USING A SINGLE PARTICLE MODEL INCLUDING DEGRADATION FOR OPTIMAL CONTROL OF LITHIUM-ION BATTERIES

Jorn M. Reniers[1]*, Grietus Mulder[2], Sina Ober-Blöbaum[3] and David A. Howey[4]

[1] Department of Engineering Science, University of Oxford, OX1 3PJ, Parks Road Oxford, UK, jorn.reniers@eng.ox.ac.uk

[2] VITO, Boeretang 200 Mol, 2400 Belgium, grietus.mulder@vito.be

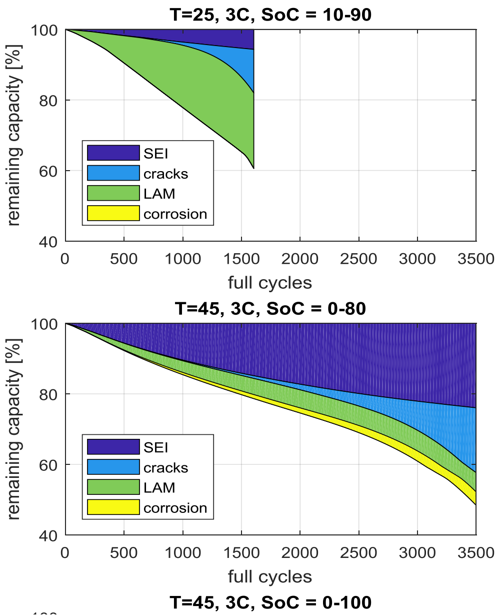
[3] Department of Engineering Science, University of Oxford, OX1 3PJ, Parks Road, Oxford, UK, sina.ober-blobaum@eng.ox.ac.uk, http://control.eng.ox.ac.uk/Sina_Ober-Bloebaum

[4] Department of Engineering Science, University of Oxford, OX1 3PJ, Parks Road, Oxford, UK, david.howey@eng.ox.ac.uk, http://epg.eng.ox.ac.uk/howey/

Key Words: *Degradation, Grid-connected Battery, Optimal control, Battery ageing.*

The lifetime of a lithium-ion battery is a key element in the business case for grid-connected batteries. Battery degradation is the result of many different processes, some being more dominant than others, depending on the operating conditions. Various battery degradation models exist, of differing complexity, accuracy and data-requirements. The simplest model is a linear degradation model [1]. A second class are the empirical degradation models, interpolating large data sets [2]. Thirdly, electrochemical degradation models try to capture the physics of the degradation processes [3].

In this work, a single particle model is extended with some degradation mechanisms. The importance of the various degradation mechanisms is assessed. As can be seen on the figure, the impact of the various mechanisms is dependent on the operating conditions, implying that a model needs to include all these mechanisms to be accurate in real-life conditions. Crucially, this model is implemented in such a way that is can be solved very efficiently. Therefore, this model can be used in an optimisation to define optimal utilisation profiles for grid-connected batteries. A case study for a battery trading power on the wholesale market illustrates the importance of accounting for degradation in the optimisation.



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