Simulink Powertrain Blockset Model

Progress and Documentation

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For detailed references and help, click the **help** button located at the bottom right of each parameter window in Simulink

This progress and documentation guide is generally organized as follows: a general description of the overarching system; a general description of any subsystems; a list of parameters grouped by tab and their status for subsystem blocks. Each subsection contains an appendix with relevant data, figures, and sources (collectively “resources”) used for parameterization so as to develop a robust, traceable, and replicable model. Each resource is labeled as A# and corresponds only to the relevant system the appendix is located in.

1. **Electric Plant**

The electric plant portion of the model includes the **battery** and the **motor**.

**Battery (Datasheet battery)**

The battery model is implemented base off discharge characteristics at different temperatures. It is most likely that the battery parameters are for a single cell. To generate parameter data: [Generate Parameter Data for Datasheet Battery Block](https://www.mathworks.com/help/autoblks/ug/generate-parameter-data-for-datasheet-battery-block.html)

Percentage Parameterized: 0%

Parameters

1. Rated capacity at nominal temperature, BattChargeMax [Ah]: Not parameterized
2. Open circuit voltage table data, Em [V]: A 1-D lookup table of voltages at specific discharge capacity breakpoints plotted against iii (see below); Not parameterized
3. Open circuit voltage breakpoints 1, CapLUTBp: Discharge capacity breakpoints used to plot ii; Not parameterized
4. Internal Resistance table data, RInt [Ohms]: A 2-D lookup table of internal resistance at specific temperatures (v) and states of charge (vi); Not parameterized
5. Battery temperature breakpoints 1, BattTempBp: Battery temperature breakpoints used to plot iv; Not parameterized
6. Battery capacity breakpoints 2, CapSOCBp: battery capacity breakpoints used to plot iv; Not parameterized
7. Number of cells in series, Ns: Not parameterized
8. Number of cells in parallel: Not parameterized
9. Initial battery capacity, BattCapInit [Ah]: Not parameterized

**Motor**

There are two variants of the motor: **MotGenEvMapped**, a representation of the motor as a map between maximum torque (Nm) and maximum power (W), and **MotGenEvDynamic**, a mathematical model of the **motor controller**, **inverter**, and **motor**. The current model uses **MotGenEvDynamic**.

Percentage parameterized: 80%

**Interior PM Controller**

A representation of a motor controller for an interior permanent magnet motor.

Motor Parameters

Parameters

1. Stator resistance, Rs [Ohm]: Parameterized, A1
2. D-axis inductance, Ld [H]: Parameterized, A1
3. Q-axis inductance, Lq [H]: Parameterized, A1
4. Permanent magnet flux, lambda\_pm [Wb]: Parameterized, A1
5. Number of pole pairs, PolePairs: Parameterized, A1

Id and Iq Calculation

The Id and Iq Calculation involves a set of derived parameters calculated by pressing the “Calculate MPTA Table Data” button. Only the first two parameters are actually entered by hand.

Parameters

1. Maximum torque, T\_max [N.m]: the maximum torque of the motor, currently set at 100 as a rough average of peak and continuous torque; Parameterized, A1
2. MTPA table breakpoints: the number of breakpoints to use in the derived parameters; Parameterized

Current Controller

Correct information could not be found for any of the parameters in this section.

Parmameters

1. Bandwidth of the current regulator, EV\_current [Hz]: Not parameterized
2. Sample time for the torque control, Tst [s]: Not parameterized

Electrical Losses

Parameters

1. Parameterize losses by: Parameterized
2. Vector of speeds (w) for tabulated efficiency, w\_eff\_bp [rad/s]: Parameterized
3. Vector of torques (T) for tabulated efficiency, T\_eff\_bp [Nm]: Parameterized
4. Corresponding efficiency, efficiency\_table [%]: roughly parameterized by visually inspecting the efficiency map found in A1. Roughly parameterized, A1

**Motor Appendix**

A1. [EMRAX 208 Techincal Data Table](https://emrax.com/wp-content/uploads/2020/03/emrax_208_technical_data_table_graphs_5.4.pdf); high voltage column