An Algorithm of Charge-Discharge Curve Estimation and Full Charge Capacity Correction for Lithium-ion Battery Module

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As measure to reduce the influence of the renewable energy penetration, virtual power plant containing lithium-ion battery is considered. For economical operation of virtual power plant, full charge capacity (FCC) and charge-discharge curves of lithium-ion battery needed to be estimated in real time, so we studied an algorithm for it.

In order to study this algorithm, 8-series lithium-ion battery module (NMC ternary compound type, 29.6V, 1.48kWh) was cycled in 1085W constant power charge-discharge and 25 centigrade atmosphere. Then module's OCV and internal impedance vs state of charge (SOC) were calculated as 12 degrees polynomials. These polynomials and FCC from initial charge-discharge data were treated as initial functions.

In the estimation of charge-discharge curves, we studied the model which corrects a polynomial of OCV vs SOC by fixed learning rate based on the actual charge-discharge measurement in every 60 seconds. In order to correct this charge-discharge curves smoothly, it carried out by adding a gauss function and fitting of a polynomial of OCV again. In the correction of FCC, two points data of voltage and SOC from charge-discharge cycles were selected from SOC range of 0.4 to 0.6 and calculated the SOC difference (ΔSOC) between two data. Initial charge-discharge cycle SOC values which correspond to these voltage values were extracted by using the initial function. Consequently, the SOC difference between these data (ΔSOCini) were calculated. FCC value was corrected by ΔSOCini /ΔSOC value and fixed learning rate.

The result of calculating 1st to 1600th (every 50 cycles) cycle is shown in fig.1. and fig.2. Thus, charge-discharge curves and FCC values were calculated with sufficient accuracy.

Fig.1. 1600th cycle curves estimation                      Fig.2. FCC values correction

References: