VIRTUAL BATTERIES AND REAL BATTERIES COMPARISON

Fraunhofer IWES

FRAUNHOFER INSTITUTE FOR WIND ENERGY AND ENERGY SYSTEM TECHNOLOGY IWES

Further Reading

Caselitz, P.; Modeling and Simulation of Lithium Ion Batteries for Hybrid and Electric Vehicles 7. Symposium Hybrid Vehicles, Electric Vehicles and Energy Management, Braunschweig February 2010

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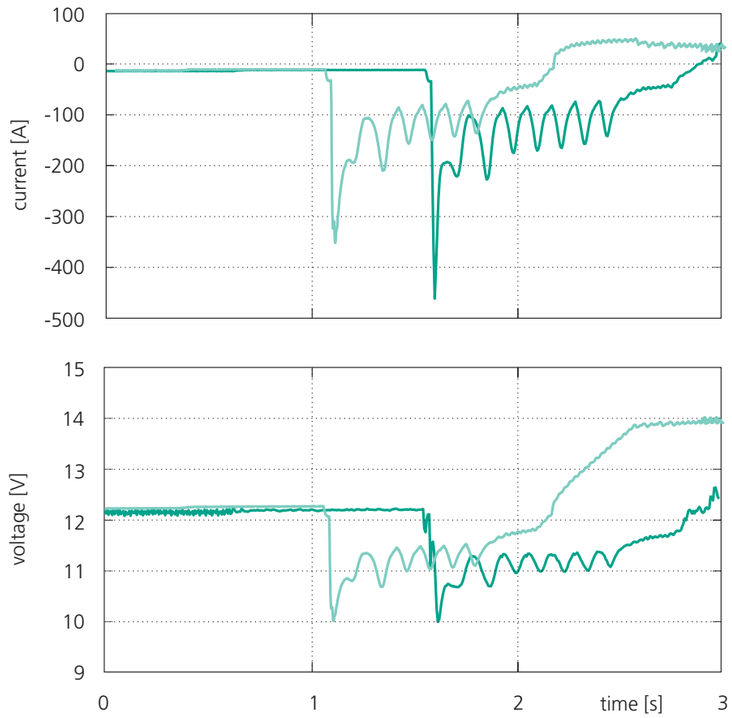
Profile of the Fraunhofer IWES
The research activities of the Fraunhofer Institute for Wind Energy and Energy System Technology cover wind energy and the integration of renewable energy into supply structures. Fraunhofer IWES was established in 2009 as a merger of the former Fraunhofer Center for Wind Energy and Maritime Engineering CWMT in Bremerhaven and the Institute for Solar Energy Technology ISET in Kassel.

The annual budget 2010 is approximately 22 million euros. Fraunhofer IWES has a staff of 230 scientists, engineers, non-technical staff, and students.

www.iwes.fraunhofer.de



Virtual starter battery with ISET-LAB-RT: Two different ignition procedures of a conventional car using a real battery (light green) and a virtual battery (green). The matching of the dynamic behaviour is clearly demonstrated.

Key Benefits

- Fast configuration of initial states
- Battery pre-conditioning not necessary
- Ambient temperature definable
- Tests exactly reproducible
- Different types of batteries can be directly compared
- Examination of aging possible
- Visualization of internal battery processes
- Available for Lithium-ion and Lead-acid batteries

VIRTUAL BATTERIES FOR E-MOBILITY APPLICATIONS

virtual battery

REAL-TIME CONTROLLED BATTERY EMULATOR

Virtual Battery

A virtual battery consists of a bi-directional power supply system connected to a control unit running a real-time battery model. The voltage output of the power supply unit is controlled by the control unit according to the voltage behavior of a real battery. The dynamical behavior of the battery is calculated by a real-time version of the IWES lead acid or lithium ion battery simulation software ISET-LAB and ISET-LIB respectively.

Bi-Directional Controlled Power Supply Unit

Commercially available products show voltage rise times of several micro seconds and are fast enough for most applications. Such power supply units are available in a wide range of voltage and current. This allows to select suitable units for nearly all kinds of applications.

Control Units

Industrial computers, programmable logic controllers (PLC) or microprocessors can be used as control units. These computer platforms are equipped with additional digital and analogue I/O interfaces, required for controlling the power supply unit and measuring electrical quantities.

Real-Time Battery Model ISET-LAB and ISET-LIB

The battery model ISET-LAB and ISET-LIB is based on the modeling of all relevant physical and electrochemical processes inside the cells of a lead-acid or lithium-ion battery respectively. The software does not only allow easy and quick definition of battery states and ambient temperatures, but also selection of battery type by a simple mouse-click. ISET-LAB and ISET-LIB allows the battery's initial state to be entered in two ways: either explicitly or as an estimation from available data like steady-state terminal voltage and degree of discharge. Only constructive parameters are needed to simulate the dynamic behavior of a selected battery.

In the automotive industry and associated supply industry ISET-LAB software has been the established standard software for simulating the dynamic behavior of lead-acid starter batteries for many years. The ISET-LIB software package has been developed on the same basis. The real-time versions ISET-LAB-RT and ISET-LIB-RT are used for implementation on the simulation environment of the control unit.

Applications

Lithium-ion batteries will play a key role in electromobility. The dynamic properties and aging behavior of these storage systems will play an important role in the development of future hybrid and electric vehicles and the design of smart systems for bi-directional grid connection.

Therefore car developers need to pay attention to the battery and it's strong non-linear behavior which depends on state, applied current and temperature. This leads to complex and time consuming battery pre-conditioning and testing processes. Virtual batteries reduce development times significantly.

A virtual battery is a valuable tool for development and testing of electrical components e.g.

- electric vehicles
- on board electrical grids
- battery converters

1 *Title: Virtual Battery (Photo: Volker Beushausen)*

2 *Simulationmodel ISET-LAB and ISET-LIB: The models describe the physical and electrochemical behaviour of Lead-Acid or Li-Ion batteries with high precision.*

3 *Virtual batteries can contribute to the development of future hybrid and electric vehicles and their grid integration (Photos: Rainer Sturm, pixelio.de; E-Up, Volkswagen AG)*

4 *Principle of a virtual battery: The setpoint for the output voltage of an electrical power source is calculated by a real time battery model using current measurements.*