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Li-ion batteries monitoring for electrified vehicles applications

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# Summary

The scenario of this work consists in the need for more information on the condition of Li-ion cells that are part of battery packs, used in electrified vehicles. A Li-ion cell consists in a complex system where electrochemical reactions happen, where heat is internally generated and where there are volumetric changes. With ageing a cell undergoes various damage mechanisms that influence the cell performance and safety, but that are very complex to be modelled. In order to have information on the cells state, quantities such as voltage, current and surface temperature of group of cells are monitored by the BMS. This information however results to be not enough to estimate with a good accuracy the cell state. Recent scientific trends show a growing interest in cells instrumentation, in order to acquire additional information in-situ and in-operando.

In this thesis, the main cells models used in electrified vehicles have been investigated together with the main state estimation algorithms. The attention has then been focused on cells instrumentation using innovative sensors for this application, such as distributed fibre optic sensors for thermo-mechanical monitoring of Li-ion cells. The selected sensors have been used for external and internal instrumentation of pouch format Li-ion cells. Thus, the cells manufacturing process has been studied and properly modified in order to allow the manufacturing of instrumented cells without compromising the cells and sensors functionality. These instrumented cells have then been tested and the distributed quantities have been acquired in operating conditions.

