Battery Management Systems

Fredrik Haag - AVL
WHO WE ARE?

Fredrik Haag
Segment Manager E-Mobility

AVL Software and Functions GmbH
Im Gewerbepark B29
D-93059 Regensburg
More than 10 years of product development!
BATTERY MANAGEMENT SYSTEM SOLUTIONS FOR HIGH VOLTAGE SYSTEMS

Highlights
- Platform Battery module management system for Electric vehicles
  - Battery cell model included, covering the most of market available battery cells
  - Tolerance and aging compensation
  - Variants to be supported by calibration
  - ISO 26262 compliant

Applications
- Commercial vehicle, passenger car, agriculture/off-road, boats, industry & stationary

Operating range
- from 48 V up to 1000 V

Architecture
- Up to 18 cells per module
- Up to 7 temperature sensors per module

High Voltage Battery Management System platform available for fast prototyping and development!
BATTERY MANAGEMENT SYSTEM CONCEPT FOR LV SOLUTIONS

**Highlights**
- Platform Battery module management system for Electric vehicles
  - Battery cell model included, covering the most of market available battery cells
  - external supply or battery stack of BMS
  - Communication interfaces
  - Shunt measurement integrated

**Applications**
- Commercial vehicle, passenger car, agriculture/off-road, boats

**Operating range**
- from 12V to 48V

**Architecture**
- Up to 14 cells
- Up to 7 temperature sensors

Concept for Low Voltage Battery Management System finished!
**Battery Management System Software Development**

AVL’s application software is based on a modular, component-based and scalable architecture.

- Clearly defined software components and interfaces
- Full **model-based** approach enables simulation and functional maturity before integration
- Well defined architecture enables software sharing approach with Tier1s and OEMs
- Functions are **calibrateable** to adapt the functionality to various applications
- Ready for integration in AUTOSAR and non-AUTOSAR environment

**AVL’s Basic software is based on a modular, component-based architecture.**

- Off-the-shelf components for OSEK OS and COM-, MEM-Stack and MCAL
- AVL developed CDD and other parts.
- Integration platform can be **full AUTOSAR** or **partly AUTOSAR**
- AVL SFR is member of Comasso organization to provide AUTOSAR based BSW
- Flashing using **UDS**
- **XCP** as calibration interface

Battery Management System SW platform available for fast adaptation to customer needs!
“Battery Management Systems”
What’s next?
BATTERY MANAGEMENT SYSTEMS TREND TOPICS

- Impedance modelling
- Thermal optimization
- Advanced Sox algorithms
- Wireless BMS
- Predictive BMS
- Multipack capability
- Big Data
WHY PREDICTIVE BMS (PBMS)?

**BMS today**

- **static limits**
  - charge control
  - temperature control
  - power de-rating

**pBMS tomorrow**

- **dynamic limits**
  - plan ahead
  - vehicle data (ADAS)
  - navigation data (e-horizon)

...
PBMS: HOW IT WORKS?

**AVL pBMS**

- Predicted power demand
- Thermal & electrical model
- Ageing model

Using additional information:

- VCU
  - Navigation data
  - Route recognition
  - Vehicle load
  - Traffic, etc.

**SAFETY & DIAGNOSIS**

**CORE FUNCTIONS**

**AUXILIARY FUNCTIONS**

**INTERFACE & COMMUNICATION**

**PREDICTIVE FUNCTIONS & BATTERY MODELS**

- Constant calculating different strategies
- Adapt operating strategy
- Optimize utilization of battery system
- Safe operation by dynamic cell failure prediction
USE CASE PBMS: OPTIMIZING FAST CHARGING

→ cooling the battery system
- in the right time
- to the right temperature
USE CASE PBMS: OPTIMIZING MILEAGE

predict power demand
thermal & electrical model
adapt operating strategy
optimization of mileage
less charge cycles

predicted power demand

-70% power
smart de-rating in cities
+60 KM mileage
smart de-rating in traffic

T=55°C
gas station
AVL
Regensburg
Passau
Wels
Graz
A
Passau
Regensburg: B

Source Picture: http://www.googlemaps.com
USE CASE PBMS:
OPTIMIZING BATTERY LIFETIME

- predict power demand
- thermal & electrical model
- adapt operating strategy
- minimize ageing
- improved lifetime

Model "Ima2"

- High power demand
- 36°C

Temperature / °C
Current / C-rate

Damage/ppm/h
BENEFITS OF PBMS:
ENABLES THE BMS TO PLAN AHEAD

- **predictive BMS**
  - optimized utilization of battery system
  - accelerated charging
  - cost reduction
  - increased lifetime
  - extended mileage
  - improved safety
Thank you!