École Polytechnique Fédérale de Lausanne
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Student project proposal

Li-Ion Cell Equivalent Circuit Model Parameters Estimation from Time-Domain Measurements

Project type ☐ MSc thesis ☒ BA semester project ☒ MSc semester project

Project responsible and e-mail
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Project description
This project aims to study the possibility of estimating the parameters of Li-ion battery cell typical equivalent circuit model (ECM) using different time domain signals. These signals can be imposed by the modeller or be dictated by the charging/discharging profile while the battery is providing a certain power grid ancillary service (e.g., primary frequency control, optimal dispatching, self-consumption, etc.). Depending on the sampling frequency and the spectral content of the excitation signals, some parameters can be estimated accurately, while others remain unobservable. The objective is to assess the estimator and analyse the identifiability of ECM parameters from different input and output signals.

Tasks of the student
- Derive a state-space representation of Li-ion cell ECM.
- Build a Simulink model and impose different excitation signals to the ECM.
- Estimate the corresponding transfer functions (e.g., using the vector fitting technique [2]) and ECM parameters from the simulated data.
- Assess and analyse the estimation quality.

Requirements
- Good base knowledge of electrical circuit theory.
- Familiarity with general concepts on batteries.
- Familiarity with basic estimation methods such as the least-squares methods.
- Good MATLAB and Simulink programming skills.

Literature
[1] S. M. M. Alavi, A. Mahdi, S. J. Payne and D. A. Howey, "Identifiability of Generalized Randles Circuit Models," in IEEE Transactions on Control Systems Technology, vol. 25, no. 6, pp. 2112-2120, Nov. 2017, doi: 10.1109/TCST.2016.2635582.

[2] B. Gustavsen and A. Semlyen, "Rational approximation of frequency domain responses by Vector Fitting", IEEE Trans. Power Delivery, vol. 14, no. 3, pp. 1052 - 1061, July 1999.

[3] G. Plett, Battery Management Systems: Volume 1, Battery Modeling.

[4] G. Plett., Battery Managements Systems: Volume 2, Equivalent Circuit Methods.