

PLECS

DEMO MODEL

Power Split Hybrid Vehicle System

Last updated in PLECS 4.4.2

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1 Overview

This demonstration shows a Lithium-ion (Li-ion), battery-powered, series-parallel hybrid vehicle system. The simulation shows the startup for an electrically and mechanically coupled hybrid system.

Note

This model contains model initialization commands that are accessible from:

PLECS Standalone: the menu **Simulation > Simulation Parameters... > Initializations**

PLECS Blockset: right click in the **Simulink model window > Model Properties > Callbacks > InitFcn***

2 Model

2.1 Power Circuit

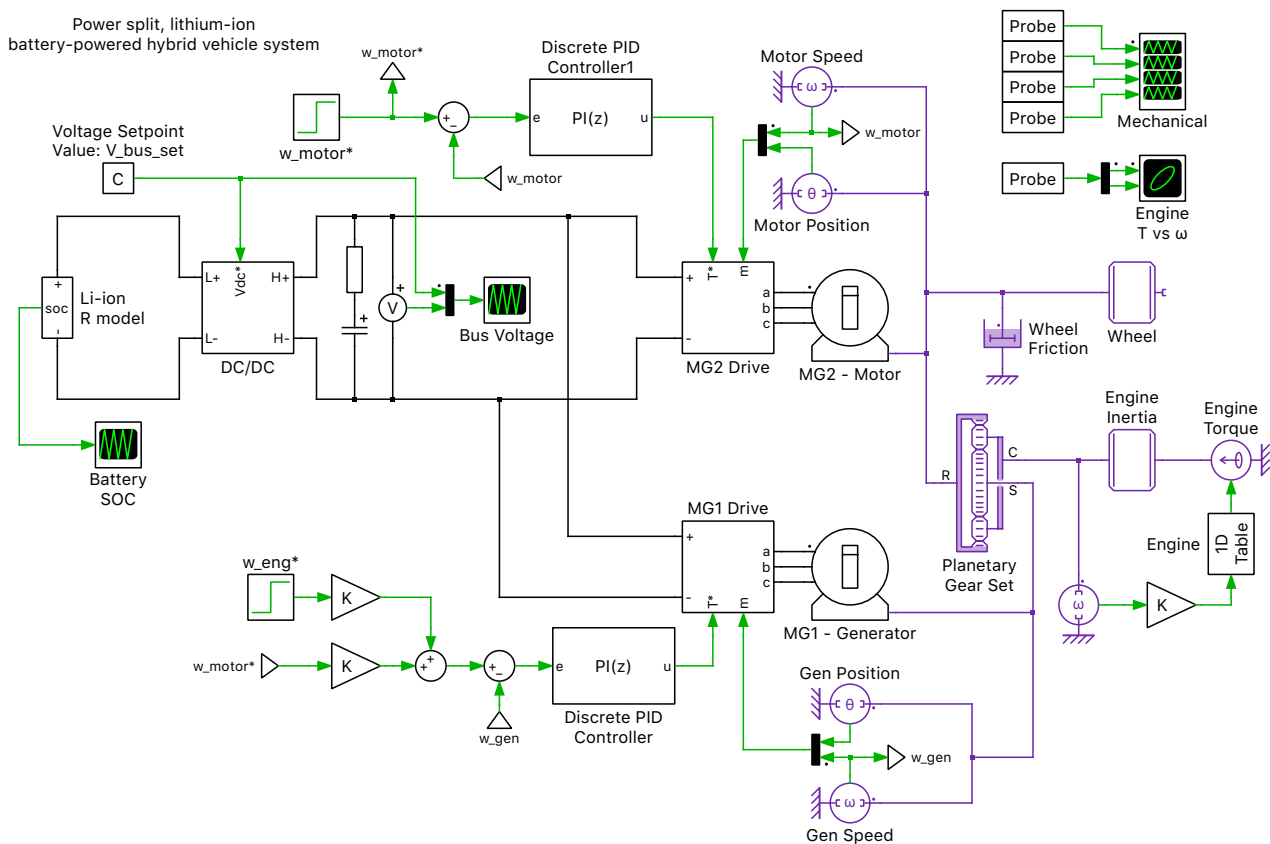


Fig. 1: Overall system model

DC/DC converter

The electrical system of the series-parallel hybrid vehicle consists of a bi-directional DC/DC converter connecting the Li-ion battery to the DC-bus. The DC/DC converter and controls are identical to the system as described in the demo model "Boosted Motor Drive".

The DC/DC converter is controlled to maintain the DC-bus voltage at 500 V using the battery.

provide the driving torque for the wheel, while MG1 is controlled to maintain the engine speed at the desired level.

A 1D look-up table is used to represent an engine operated to minimize the brake specific fuel consumption (BSFC). The data for the engine was obtained from Fig. 14 in [2].

3 Simulation

In this simulation, MG2 is used to accelerate the wheel from rest to a desired speed. MG1 is controlled to accelerate the engine speed at initially to about 125 rad/s (1200 rpm). At 70 ms, the desired engine speed is increased to about 188 rad/s (1800 rpm) while maintaining the same wheel speed. At 120 ms, the desired wheel speed is increased while the engine is maintained at 1800 rpm.

The motor torque along with speeds for MG1, MG2, and the engine are shown in Fig. 4.

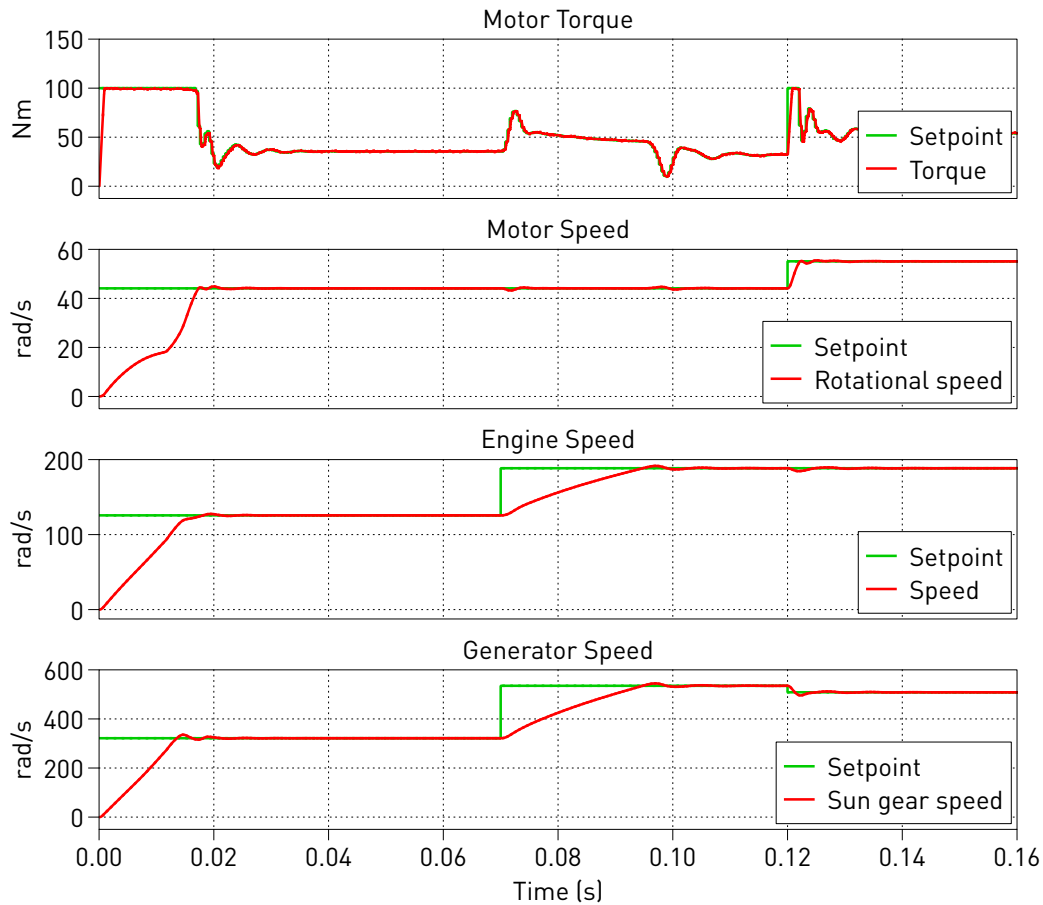


Fig. 4: Mechanical waveforms

Energy is drawn and stored in the battery to maintain the DC-bus voltage at the desired 500 V. The DC bus voltage is seen in Fig. 5.

The Torque-Speed operating point of the engine is shown in Fig. 6. This represents the operation of the engine to minimize the BSFC in this simulation. As can be seen, the engine is not engaged below 850 rpm.

4 Bibliography

- [1] Tremblay, O., Dessaint, L.-A. "Experimental Validation of a Battery Dynamic Model for EV Applications." World Electric Vehicle Journal. Vol. 3 - ISSN 2032-6653 - Copyright 2009 AVERE, EVS24

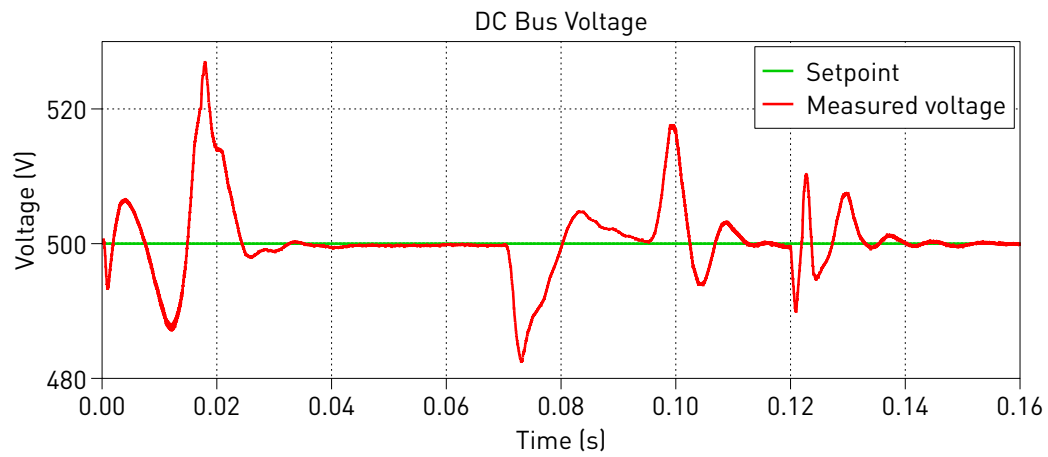


Fig. 5: DC voltage

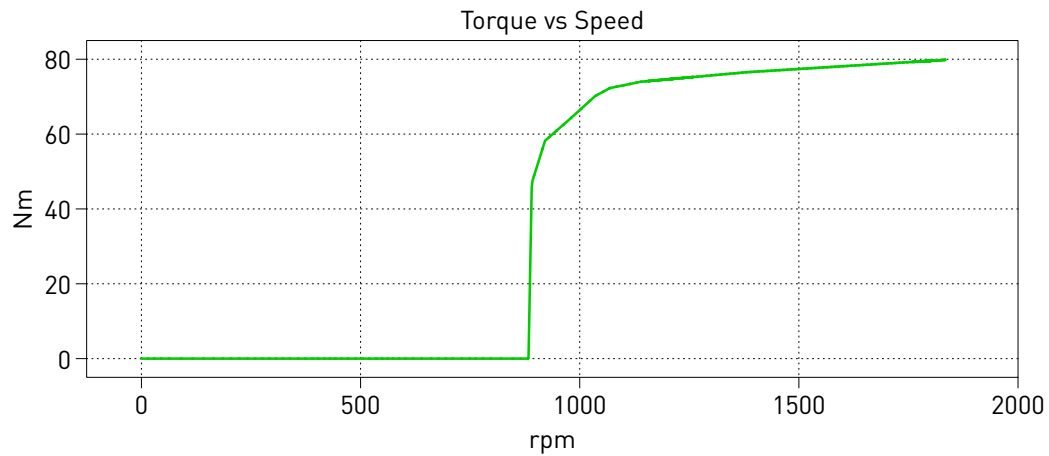


Fig. 6: Torque-speed curve

Stavanger, Norway, May 13-16, 2009.

- [2] Liu, J., Peng, H. "Modeling and Control of a Power-Split Hybrid Vehicle," in Control Systems Technology, IEEE Transactions on , vol.16, no.6, pp.1242-1251, Nov. 2008

Revision History:

PLECS 4.3.1	First release
PLECS 4.4.2	Update PI controller component

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PLECS Demo Model

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