

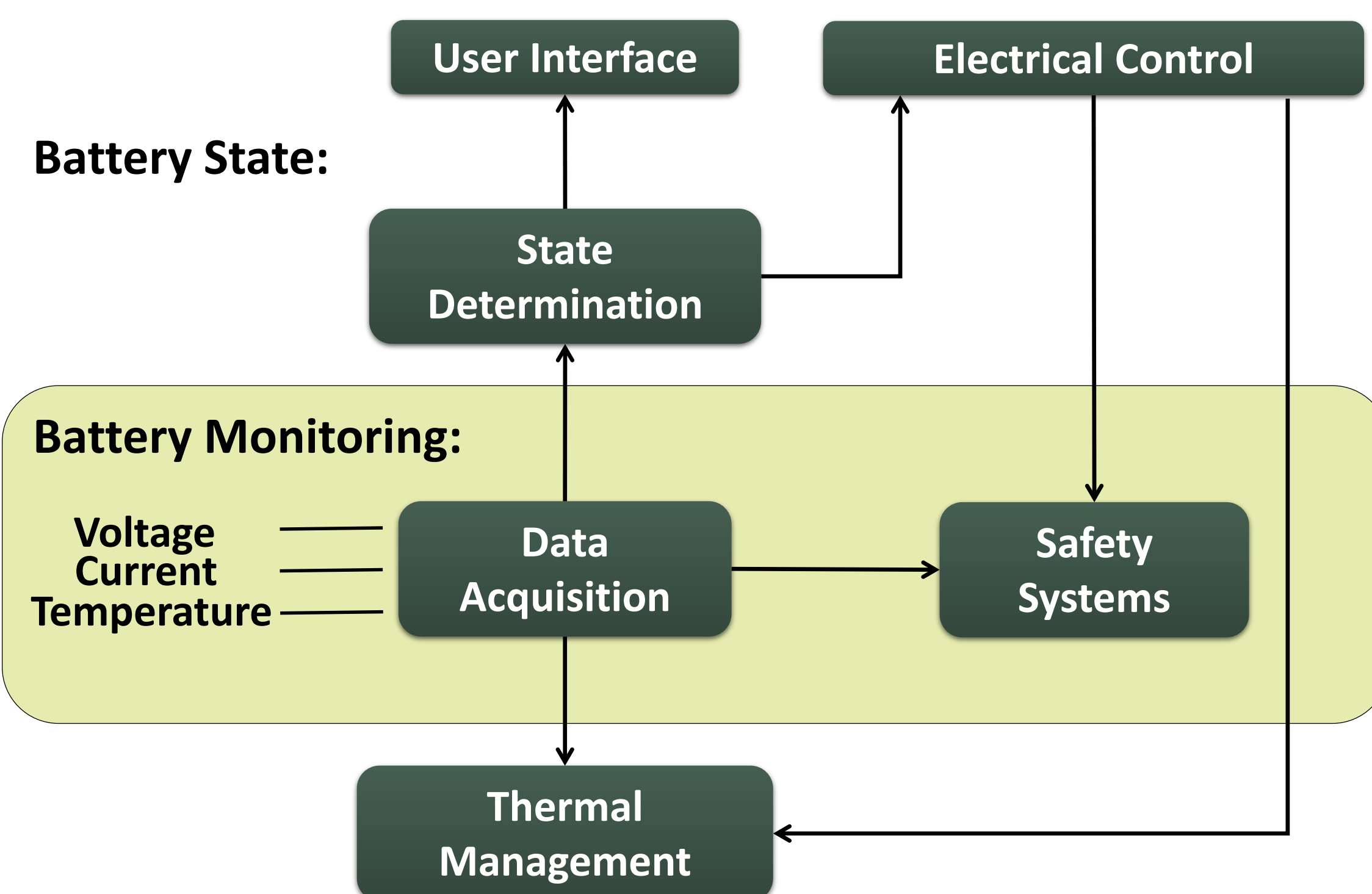
Battery Impedance Mapping and Characterization

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EECOMOBILITY (ORF) &
HEVPD&D CREATE

Electric Vehicle Battery Systems

Battery Management:

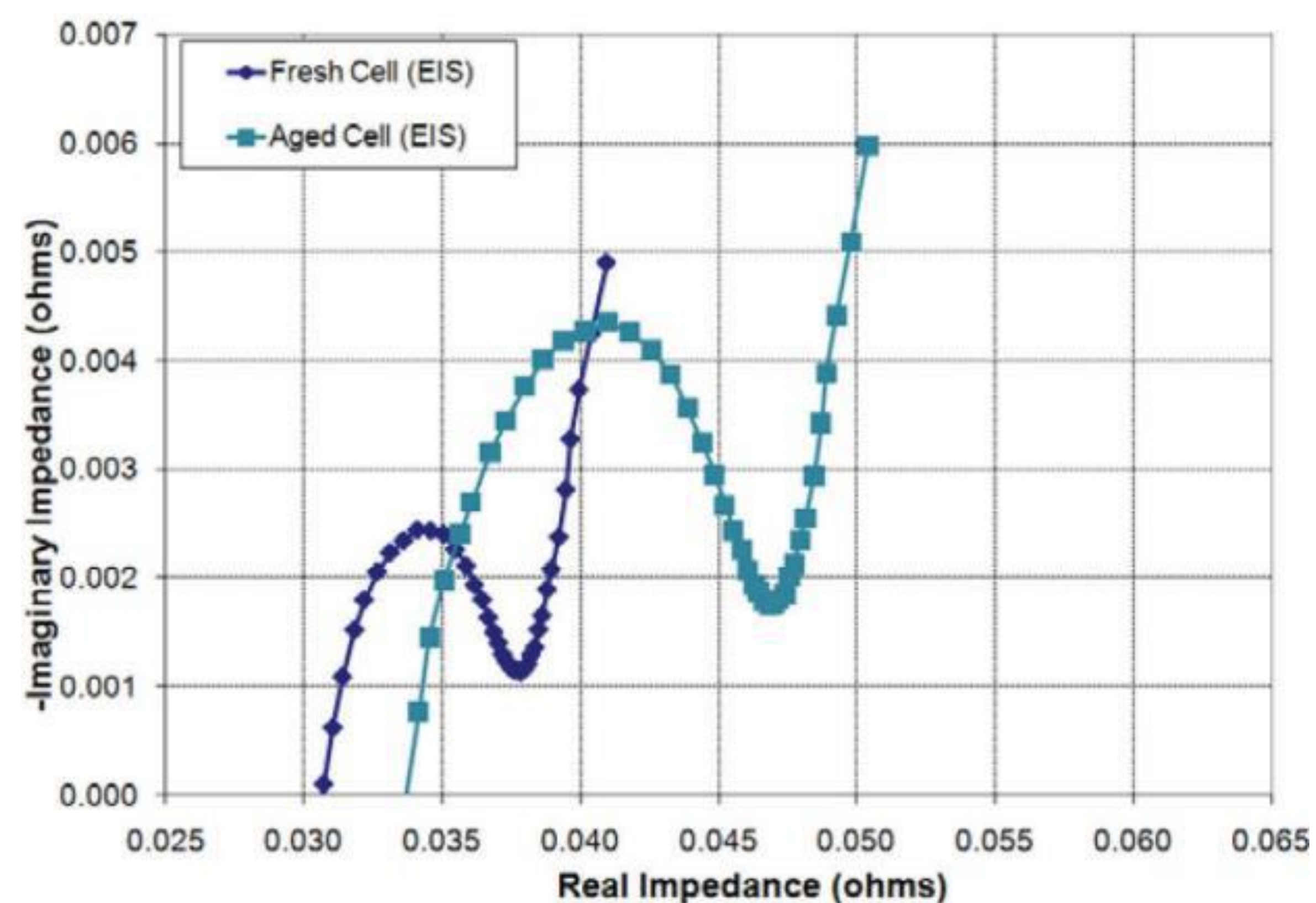


- Batteries are an important element of hybrid and electric vehicles.
- The most important considerations for batteries include energy density, cost, safety and performance.
- Batteries in electric vehicles need to be managed appropriately and operated within their safety specifications.
- Battery Management Systems (BMS) are used onboard electric vehicles to monitor battery characteristics such as voltage, current and temperature.
- The BMS provides real-time information on the state of charge, state of health and state of power, indicating the driving range available based on the current condition of the battery.

Xing et al. 2011. "Battery Management Systems in Electric and Hybrid Vehicles." Energies 4, no. 11: 1840-1857.

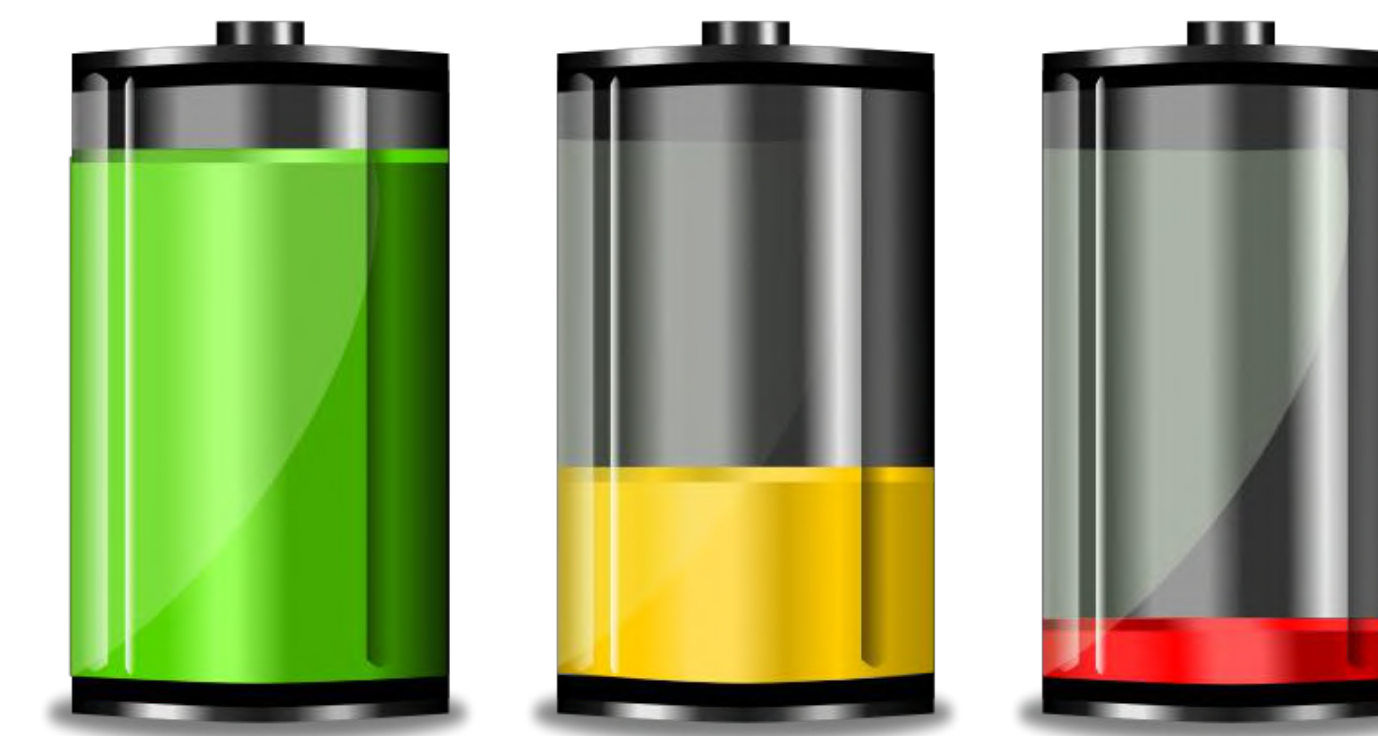
Electrochemical Impedance Spectroscopy (EIS) Testing

- Electrical impedance is a measure of a circuit's ability to resist current flow.
- Although it is similar to resistance, it is more useful to use impedance in real-world applications that demonstrate much more complex properties.
- Using Electrochemical Impedance Spectroscopy (EIS) testing allows us to examine the dynamic characteristics of the battery.
- This is usually done by applying an AC potential to 'excite' an electrochemical cell, and then measuring the current through the cell.
- EIS can tell us important information about the health of the cell and the chemical processes involved. It can help us understand where cell degradation is occurring and how aging affects the performance of the cell.



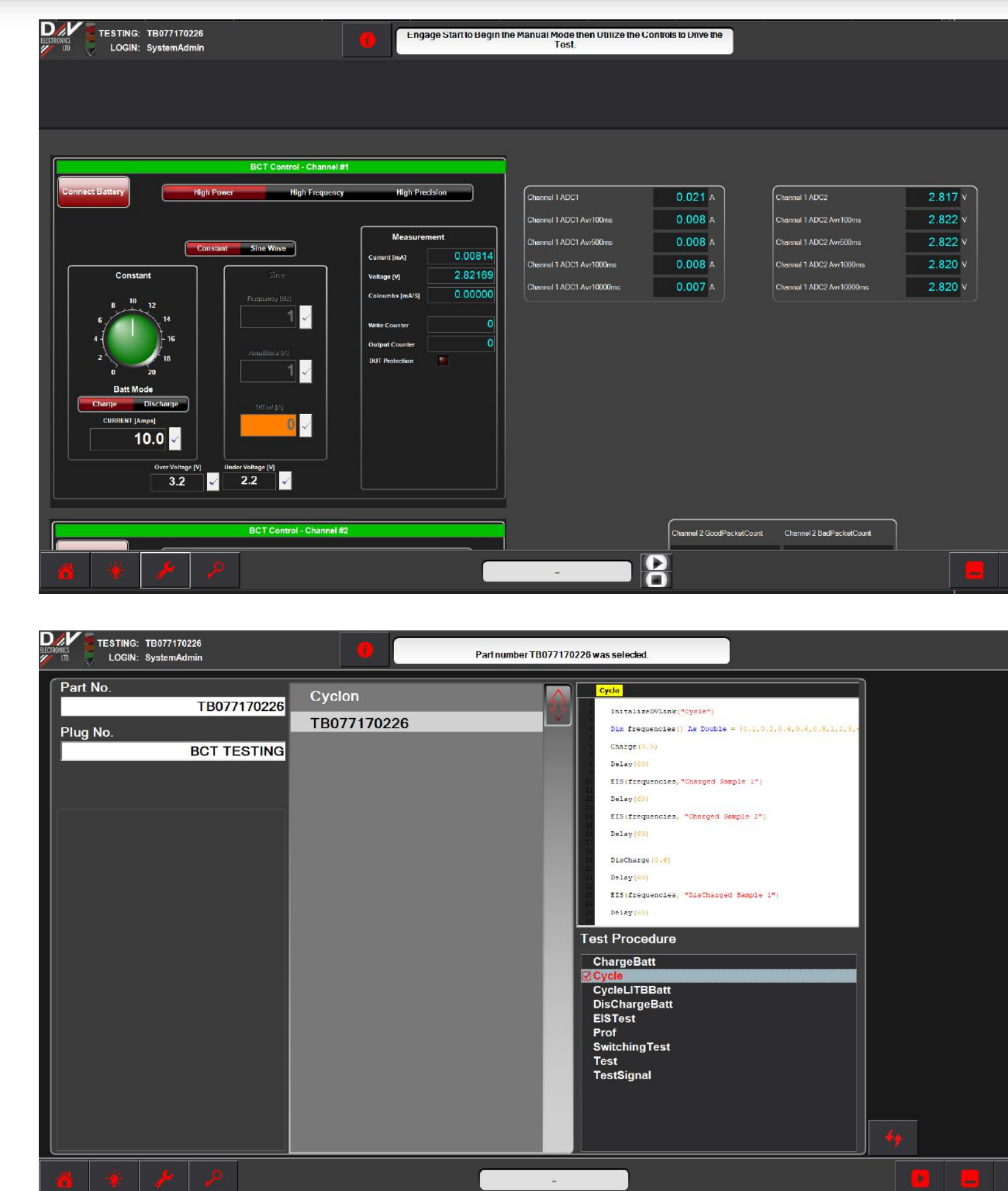
Christoffersen et al. (2012). Rapid Impedance Spectrum Measurements for State-of-Health Assessment of Energy Storage Devices. SAE International Journal of Passenger Cars - Electronic and Electrical Systems. 5. 246-256. 10.4271/2012-01-0657.

Scope of Research



- This research will consider battery performance under various operating conditions pertaining to SoC, aging, temperature and C-rate.
- Looking at analyzing impedance characterization and trying to understand how the battery is affected under those different operating conditions.
- EIS test data will be correlated to models that have been previously developed (electro-chemical, empirical and equivalent circuit).
- D&V Electronics' unique battery cell tester will be used for this research.
- As part of this research, the functionality of the tester will be refined.

D&V Electronics Cell Tester



D&V Electronics has developed a unique cell tester that enables EIS, drive cycle and columbic efficiency testing and characterization. The tester is able to switch between three different test modules, including a high frequency signal module. This integration allows the tester to streamline the testing procedure and provide better estimates for state of health (SoH) and state of charge (SoC).



"D&V Electronics." BCT Series - Battery Cell Testers: BCT-150, www.dvelectronics.com/products/electric-powertrain-battery-testers/product-capabilities/specialty/bct-150-battery-cell-tester.html.