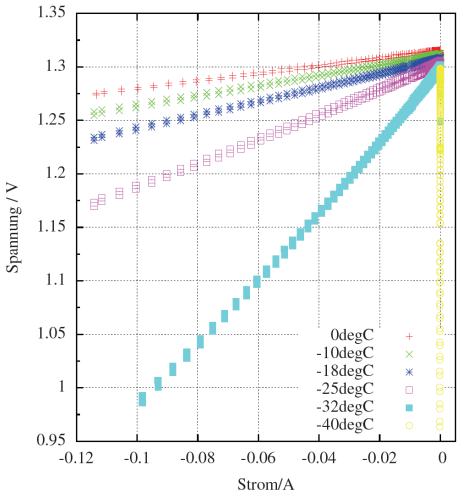
Bachelor Thesis

« State of charge prediction of electrochemical energy storages in embedded systems »

Background

Energy is the most limiting resource in embedded systems, especially the nodes in wireless sensor networks. To store electrical energy usually an electrochemical energy storage or a supercapacitor is used. To calculate the remaining node lifetime, the node should be aware of the battery's state of charge.

Many wireless sensor networks operate outdoors and suffer from severe temperature fluctuations. Electrochemical energy storages have a characteristic discharge curve, which depends on several factors. However the measurement capabilities on the node are limited. Usually only the battery voltage and the temperature is available. If an appropriate profile for the energy storage is available, it can be used by the node to calculate its battery state of charge.



Work Description

Objective of this work is to analyze the temperature dependency and create a temperature model for different energy storage technologies. The model aims at correlating the available energy with temperature and voltage. A profile is to be generated for the following technologies under controlled conditions in a climate chamber for a temperature range between -40 °C and 60 °C:

- Lithium-ion polymer (60 mAh)
- Lithium iron phosphate (CR123A size, 350 mAh)
- LSD Nickel-metal hydride (AA size, 2000 mAh)
- Rechargeable alcaline manganese (RAM, AA size, 1800 mAh)
- Supercap (electric double layer capacitor, 1-200 F)

The second step is the integration of the model into a wireless sensor node, the Atmel ATmega128RFA1. The programming task includes measurements and state of charge calculations with good performance. Knowledge in C-programming is required (preferably taking the course SES). Hardware knowledge for the measurement circuit is appreciated.

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