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Simulations of Electric Vehicle Driving Range and Battery Aging Using Experimental Data

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Abstract

Driving range and battery aging, which are two important topics considered by consumers when purchasing an electric vehicle, are studied in this research. This research started with experiments on LiNiMnCoO2 battery cells. Experimental results of discharging voltage, OCV, and internal resistance are obtained under different ambient temperatures. Cycle aging of battery cells is also investigated by experiments. The obtained experimental data is used to develop the battery pack model in the electric vehicle model as well as the battery aging model. The developed electric vehicle model is used to investigate electric vehicle's driving range. Within the ambient temperature range between -30°C to 50°C, the driving range decreases with the ambient temperature. The driving range can also be heavily reduced by high-speed and aggressive driving. By using the developed battery aging model, cycle aging of the onboard battery of an electric vehicle after its 15,000-hour usage is investigated. Simulation results show that battery cell has a quicker cycle aging process under higher ambient temperatures. Large discharging and charging currents involved in aggressive driving can also accelerate battery aging. In addition, cycle aging of the onboard battery will be accelerated if the battery is almost used up before recharging every time. This research presents a novel approach to studying the driving range and battery aging of electric vehicles and includes valuable results for automotive engineers and consumers of electric vehicles.

Keywords
Battery Testing, Modeling and Simulation, Battery State Estimation, and Vehicle Electrification.

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Biographies
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Nicci VandeVeegaete is the Faculty Program Coordinator and Advisor for the Bachelor of Applied Science in Industrial Technology & Management and the Lean Technology certificate programs at Ferris State University. She earned B.S. in Manufacturing Systems Engineering from GMI Engineering and Management Institute (now Kettering University), and Master's in Industrial Operations from Lawrence Technological University. Prior to working in higher education, she had an accomplished engineering career with a major automotive manufacturer.

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