

Measurement of Performance and Ageing of Super Capacitors

Master thesis project



Figure 1 Maxwell super capacitor bank (www.amazon.com)

Summary:

The aim of this thesis is to model and characterize supercapacitors for determining capacitance, resistance, tan-delta loss factor, energy and storage parameters in SC. It is important to also look at rapid and accurate measurements and hence an overview of several measurements techniques and its comparison is important.

Problem definition:

Super capacitors are important as an additional option for high power density and energy storage including peak shaving in different applications including hybrid energy storage (coexisting battery- super capacitor) solutions. There is a lack of standards for multiparameter equivalent circuits of SC. This thesis will look into measurements of the super capacitors for accurate and fast measurements.

Method:

1. Perform a literature survey on different electrochemical parameters of super capacitors
2. Model, develop ECMs using EIS (Electrochemical Impedance Spectroscopy) and characterize the capacitance, resistance, energy and power storage parameters including derived states (SOC, SOH) in SC
3. Perform a survey of measurement techniques (dc measurements, EIS etc) and compare the various techniques interms of different criteria speed, accuracy etc
4. Consider different mission profile based charging rates and perform measurements of the system under these conditions
5. Validate the performance measurements with both individual and bank based measurement
6. ML/AI as tool for predicting the SOH can additionally be explored, including other diagnostics and prognostics

Courses and supervision:

This is a a challenging, hands-on power electronics project. Background of EE and power electronics and battery-related courses are considered mandatory.

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