IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 10, April 2025
Impact Factor: 7.67

Anomaly Detection System for Internal Faults in Electric Vehicles

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Abstract: *The increasing focus on the safety of lithium-ion batteries (LIBs) in electric vehi- cles (EVs) necessitates early detection of soft short circuits (SCs) to prevent severe faults such as fire or thermal runaway. This paper proposes an on-board soft SC fault diagnosis method using the extended Kalman filter (EKF). The EKF adjusts a gain matrix based on real-time measured voltages to estimate the state of charge (SOC) of the faulty cell. The SOC difference is then utilized for soft SC fault detection, with identified soft SC resistance values indicating the severity of the fault. Experimental validation on a series-connected battery pack confirms the method's effectiveness in promptly detecting soft SC faults and accurately estimating their resistance*

While lithium-ion batteries offer advantages such as high energy density and quick charging, concerns about their thermal stability hinder their widespread use due to potential fire and explosion risks. This manuscript comprehensively reviews the ther- mal runaway phenomenon and fire dynamics in both single LIB cells and multi-cell battery packs. It discusses potential fire prevention measures, emphasizing the chal- lenges associated with ensuring the safety of LIB applications in electric vehicles and energy storage systems. Additionally, the paper provides an overview of fault detection methods for critical EV components, including Permanent Magnet Synchronous Motors (PMSMs) and lithium-ion battery packs, stressing the importance of accuracy, speed, sensitivity, and cost-effectiveness in fault detection approaches, with a focus on the latest research developments.

Keywords: lithium-ion batteries

DOI: 10.48175/568