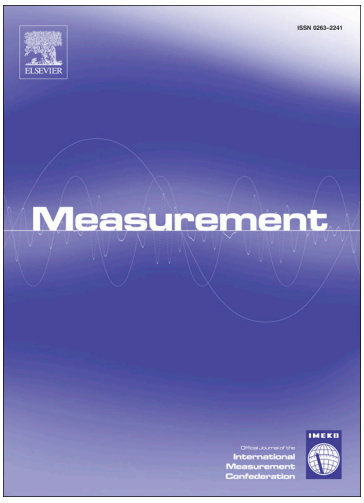

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PII: S0263-2241(17)30603-6
DOI: https://doi.org/10.1016/j.measurement.2017.09.031
Reference: MEASUR 4981

To appear in: *Measurement*

Received Date: 21 May 2017
Revised Date: 16 September 2017
Accepted Date: 19 September 2017

Please cite this article as: H. Nordmann, M. Frisch, D. Uwe Sauer, Thermal Fault-Detection Method and Analysis of Peripheral Systems for Large Battery Packs, *Measurement* (2017), doi: https://doi.org/10.1016/j.measurement.2017.09.031

Thermal Fault-Detection Method and Analysis of Peripheral Systems for Large Battery Packs

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Abstract: Complex electrical systems such as battery packs are pushed further to comply with the continuously rising demands for power, energy and safety. This triangle of requirements needs to be optimized in all three directions, but has to be well balanced using as much information about the battery's parameters, such as temperature. Today's battery packs lack of gapless temperature acquisition due to a limited sensor count. To increase the temperature information count and herewith the safety, additional sensors would need to be installed, which is rather expensive. A different approach is provided in this paper: Already existent wire harnesses are put into a secondary use to acquire thermal hotspots. Additionally, the proposed method allows to localize the thermal event which leads to a more detailed knowledge of battery pack's thermal situation. By accomplishing a gapless temperature supervision, the mentioned requirement triangle can be further optimized to match future application demands.

Keywords: Temperature based faults; hotspot localization; value-added battery management functions; peripheral detection of faults.

1. Introduction

Battery management plays a crucial role in today's battery packs that strive for high reliability and safety of the applications. The type of applications using battery packs are widespread – starting from single cell usage in smartphone energy sources to small handheld devices like notebook computers, up to large battery packs that are needed to supply high power like land based mobility or aviation.

Handling lithium-ion battery technology is sophisticated as recent news about cell phones bursting into flames[i] show. Electric vehicles can catch fire, as conventional gasoline powered vehicles can. However, the processes that lead to a fire are different and must be detected as early as possible. Modern electric vehicles have a battery management system installed, that is able to acquire several parameters to determine the battery's state. Improving the way, these variables are acquired and analysed, must be the goal to avoid potential dangerous situations, as happened September 2016, when a test driving electric vehicle caught fire due to a faulty interconnection[ii].

There are various fault sources that originate from the battery cells alone. However, it is not as simple as finding the sole reason of a battery pack failure within just the battery cells themselves. First, a brief overview will be given on components of a general battery pack that is used in many applications in the same structure or in light variations thereof. Afterwards an introduction of possible fault events concerning temperature and their effects on peripheral devices of battery packs are shown followed by methods to catch these faults at early stages of their occurrence.

2. Battery Packs and Their Potential Fault Spots

A typical battery pack that is used for modern land-based mobility purposes uses a serial connection of dozens of battery cells. Each of these battery cells is connected by interconnections that have to carry the full current the pack is designed for.

[i] http://www.phonearena.com/news/Samsung-sued-over-an-exploding-phone-and-its-not-the-Galaxy-Note-7_id85274, fetched January, 10th, 2017.

[ii] https://electrek.co/2016/09/09/tesla-fire-france-electrical-connection-improperly-tightened-human-robot/, fetched January, 10th, 2017