BATTERY MANAGEMENT SYSTEM MASTERCLASS

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The Complete Battery Management System program that can start even without no prior knowledge.

The program provides a step-by-step learning experience, guiding participants from basic battery module simulations to advanced BMS algorithms and deployment.

Participants gain practical skills by actively creating simulations and designs using MATLAB and Simscape, fostering a deep understanding of battery systems and BMS.

Key Description:

The Battery Management System (BMS) is crucial for ensuring optimal performance, safety, and longevity of battery packs by monitoring and managing parameters like voltage, current, temperature, and state of charge. Beginning with a Basic Battery Module Simulation in MATLAB and Simscape, the process expands into an Elementary Battery Pack Simulation, then further into a Battery Pack Model for Grid-Connected Energy Systems and a Simulation Model for a Hybrid Cell Battery Pack.

Basic Battery Module Simulation:

Initiating the learning process, this module involves creating a virtual representation of a single battery module in MATLAB and Simscape. The simulation allows for analysis and testing, providing insights into the module's behaviour under diverse conditions.

Elementary Battery Pack Simulation:

Building upon the basic module, this module combines multiple modules to form a battery pack. It considers the interaction between individual modules, ensuring a comprehensive understanding of the pack's performance.

Battery Pack Model for Grid-Connected Energy Systems:

This module explores the behaviour of batteries when connected to the grid, introducing real-world scenarios and considering charging, discharging, and grid interactions. It also delves into compatibility with diverse cell types within a battery pack, analysing the performance of hybrid configurations.

Battery Monitoring System & Charging and Discharging using Simulink/ Simscape:

Learn real-time monitoring algorithms for key parameters like voltage, current, and temperature, ensuring the safety and efficiency of the battery. It also involves creating control strategies for the charging and discharging processes, including the design of a simple circuit model to simulate electrical behaviour.

Passive and Active Cell Balancing:

Addressing cell balancing through passive (resistors) and active (circuitry) methods, this module ensures the equalization of cell states within the pack. It utilizes Coulomb Counting, Kalman Filter, and Unscented Kalman Filter/EKF methods for accurate state of charge estimation, providing crucial insights into energy levels.

Algorithms to Control Battery Temperature:

This module involves developing algorithms to assess the battery's health over time, considering degradation factors and deriving health metrics from the simulation. It integrates control strategies to activate heaters or coolants based on temperature monitoring, optimizing performance and lifespan.

Thermal Analysis for New and Aged Battery Packs:

Studying the thermal behaviour of newly manufactured and aged battery packs, this module considers factors like heat dissipation and thermal resistance.

Battery Controller in MATLAB/Simulink:

Designing a control system managing various aspects of battery operation, including charging, discharging, balancing, and temperature control.

Equivalent Circuit Designs, BMS Software Testing, Communication Protocols:

Covers the design of equivalent circuits, testing BMS software, and understanding communication protocols like CAN bus, LIN bus, and UART.

Data Exchange and Closed-Loop Testing:

Explores mechanisms for data exchange and conducts closed-loop testing to evaluate BMS performance in real-world conditions.

Code Generation and Deployment:

Guiding through generating code for a BMS and deploying algorithms on specific hardware, such as the NXPS32K microcontroller, ensuring practical implementation.

30 Days Agenda of Battery Management Systems

Day 1: Creating Basic Battery Module Simulation in MATLAB and Sims cape.

Day2: Constructing Elementary Battery Pack Simulation in MATLAB and Simscape

Day3: Designing Battery Module Model Considering Thermal Influences.

Day4: Developing Battery Pack Model Incorporating Cell Aging

Day5: Constructing Battery Pack Model with Integrated Cell Balancing Circuitry.

Day6: Creating Battery Pack Model for Grid-Connected Energy Systems.

Day7: Designing Simulation Model for Hybrid Cell Battery Pack

Day8: Develop a battery monitoring using Simulink/Simscape.

Day9: Developing a battery charging and discharging using Simulink (simple circuit design) and Simscape.

Day10: Design a battery using passive cell balancing

Day11: Design a battery using active cell balancing.

Day12: Battery state of charge estimation using coloumb counting method in Simulink/Sims cape.

Day13: Battery state of charge estimation using Kalman filter method in Simulink/Simscape.

Day14: Battery state of charge estimation using unscented Kalman filter /EKF method using Simulink/simscape.

Day15: Battery state of health estimation using Simulink/Sims cape.

Day16: Develop algorithms to control the temperature of the battery by activating heaters or coolants.

Day17: Design a Thermal analysis for New and aged battery packs.

Day18: Design a battery controller in MATLAB/ Simulink.

Day19: Design a lithium battery cell 2 RC branch equivalent circuit in MATLAB /Simulink.

Day20: Battery charging and discharging using MATLAB/Simulink.

Day21: Design a Lithium 1RC equivalent circuit using MATLAB Simulink

Day22: Design lithium 1Rc equivalent circuit for estimation (different soc methods)

Day23: Introduction to testing BMS software.

Day24: Communication Protocols CAN bus, LIN bus, UART, etc.

Day25: Data exchange between BMS and other vehicle components.

Day26: Testing for a battery management system MATLAB/Simulink

Day27: Generating code for a battery management system using MATLAB/Simulink

Day28: Design a Closed loop testing of BMS using MATLAB/Simulink

Day29: Managing requiring for BMS in MATLAB/Simulink

Day30: Deploying BMS algorithms on NXPS32K

Tools Covered

- MATLAB
- Simulink