

REM2011

„Hands on Hybrids“ Practical Education at the University of Applied Sciences Bochum

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Introduction

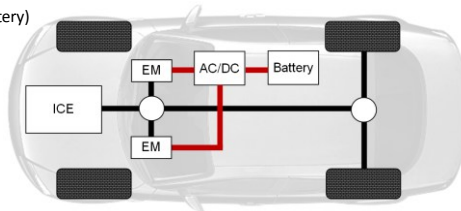
- New components and drivetrains in education
- Many types of drivetrains are possible:
 - Fully electrical
 - Micro hybrid
 - Mild hybrid
 - Full hybrid
- Complex control strategy is needed

Introduction

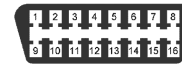
	Micro Hybrid	Mild Hybrid	Full Hybrid
Voltage level	12V	<200V	<1000V
Functions	Auto-Start-Stop	Auto-Start-Stop Boost Regenerative braking	Auto-Start-Stop Boost Regenerative Braking Full electric driving
Example	BMW 1er	Honda Insight	Toyota Prius

Toyota Prius

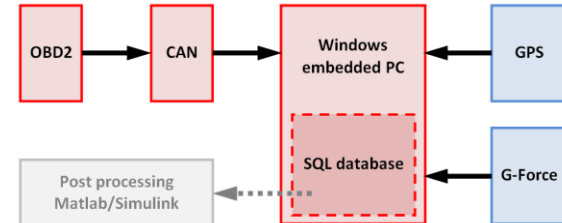
- Full hybrid
- Power-split drivetrain called “Hybrid Synergy Drive”
- Very complex control strategy
- Voltage:
 - 201,6V (HV battery)
 - 500V (EM)



Measurement System



OBDII interface



Measurement System



Practical Training for the Students

- The described hardware will be used for lessons at the Bochum University of Applied Sciences
- Each course is divided into three parts
 - Theoretical lessons
 - A test drive
 - Post processing of the acquired data

Practical Training for the Students

Theoretical lessons

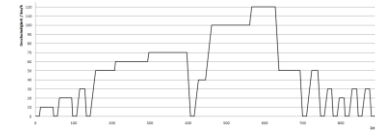
- Drivetrain basics
- Limits of the components
 - Maximum battery current
 - Maximum revolution of the EM
- Car specific parameter
 - Maximum full electric speed
 - Usable SOC



Practical Training for the Students

Theoretical lessons

- Drive cycle
 - Created by students in smaller groups
 - Should cover all possible interactions of the drivetrain components
 - Could be designed to get a deeper view into the drivetrain operations or to compare several hybrid electric vehicles against each other on a defined drive cycle
- The students have to estimate the relevant parameters to be stored in the database and set up the measuring system accordingly



Practical Training for the Students

Test drive

- Each cycle should be driven several times
- Pedal positions must be tracked in every case
- Should be done by different team members



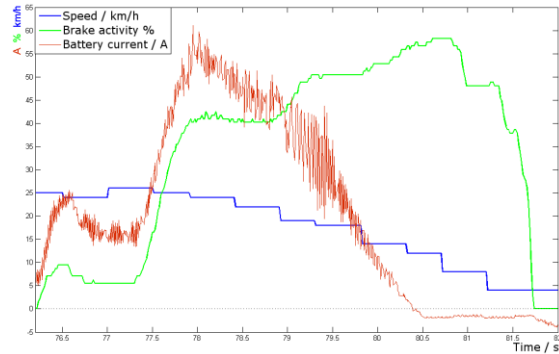
Practical Training for the Students

Post processing

- The students analyze the recorded data with Matlab
- Getting experience in Matlab is another advantage of the described way of studying
- The raw data from the MySQL database must be transformed into useful values and units by the students
- Filters should be applied to minimize noise

Practical Training for the Students

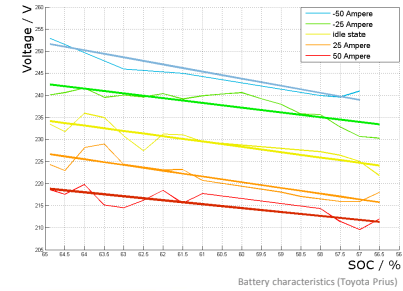
Post processing with Matlab



Practical Training for the Students

Post processing

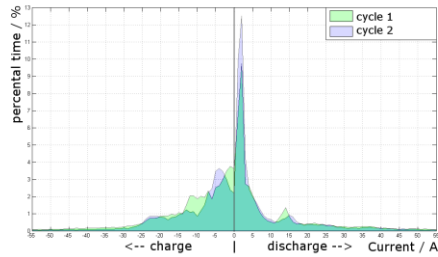
- Different data sets can be combined to characterize single components (for example the HV-battery)



Practical Training for the Students

Post processing

- Different data sets can be combined to get information about the stress on several drivetrain components



Percentile time of specific currents (Toyota Prius)

Summary

- The students have the opportunity to get their “hands on hybrids”
- The students can fully understand the complexity of hybrid electric vehicles
- The students get used to the engineering workflow

Future



Thank you!