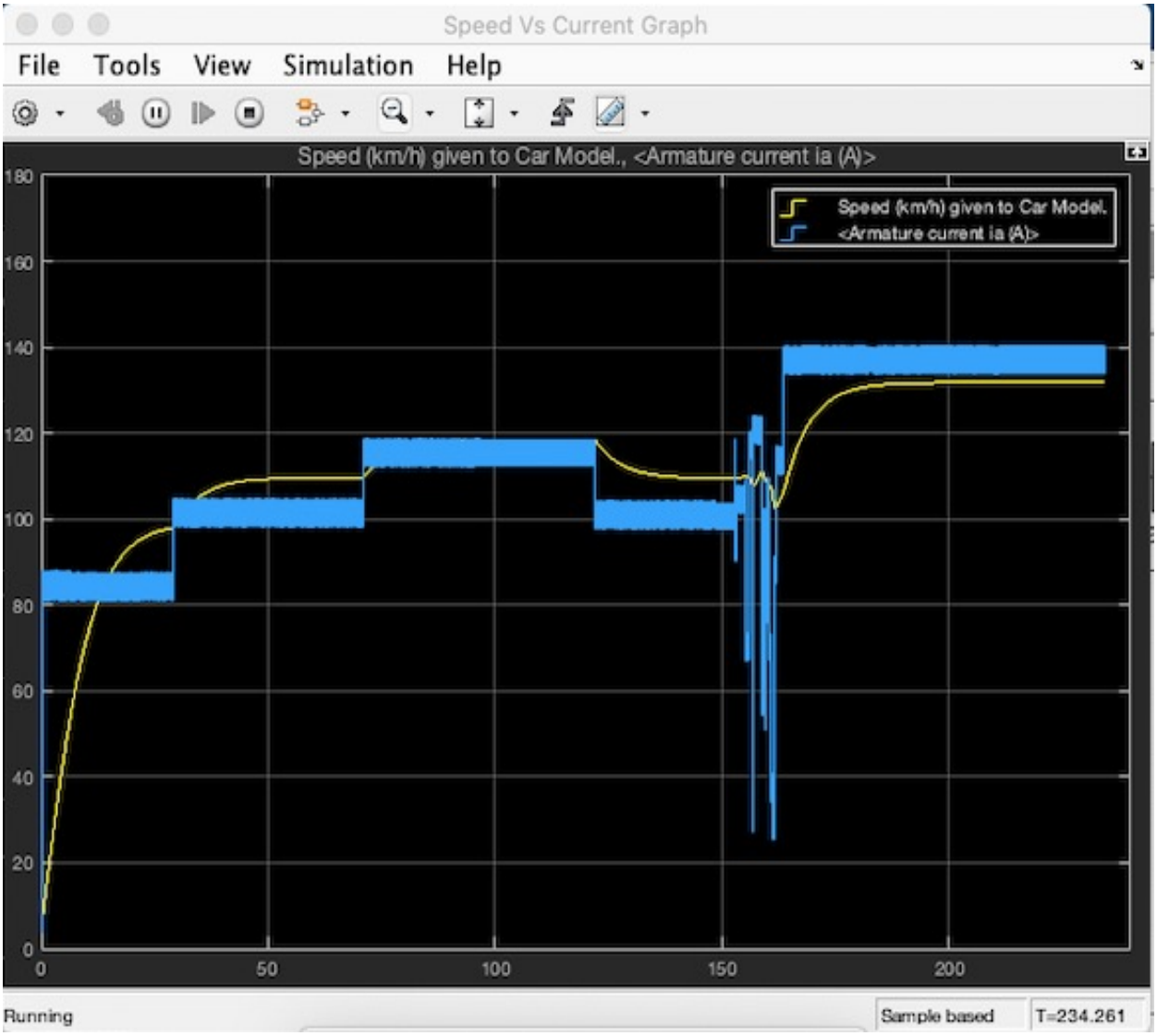
Toruqe regulator has been made with the help of slider gain. For creating the slider gain one hase to previously connect to ‘constant block’ with constant value 1. It provides to set the thresholds with high and low.

Special feature about this block is it allows user to change the value even during the simulation process in software. So it is better to set the simulation time infinite ‘inf’.

Results:



This picture shows the slider gain and scope block, I have continously change the value over the simulation time with slider gain and get the results from the scope block.



- As you can observe that yellow line represents the vehicle speed and blue thick line stands for the armature current of motor. The total simulation time for this case is 240 seconds. The values of current had been changed many times over the simulation process time.
- As I changed the values of current ranges between 0 to 182.7 A with the help of slider gain correspondingly the vehicle speed has also changed.
- Motor current is directly proportional to motor torque and so vehicle speed.