Physical and virtual sensing of lithium-ion batteries through optical fiber sensors

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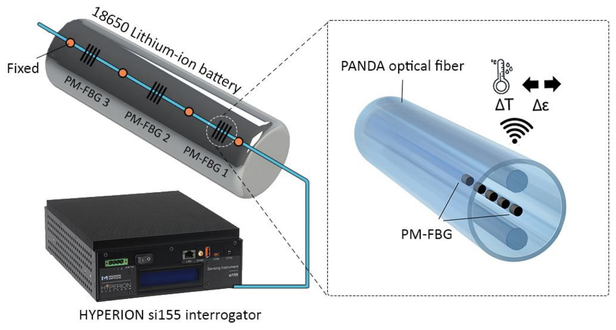
L. Matuck, V. Neto, J. Pinto, C. Marques, M. Nascimento

i3N & Department of Physics, University of Aveiro, 3810-193 Aveiro, Portugal

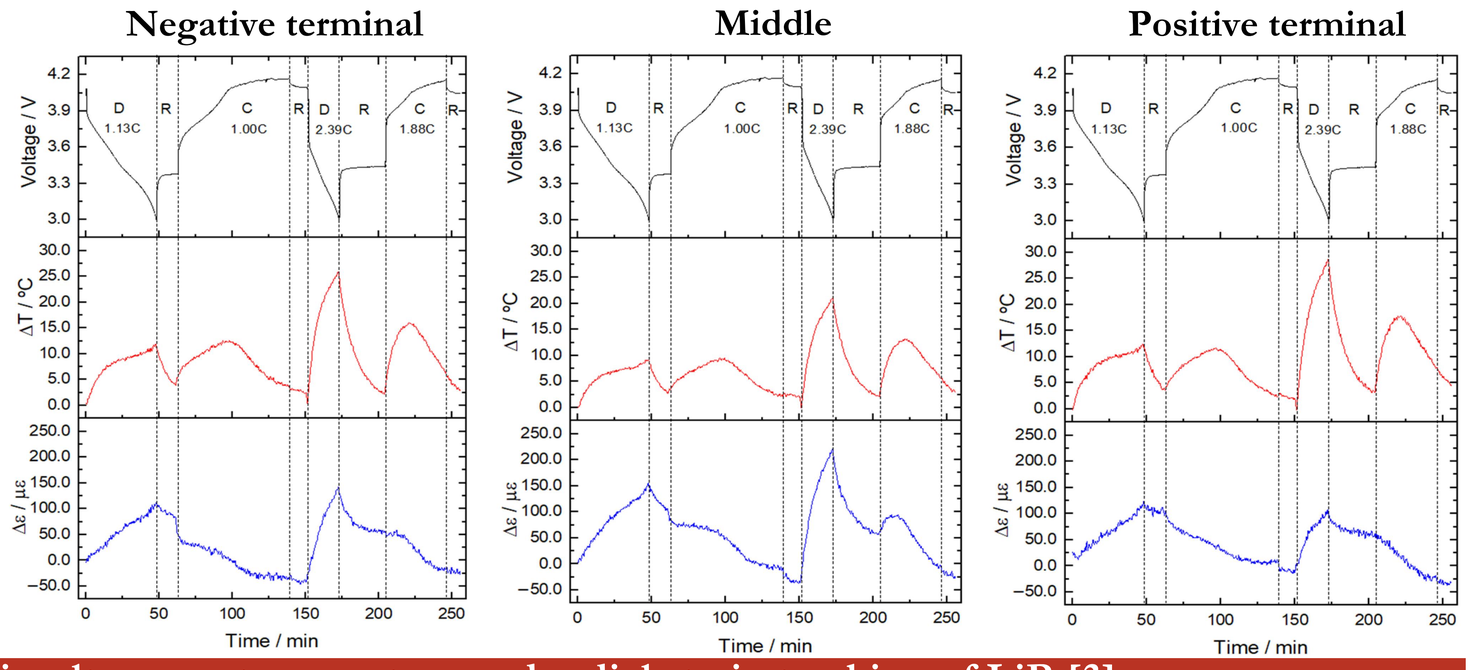
Abstract

- **INSTABAT** EU-project intended to monitor in operando, key parameters of a Li-ion battery (LiB) cell, in order to provide higher accuracy states of charge, health, power, energy and safety cell indicators, to improve safety and quality, reliability and life of LiBs [1].
- UA/i3N team is dedicated to design and to develop innovative optical fiber sensors (OFS) to internal and simultaneous track temperature, strain and pressure variations in the LiBs.
- This poster shows recent works elaborated by UA/i3N team of **INSTABAT** project, from applications of polarization-maintaining fiber Bragg grating (PM-FBG) sensors to track temperature and strain variations in an 18650 LiB [2,3] and an exploratory study of a Particle Filter (PF) and the consecutive comparison to the Extended Kalman Filter (EKF) to predict temperature and state of charge (SOC) in LiB [4].

1st Work - Simultaneous strain and temperature discrimination in 18650 LiB using PM-FBG [2]

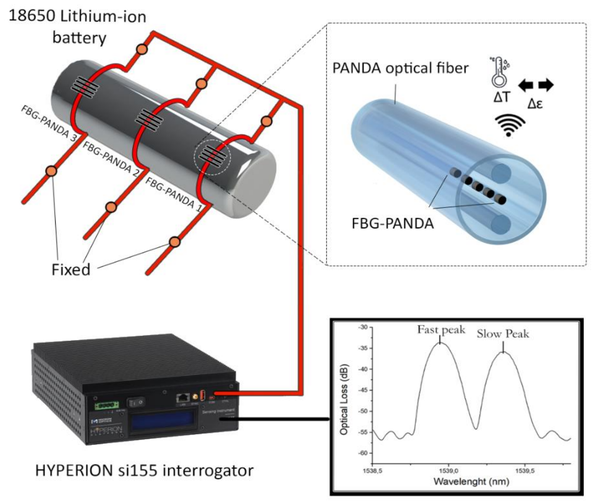


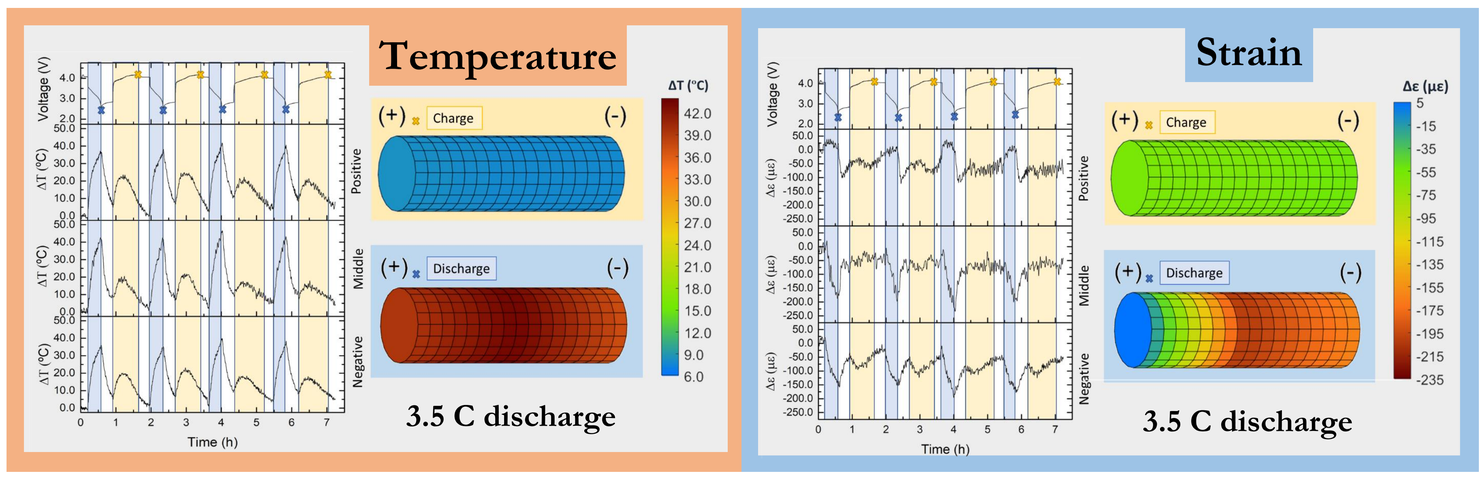
- PM-FBG sensors were attached to the LiB aiming to acquire data regarding temperature and strain variations on three different locations.
- The effects of fast discharging are more evident in positive terminal.



2nd Work - Multipoint and simultaneous temperature and radial strain tracking of LiB [3]

- PM-FBG sensors were attached to the LiB to acquire data regarding temperature and radial strain variations on three different locations.

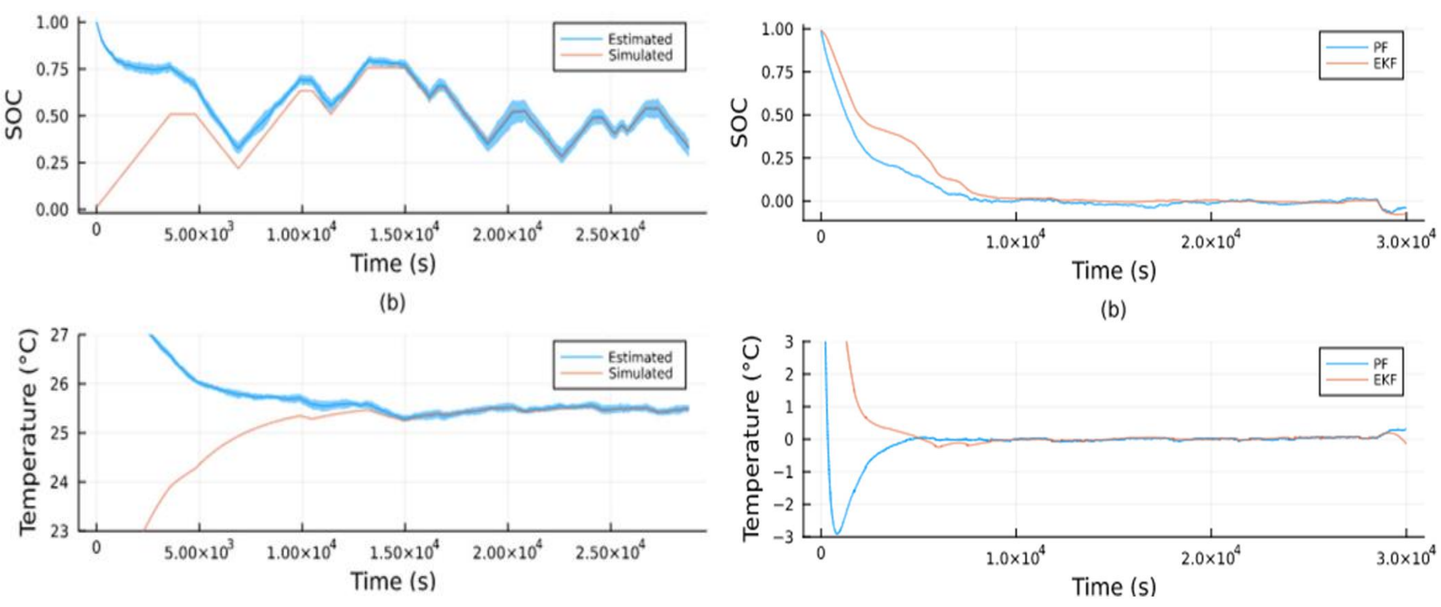




- The effects of fast discharging are more evident in the battery middle spot.
- Higher strain variation were tracked in the middle location of LiB, during fast discharge cycles.

3rd Work - A PF-based virtual sensor for estimating the SOC and internal temperature of LiB [4]

- A PF based strategy to monitor simultaneously the SOC and the internal temperature of a LiB was developed.
- The electrical and thermal characterization of the battery was suited by an equivalent circuit model and by an equivalent thermal network model, respectively.
- The entry variables of the algorithm were the electrical current and voltage of the battery.
- The PF were tested by simulation data and later compared in terms of convergency velocity and error to the consolidated EKF.



References and Acknowledgments

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