

Preface

An explosive market of Li-ion batteries has led to aggressive demand for fundamental understanding and mathematical modeling for accurate battery management systems (BMS). Researchers from multi-various backgrounds contribute from their respective background, leading to a lateral growth. Risk of this runaway situation is that indiscriminate use without appreciating the cohesive fundamentals often results in misinterpretation. It is worthy to note that the guiding principles are similar and it is the lack of clarity that impedes significant advancements. A pivotal contribution can hence be made by explaining the fundamentals in a coherent manner. Such an offering would enable researchers from multiple domains appreciate the bedrock principles and forward the frontiers. The contents of this book thus compliment the multitude of research publications in this domain by providing inner understanding.

Battery is an electrochemical system, and any level of understanding cannot ellipse this premise. The common thread that needs to run across from detailed electrochemical models to algorithms used for real-time estimation on a microchip is that it be physics based. Build on this theme, this book has three parts. Each part starts with developing a framework often invoking basic principles and ends with certain verified real-time applications. Part I deals with electrochemical modeling the second with model order reduction and the last with state and health estimation. The electrochemical model is derived from thermodynamics and a physics-based model order reduction is evolved. The state estimation is explained using a generic Bayesian framework and health estimation is described using Machine Learning (ML) tools. This book is unique to be the only one completely dedicated to battery modeling for all such components of BMS applications. We hope this offering would satisfy a practicing engineer with a basic perspective and a budding researcher with essential tools for a comprehensive understanding.

Bangalore, India
August 2017

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Mathematical Modeling of Lithium Batteries
From Electrochemical Models to State Estimator
Algorithms

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2018, XIV, 211 p. 73 illus., 34 illus. in color., Hardcover

ISBN: 978-3-319-03526-0