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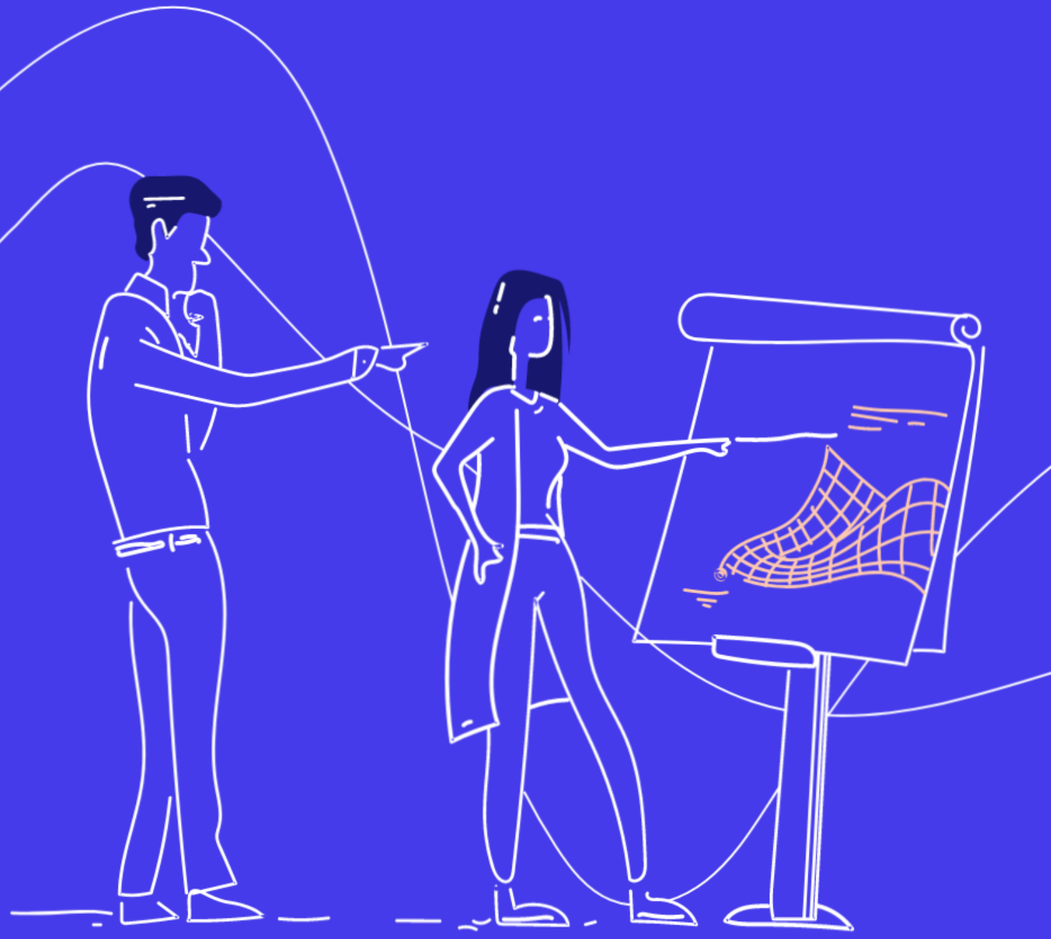
Battery Modeling and Algorithm Development with Simulink



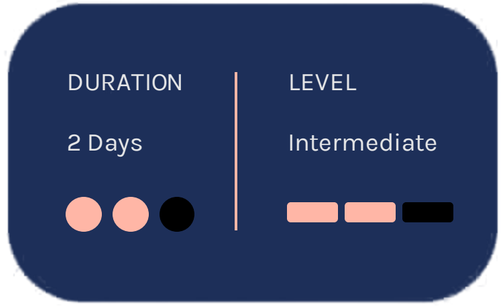
SciEngineer's training courses are designed to help organizations and individuals close skills gaps, keep up-to-date with the industry-accepted best practices and achieve the greatest value from MathWorks® and COMSOL® Products.

Battery Modeling and Algorithm Development with Simulink

This two-day course focuses on modeling battery packs using Simscape™ and designing key control functionalities of battery management system using Stateflow®.

Prerequisites

Fundamental knowledge of Simulink, Stateflow and Simscape.



TOPICS

Day 1

- Getting Started with a Battery Cell
- Cell Characterization
- Battery Pack Modeling

Day 2

- Battery Management System
- State of Charge Estimation
- Fault Monitoring and Current Limit Computation
- Appendix A: Kalman Filter and Extended Kalman Filter

Getting Started with a Battery Cell

OBJECTIVE: Define terms used in a battery component. Construct a charging circuit to simulate the CC-CV charging of the cell.

- Define battery terms (cell capacity, C-rate, open circuit voltage)
- Model battery characteristics using the Battery(table-based) block
- Construct charge and discharge circuit with Simscape™

Cell Characterization

OBJECTIVE: Analyze the equivalent circuit model of a cell. Perform characterization of a given cell.

- Equivalent circuit model of a Battery block
- Overview of parameter estimation
- Perform cell characterization

Battery Pack Modeling

OBJECTIVE: Connect characterized cells in series configuration to create battery packs. Create thermal environment to perform multi-domain system level simulation.

- Create battery modules
- Model cell degradation and cell inconsistencies
- Model cell thermal effects using Simscape™
- Add thermal fidelity to the battery module

Battery Management System

OBJECTIVE: Introduction to battery management system. Develop supervisory control scheme for efficient and safe battery pack operation.

- Overview of a battery management system
- Design requirements and constraints
- Design Stateflow® logic to charge a cell using CC-CV control scheme
- Design supervisory control logic of battery management system using Stateflow®
- Implement a passive cell balancing network using Simscape™ and Stateflow®
- Create test scenarios for battery management system using Simulink Test™

State of Charge Estimation

OBJECTIVE: Estimate state of charge (SoC) of a cell. Balance charge levels using a passive cell balancing scheme.

- Estimate the cell's state of charge using coulomb counting
- Estimate the cell's state of charge using extended Kalman Filter

Fault Monitoring and Current Limit Computation

OBJECTIVE: Compute battery pack's charging and discharging current limits that satisfy design constraints and detect faults during pack operation.

- Detect over-voltage/over-current, short circuit, under-voltage/under-current faults during battery operation
- Compute current limits for host application
- Closed-loop simulation of battery pack with battery management system

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