Online estimation of lithium-ion battery remaining discharge capacity through differential voltage analysis

Abstract
The estimation of battery remaining discharge capacity (Q(sub RDC)) is essential for the remaining driving range prediction on pure electric vehicles. A traditional Q(sub RDC) estimation method is based on the determination of battery state of charge (SOC), in which the estimation accuracy could be affected by the variation in discharge conditions. In this research, a novel Q(sub RDC) estimation method through differential voltage (dV/dQ) analysis is introduced for lithium-ion batteries. Through analyzing the characteristics of terminal voltage variation, the present Q(sub RDC) could be estimated by the dV/dQ value, which is capable to provide an accurate estimation result under various discharge conditions. On a commercial lithium-ion battery, the dV/dQ method is implemented for Q(sub RDC) estimation under pulse discharge profiles and dynamic profiles. The result shows that the dV/dQ method could provide accurate Q(sub RDC) estimation results under various discharge profiles in the latter part of the discharge process, and the Q(sub RDC) estimation accuracy could hence be improved by combining the differential voltage analysis with the SOC-based method. Owing to the simple computation process, the dV/dQ-based estimation method is very competitive in onboard applications. [All rights reserved Elsevier]