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July 2021

BATTERY IMPEDANCE ESTIMATION USING TELEMETRY DATA

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Recommended Citation
INC, HP, "BATTERY IMPEDANCE ESTIMATION USING TELEMETRY DATA", Technical Disclosure Commons, (July 26, 2021)
https://www.tdcommons.org/dpubs_series/4488

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Battery Impedance Estimation Using Telemetry Data

Abstract: Battery impedance can be determined in situ in an electronic device using telemetry data to calculate the open-circuit voltage and the voltage and current under load.

This disclosure relates to the field of batteries.

Batteries are used to power a variety of electronic devices, including portable laptop and notebook computers. Battery Impedance (Rbat) is an important property of a battery. The impedance of battery changes over time, after the battery starts to discharge and charge. The impedance is a useful parameter to know. For example, it may be related to the remaining lifetime of the battery.

When a battery is in the system, it is difficult to measure and track battery impedance. Typically, the impedance of a battery is measured by disconnecting the battery from all loads; measuring the open cell voltage; applying a load to the battery; and measuring the voltage (V) of the battery and the current (I) across the load. However, doing so would require that the battery be detached from the rest of the system and additional hardware and logic. As a result, this method of measuring battery impedance is not very practical to the user of the electronic device.

According to the present disclosure, by using telemetry data the battery impedance may be measured and tracked in situ, without disconnecting the battery from the electronic device which it is powering.

Telemetry data acquires the battery status at various times, and/or in various battery states. For example, the telemetry data may be collected periodically – e.g. every 15 minutes. Alternatively, or additionally, it can be collected based on the occurrence of an event – e.g. a transition of the device from AC power to battery DC power, or vice-versa.

First, the open circuit voltage (OCV) is determined as follows:

OCV = Vbat when (Ic =0 and Id = 0) or BS= “On AC and Fully Charged”

where:
Vbat = battery voltage
Ic = charge current
Id = discharge current
BS = battery state

Thus, the OCV is the battery voltage measured when both (a) the battery is on AC power and not charging, and (b) the battery is not supplementing AC power.

Note that an OCV approximation is required because it depends on the remaining capacity. In one example, a linear approximation is used:

OCV = OCVrcc100 - (OCVrcc100 – EDV) *(1-RCC) as linear approximation)

where:
EDV = end of discharge voltage

RCC = remaining charge capacity
OCVrcc100 = OCV at RCC = 100

Next, the voltage under load (V) and current under load (I) are measured when BS = discharging:

The Battery Impedance is then calculated as follows:

R = (OCV-V) / I

The disclosed technique advantageously determines the battery impedance in real time while the battery is connected to a device it is powering. This technique can be used in a wide variety of applications.

Disclosed by Fangyong Dai, Peter Zhang, and Steve Chen, HP Inc.