Höcherl & Hackl
The electronic load

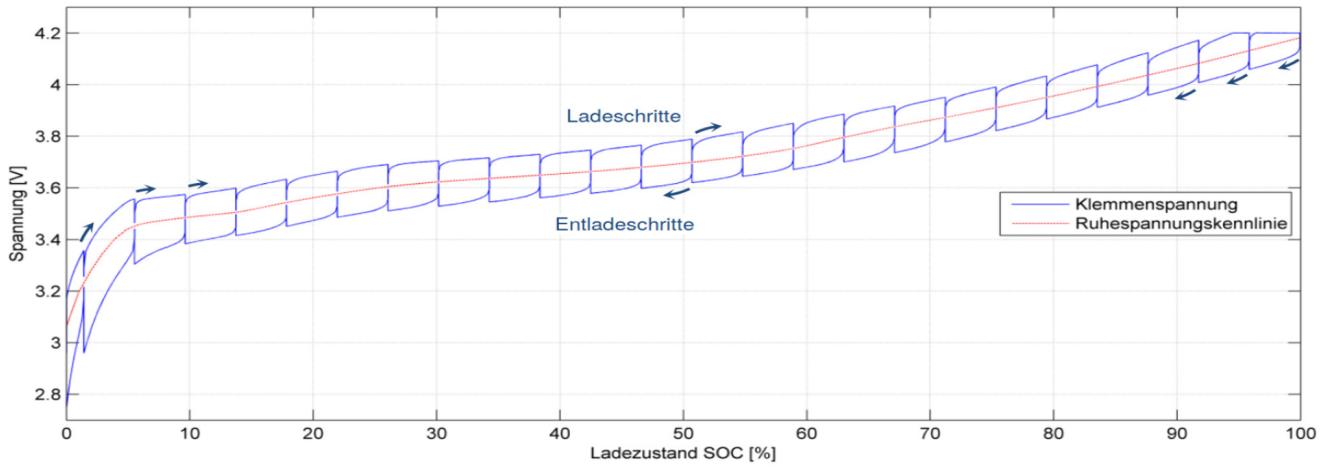
Customer Application #19

Increasing Accuracy for State of Charge Determination

Since 2009, the „Fast Forest“ team at the Deggendorf Institute of Technology has been developing electrically powered racing vehicles as part of Formula Student. Formula Student is an international design competition in which more than 600 teams compete against each other with self-constructed vehicles at worldwide events.

The evaluation of the racing car is carried out in so-called disciplines, which are divided into two areas. In static disciplines the economic background and the construction are evaluated by means of presentations. In the dynamic disciplines, the vehicle must prove its practical suitability on a race track. The supreme discipline here is the Endurance, which is the longest race with a distance of 22 km.

The traction battery is the energy storage device within an electrically driven vehicle. In order to provide a high energy density, especially for the Endurance, traction batteries are preferably composed of lithium-ion cells. In order for the cells to achieve a long service life, constant monitoring of the cell parameters is necessary, which is typically performed by a battery management system.



Exemplary open-circuit voltage characteristic of a lithium polymer cell

An important parameter monitored by the battery management system is the state of charge. The state of charge is a percentage characteristic value for the state of charge of batteries. It indicates the remaining available capacity of a battery in relation to the maximum capacity that can be discharged. It is not possible to measure the state of charge directly, since it is not a physical quantity but a state variable. For this reason, the state of charge can only be determined by means of estimation procedures, but by summing up the errors, this procedure leads to a high degree of inaccuracy.

Höcherl & Hackl has provided the „Fast Forest" team with a 2-quadrant power supply of type NL1V 20C80. The power supply offers a charging and discharging current of up to 80 A each. In addition, the measuring electronics has a high accuracy and offers good configuration possibilities via the NL software tool and an integrated measurement data acquisition. The CSV export of the data also allows processing of the measurement data with Matlab.

Within the scope of a project work, procedures for determining the state of charge were evaluated. The source-sink from H&H was used to record quiescent voltage characteristics with 21 interpolation points and eight different charging and discharging currents. Using these recordings, a battery model was created which was implemented in the Kalman filter of the battery management system. Compared to the conventional methods of state of charge determination, an accuracy increase of 8% could be determined in a reference measurement.

This application report was produced in association with Fast Forest.