A Simulation-based Probabilistic Framework for Lithium-ion Battery Modeling

Arvind Rajan, V. Vijayaraghavan, Melanie Po-Leen Ooi, Akhil Garg, Ye Chow Kuang

PII: S0263-2241(17)30656-5
DOI: https://doi.org/10.1016/j.measurement.2017.10.033
Reference: MEASUR 5035

To appear in: Measurement

Received Date: 13 June 2017
Revised Date: 16 September 2017
Accepted Date: 12 October 2017

Please cite this article as: A. Rajan, V. Vijayaraghavan, M. Po-Leen Ooi, A. Garg, Y. Chow Kuang, A Simulation-based Probabilistic Framework for Lithium-ion Battery Modelling, Measurement (2017), doi: https://doi.org/10.1016/j.measurement.2017.10.033

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.
A Simulation-based Probabilistic Framework for Lithium-ion Battery Modelling

Arvind Rajan¹, V. Vijayaraghavan*¹, ², Melanie Po-Leen Ooi¹,³, ⁴, Akhil Garg*⁵, Ye Chow Kuang¹

¹School of Engineering, Monash University Malaysia, Bandar Sunway 47500, Malaysia
²School of Mechanical and Manufacturing Engineering-UNSW, Library Rd, Kensington NSW 2052, Australia
³Unitec Institute of Technology, 139 Carrington Road, Mount Albert, Auckland 1025, New Zealand
⁴Heriot-Watt University, No 1 Jalan Venna P5/2, Precinct 5, 62200 Putrajaya, Malaysia
⁵Department of Mechanical Engineering, Shantou University, Shantou, China

Abstract

State-of-the-art researches on the modelling of lithium-ion batteries for electric vehicle have been conducted based on the physics and empirical-based models to estimate their states. However, less attention has been paid to evaluating the mechanical strength of the batteries when the battery pack is subjected to sudden external impact or crash. The present work, therefore, proposes a simulation-based probabilistic framework that combines artificial neural network and a moment-based uncertainty evaluation technique utilising the finite element model of a lithium-ion battery to evaluate its mechanical strength. The study was based on the following inputs: displacement, temperature and strain rate of the battery, and their uncertainties when the battery is subjected to sudden impact. The artificial neural network outperforms other well-known modelling methods, such as the radial basis function neural network and polynomial regression, for the global mechanical strength modelling, and the probability distribution obtained from the proposed uncertainty evaluation procedure is shown to be accurate. Further analysis employing the framework reveals that the mean mechanical strength of the battery decreases with increasing temperature, but increases with increasing displacement and strain rate. It was also found that the displacement and temperature have similarly high influence on the mechanical strength of the battery compared to the strain rate. The proposed framework and presented findings can help battery manufacturers improve the road safety of electric vehicles.

Keywords: Finite element; Simulation; Uncertainty; Probabilistic analysis; Reliability; Battery pack
دریافت فوری متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات