New software to provide greater accuracy in measuring battery life

October 9 2012, by Matt Shipman And Dr. Mo-yuen Chow

(Phys.org)—Researchers from North Carolina State University have developed a new technique that allows users to better determine the amount of charge remaining in a battery in real time. That's good news for electric vehicle drivers, since it gives them a better idea of when their car may run out of juice.

The research is also good news for battery developers. "This improved accuracy will also give us additional insight into the dynamics of the battery, which we can use to develop techniques that will lead to more efficient battery management," says Dr. Mo-Yuen Chow, a professor of electrical and computer engineering at NC State and co-author of the paper. "This will not only extend the life of the charge in the battery, but extend the functional life of the battery itself."

At present, it is difficult to determine how much charge a battery has left. Existing computer models for estimating the remaining charge are not very accurate. The inaccuracy stems, in part, from the number of variables that must be plugged in to the models. For example, the capacity of a battery to hold a charge declines with use, so a battery's history is a factor. Other factors include temperature and the rate at which a battery is charged, among many others.

Existing models only allow data on these variables to be plugged in to the model once. Because these variables – such as temperature – are constantly changing, the models can become increasingly inaccurate.

But now researchers have developed software that identifies and processes data that can be used to update the computer model in real time, allowing the model to estimate the remaining charge in a battery much more accurately. While the technique was developed specifically for batteries in plug-in electric vehicles, the approach is also applicable to battery use in any other application.

Using the new technique, models are able to estimate remaining charge within 5 percent. In other words, if a model using the new technique estimates a battery's state of charge at 48 percent, the real state of charge would be between 43 and 53 percent (5 percent above or below the estimate).

More information: "Adaptive Parameter Identification and State-of-Charge Estimation of Lithium-Ion Batteries", Presented: Oct. 25-28, 38th Annual Conference of the IEEE Industrial Electronics Society, Montreal, Canada, www4.ncsu.edu/~chow/Publicatio … ry_IECON12_Habib.pdf

Abstract:
Estimation of the State of Charge (SOC) is a fundamental need for the battery, which is the most important energy storage in Electric Vehicles (EVs) and the Smart Grid. Regarding those applications, the SOC estimation algorithm is expected to be accurate and easy to implement. In this paper, after considering a resistor-capacitor (RC) circuit-equivalent model for the battery, the nonlinear relationship between the Open Circuit Voltage (VOC) and the SOC is described in a lookup table obtained from experimental tests. Assuming piecewise linearity for the VOC -SOC curve in small time steps, a parameter identification technique is applied to the real current and voltage data to estimate and update the parameters of the battery at each step. Subsequently, a reduced-order linear observer is designed for this continuously updating model to estimate the SOC as one of the states of the battery system. In

designing the observer, a mixture of Coulomb counting and VOC algorithm is combined with the adaptive parameter-updating approach and increases the accuracy to less than 5% error. This paper also investigates the correlation between the SOC estimation error and the observability criterion for the battery model, which is directly related to the slope of the VOC- SOC curve.

Provided by North Carolina State University