Optimized Sensitivity-Based Current Profiles for Battery Parameter Identification

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ABSTRACT

Researchers at the University of California, Davis have developed a method to design optimized current profiles for lithium-ion batteries using analytic sensitivity functions. By leveraging a reduced electrochemical model, the approach enables fast and accurate identification of key parameters, improving battery management systems and reducing testing time.

FULL DESCRIPTION

Accurate estimation of battery parameters such as diffusion coefficient and active material fraction is critical for performance and safety. Traditional methods rely on generic test cycles that often lack sensitivity, resulting in slow and uncertain identification. This invention uses analytic sensitivity functions derived from a single-particle model to optimize current profiles, ensuring voltage data is highly informative about target parameters.

The optimized profiles reduce computation time and improve accuracy, supporting better state-of-charge and health estimation in battery management systems. This translates into faster development cycles, improved reliability, and reduced operational risks for electric vehicles, energy storage systems, and other battery-powered applications.

APPLICATIONS

- Battery R&D and characterization for new chemistries.
- Quality control in cell and pack manufacturing.
- Calibration of battery management systems (BMS).
- Diagnostics for warranty and field service.
- Energy storage system performance optimization.
- Electric vehicle battery testing and validation.

FEATURES/BENEFITS

- Optimized current profiles for faster parameter identification.
- Improved accuracy using analytic sensitivity functions.
- Reduced testing time and computational effort.
- Supports safer and more reliable battery operation.
- Integrates with existing test benches and workflows.
- Enhances predictive maintenance and lifecycle management.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	12,270,858	04/08/2025	2021-642
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OTHER INFORMATION

KEYWORDS

battery diagnostics, battery parameter identification, BMS calibration, electrochemical modeling, lithium-ion, optimized current profile, sensitivity function, single particle model, SOC estimation, SOH estimation

CATEGORIZED AS

- **Computer**
  - Software
- **Energy**
  - Other
  - Storage/Battery

- **Engineering**
  - Engineering
- **Sensors & Instrumentation**
  - Analytical
  - Scientific/Research

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