

**T. Y. B. Tech (Electrical and Computer Engineering)**

**Trimester: V**

**Subject: Electric vehicle technology**

**Name: Mukund Narsaria**

**Class: TY BTECH EL&CE**

**Roll No: 37**

**Batch: A2**

**Experiment No: 01**

**Name of the Experiment:** Introduction to Simscape and Powertrain block set for EV simulation

**Performed on**

**Marks**

**Teacher's Signature with date**

**Submitted on**

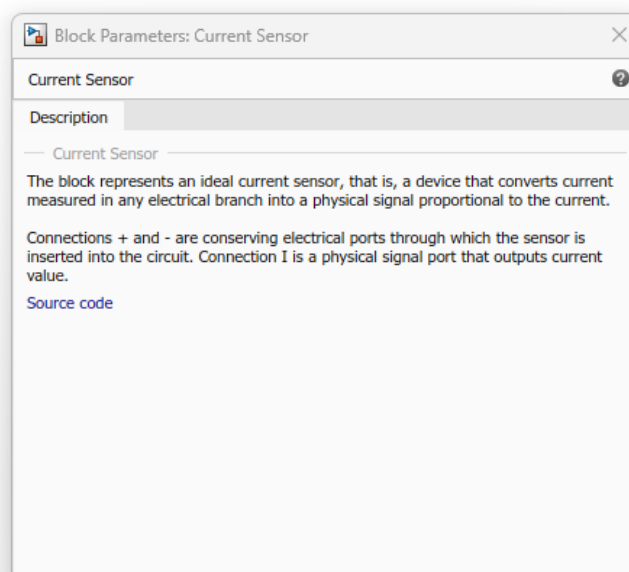
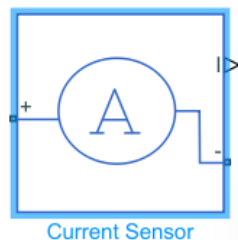
**Aim:** To understand the building blocks of Simscape and Powertrain block set

**Resources:** Matlab 2022, Simscape toolbox, powertrain toolbox

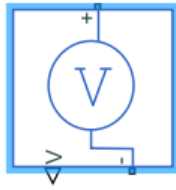
**Theory:**

Simscape is a tool in MATLAB/Simulink for modelling and simulating complex physical systems across multiple domains like electrical, mechanical, and hydraulic. It offers pre-built component libraries, custom component creation, seamless integration with Simulink, parameterization, model reusability, and real-time simulation capabilities. It's widely used in industries such as automotive, aerospace, and robotics for system-level simulation and analysis.

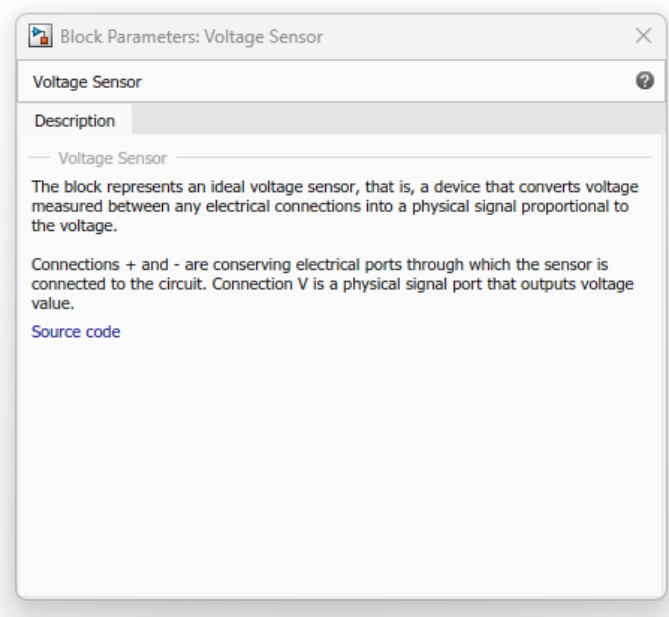
1. What are the various building blocks that are present in Simscape for the EV simulation?
  - Current Sensor



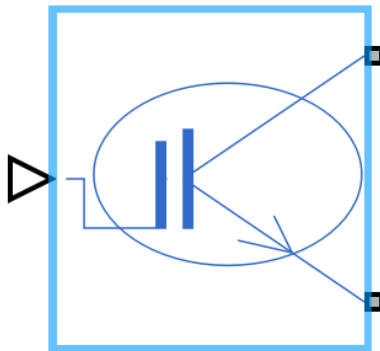
- Voltage Sensor



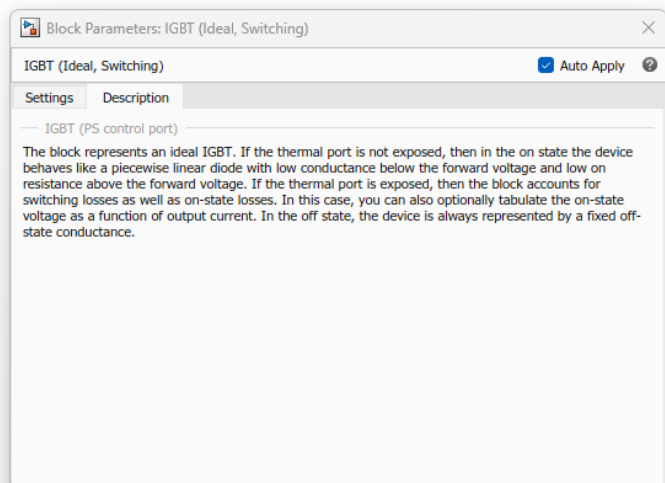
Voltage Sensor



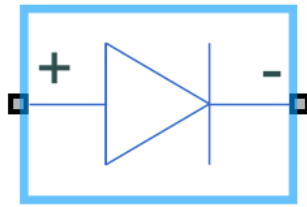
- IGBT



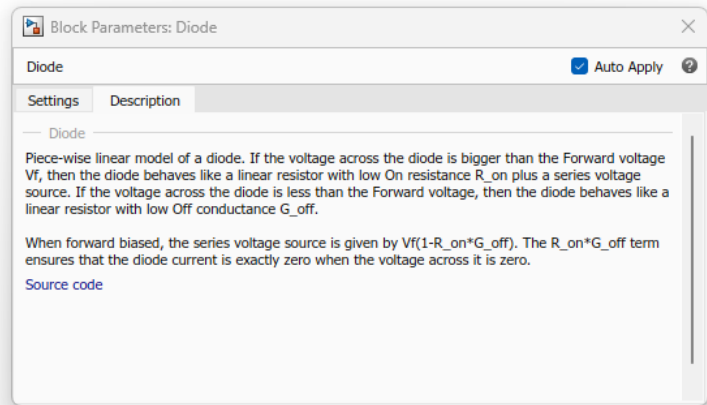
IGBT  
(Ideal,  
Switching)



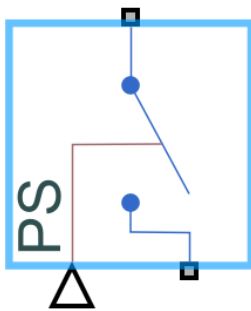
- Diode



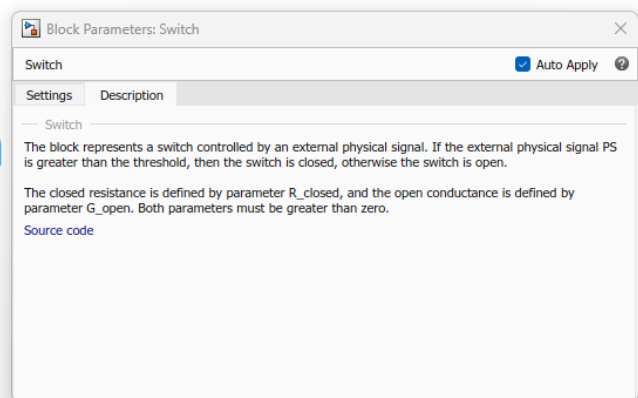
Diode



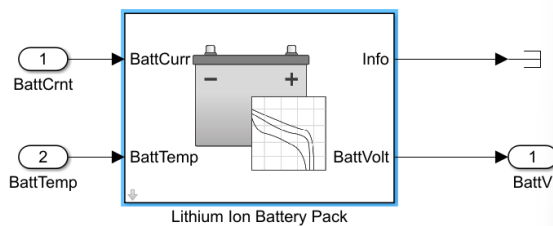
- Switch



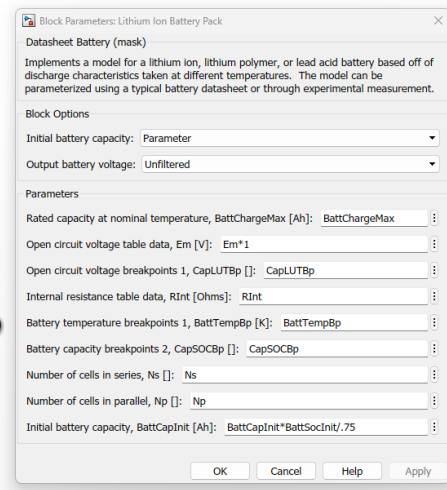
Switch



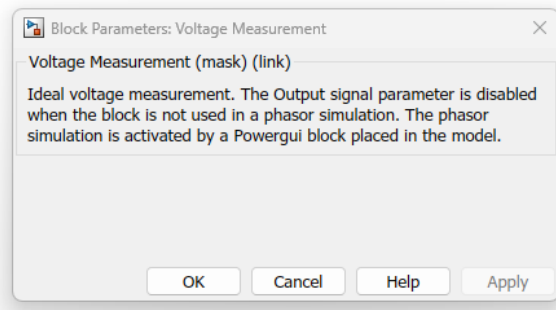
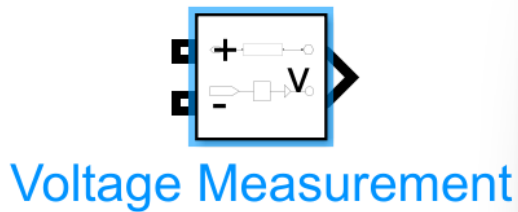
- Battery



Copyright 2015-2021 The MathWorks, Inc.

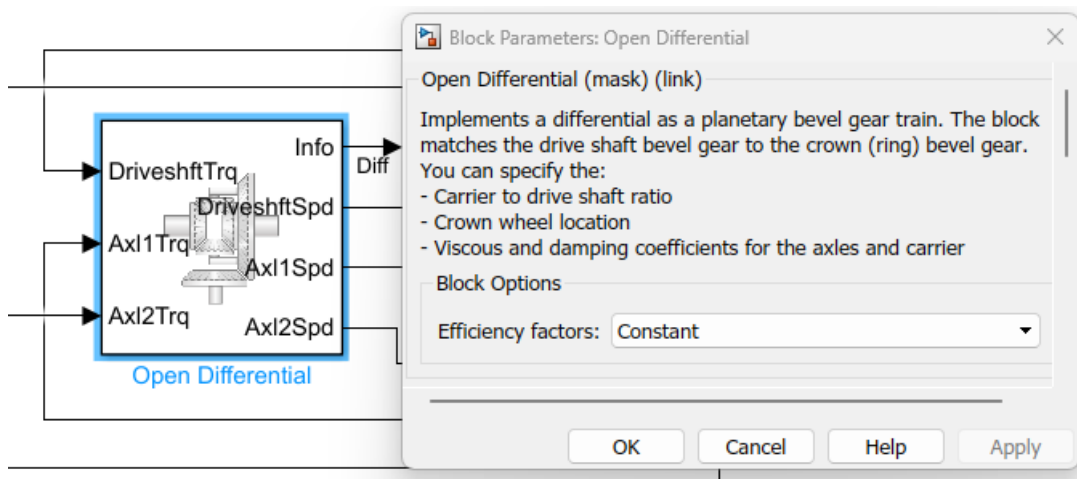


- Voltage Measurement

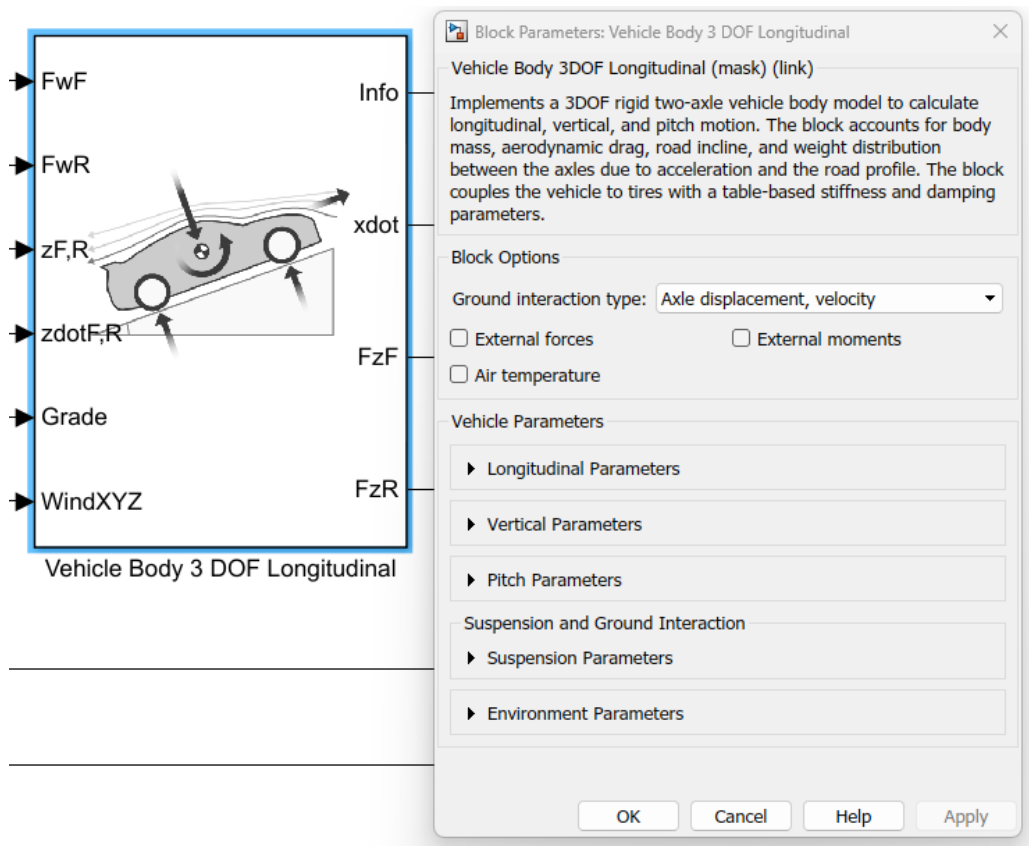


2. What are the various building blocks present in the power train block set for the EV simulation?

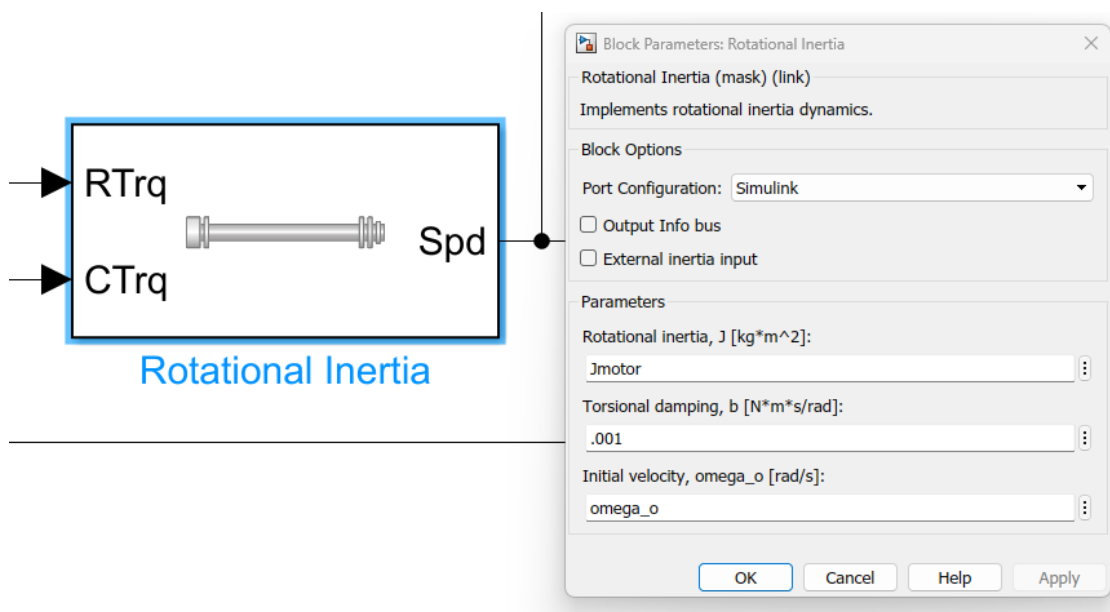
- Open differential



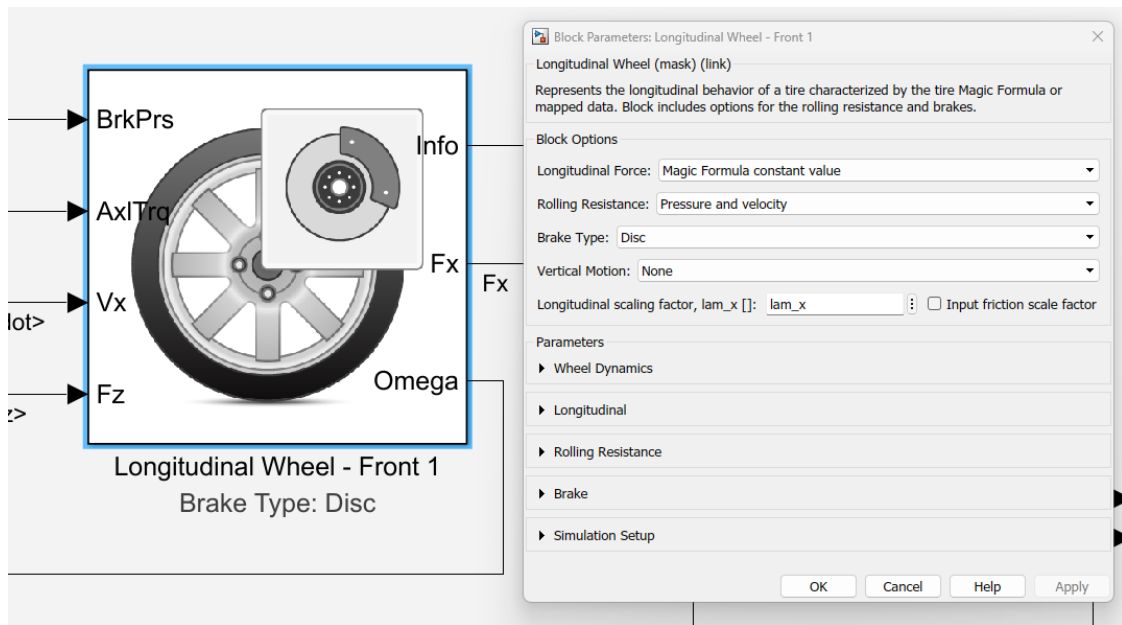
- Vehicle Body 3 DOF Longitudinal



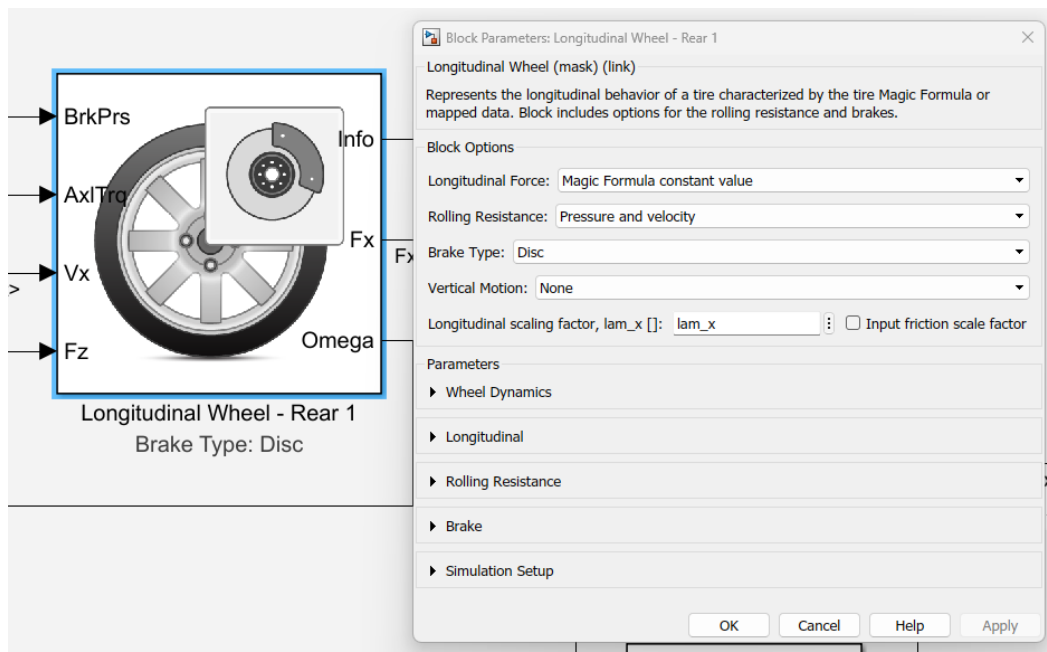
- Rotational Inertia



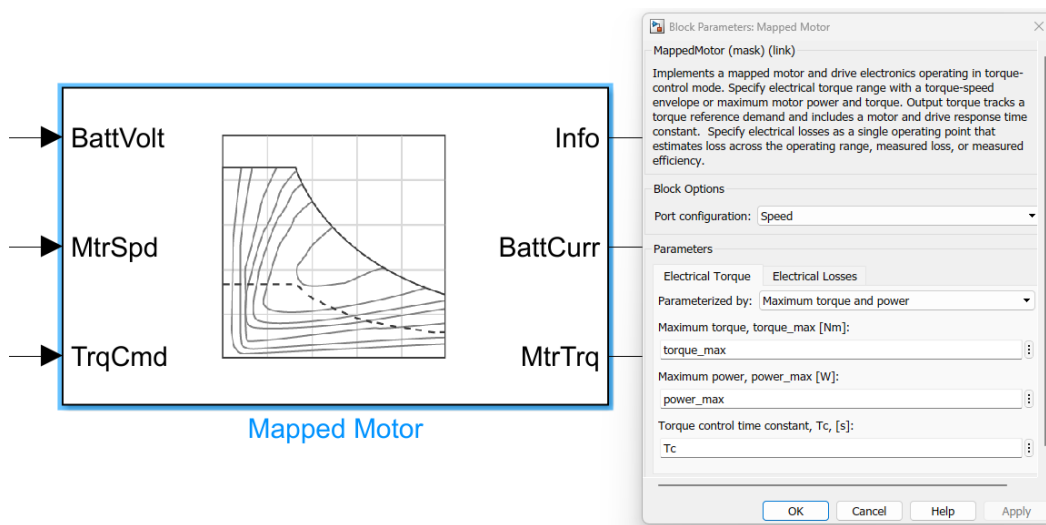
- Longitudinal wheel – front



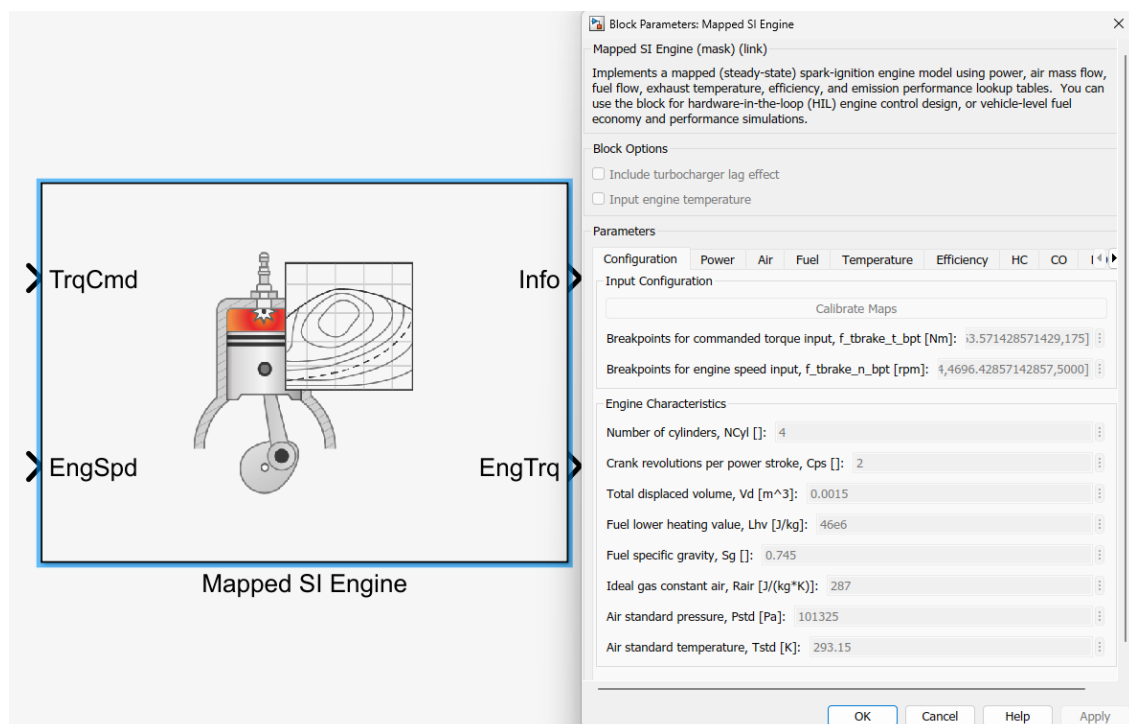
- Longitudinal wheel – Rear



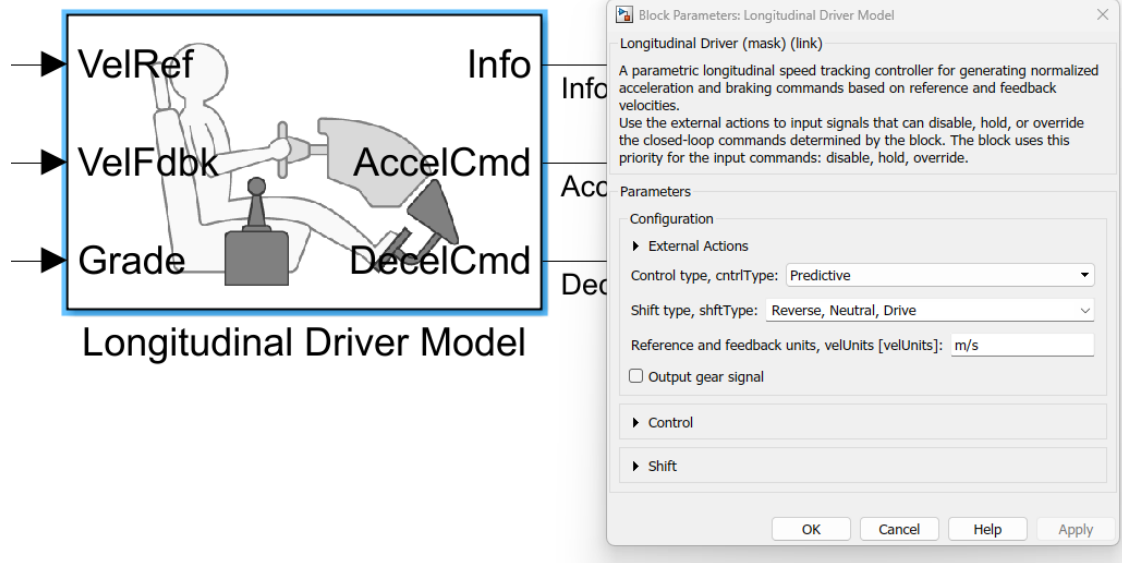
- Mapped Motor



- Mapped SI Engine

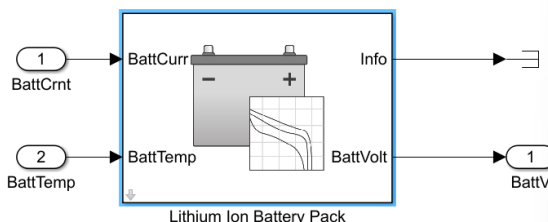


- Longitudinal Driver



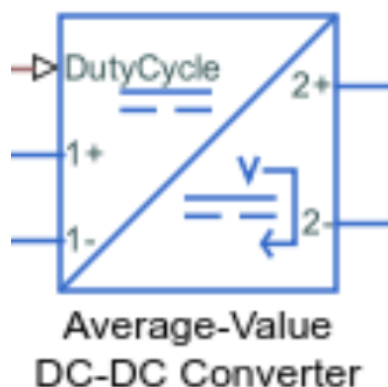
- What are the various block sets that are present in Simscape or power train for battery modelling, electric drive building and simulation of power converters?

- Battery pack



Copyright 2015-2021 The MathWorks, Inc.

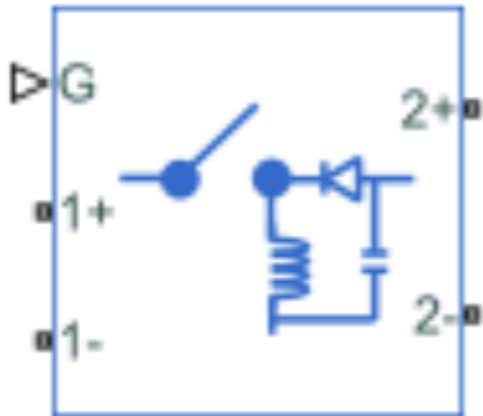
- DC-DC converters



The DC-DC Converter block represents a behavioural model of a power converter. This power converter regulates voltage on the load side. To balance input power, output power, and losses, the required amount of power is drawn from the supply side. Alternatively, the converter can support regenerative power flow from load to supply.

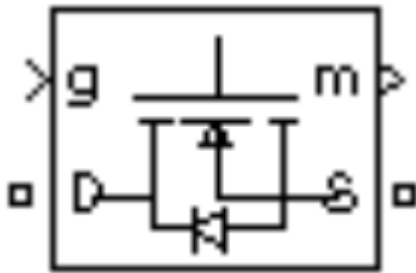


- Buck-boost converter



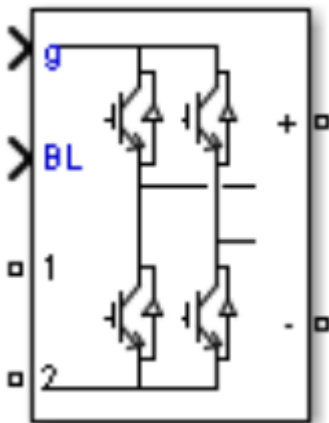
The Buck-Boost Converter block represents a DC-DC converter that can either step up or step down DC voltage from one side of the converter to the other as driven by an attached controller and gate-signal generator. Buck-boost converters are also known as step-up/step-down voltage regulators because they can increase or decrease voltage magnitude.

- MOSFET



The metal-oxide semiconductor field-effect transistor (MOSFET) is a semiconductor device controllable by the gate signal ( $g > 0$ ). The MOSFET device is connected in parallel with an internal diode that turns on when the MOSFET device is reverse biased ( $V_{ds} < 0$ ) and no gate signal is applied ( $g=0$ ). The model is simulated by an ideal switch controlled by a logical signal ( $g > 0$  or  $g=0$ ), with a diode connected in parallel.

- Full Bridge power converter



The metal-oxide semiconductor field-effect transistor (MOSFET) is a semiconductor device controllable by the gate signal ( $g > 0$ ). The MOSFET device is connected in parallel with an internal diode that turns on when the MOSFET device is reverse biased ( $V_{ds} < 0$ ) and no gate signal is applied ( $g=0$ ). The model is simulated by an ideal switch controlled by a logical signal ( $g > 0$  or  $g=0$ ), with a diode connected in parallel.

**Procedure:**

1. Open MATLAB
2. Design the electrical component of the EV using the Simscape and the power train block set available in MATLAB
3. Double-click the block icon to add the block to the simulation
4. Double-click the block to see the description of the block and set the parameters
5. Set the parameters to the required values and apply
6. Start the simulation

**Conclusion:**

Understood the reason for using various blocks in building an EV simulation. Learned which building blocks belong to Simscape and power train block set.