



COLLÈGE
DE FRANCE
—1530—



Master internship

Improvement of battery lifetime prediction using optical sensing

Laboratory

Solid State Chemistry and Energy Laboratory (CSE), Collège de France, Paris

Context

Within the Collège de France, the Solid State Chemistry and Energy (CSE) laboratory, which is also part of the French network on electrochemical storage (RS2E), studies the problems of energy storage and conversion at both fundamental and applied levels.

Currently, batteries are ubiquitous in a wide range of applications, including mobile phones, laptops, automotive vehicles and smart grid. In this context, the estimation of vital battery parameters such as state of charge (SOC) and state of health (SOH) is of paramount importance. These parameters guarantee the safety of the batteries and the optimisation of their operating conditions. However, the diversity of cell construction and operating conditions leads to non-linear degradation, making the prognosis of ageing mechanisms complex.

Recently, the democratisation of statistical and machine learning techniques has accelerated progress in the estimation of SOC and SOH [1]. Nevertheless, the input data of current algorithms is mainly based on exogenous characteristics (current, potential, temperature) of the battery. In real conditions, these variables may fail to unravel the underlying physical/chemical phenomena that determined the SOC and SOH of the batteries. Thus, the originality of our approach lies in the use of optical sensors integrated into the battery to acquire both intrinsic and more accurate data. In this context, fibre optic sensors allow for access to physical (temperature, stress and pressure) and chemical (refractive index, chemical groups) properties intrinsic to the battery [2,3]. These new data are promising for extracting new information on battery lifetime and applying it to SOC and SOH prediction algorithms.

Aim of the internship

In a multidisciplinary context, the objective of the internship is to participate in the creation of an algorithm for predicting the state of health of batteries from data obtained by optical sensors.

Main tasks:

- Data preparation (preparation of batteries, integration of optical sensors)
- Data mining (analysis, cleaning, identification of important features ...)
- Development and comparative analysis of several prediction models by applying machine learning techniques on these new data.

Supported by the RS2E and Hong-Kong University of Science and Technology (Guangzhou), this internship is part of a project combining international academic and industrial research. The student will have the opportunity to meet specialists in different fields (electrochemistry, optics, artificial intelligence) and present these results at conferences.

Profile of the candidate

Student preparing a Master's or Engineer's degree in statistic, data science, mathematics or in chemistry/physics with a specialization in data science.

Skills in Python programming, statistics, Machine learning libraries, big data visualization and manipulation are required.

Language: English

Contract duration: 4-6 months

Supervisors: Dr. Charlotte Gervillié, Dr. Jiaqiang Huang, Prof. Jean-Marie Tarascon

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- [3] J. Huang, X. Han, F. Liu, C. Gervillié, L.A. Blanquer, T. Guo, J.-M. Tarascon, Monitoring battery electrolyte chemistry via in-operando tilted fiber Bragg grating sensors, *Energy Environ. Sci.* (2021). <https://doi.org/10.1039/D1EE02186A>.