Institute for Electrical Machines, Traction and Drives

Location:
Hans-Sommer-Str. 66
38106 Braunschweig

Office building
lab for electrical machines
lab for power electronics
workshop
IMAB – Research

Power Electronics
- Converter Topologies
- Cooling Systems
- IGBT Driver Design
- Integration
- Application of Converters for EM
- Inductive Power Transfer
- Control of el. Drives

Electrical Machines
- Polyphase Machines
- Rotational, high power (HTSL)
- New Materials (Magn., SMC)
- Linear Actuators
- High Power Test beds
- System design, Simulation
- Measuring, Validation

Special Fields
- Superconducting Bearings
- Energy Storage Systems
- Flywheel Storages
- Intell. Batterymanagement
IMAB Core Competence: Prototyping of Electrical Drives

Rough calculation

Accurate design

Performance Analysis

$P_{\text{max}}, M_{\text{max}}, n_{\text{max}}, \eta$

Testing, Validation

Prototype Fabrication

Optimization
Powertrain Simulation of Hybrid and Full Electric Vehicles

Simulation Environment by IMAB

Tools:
Matlab / Simulink
FLUX, ANSYS
Investigation of Special Effects in Electrical Machines

Segmented rotor of PMSM with eddy currents in magnet material

**Results:**
- Analytic models were verified via FEM-calculation
- Verification of numerical calculations via measurements

**Eddy current losses in permanent magnets**
- Development of analytic calculation tools
- Models which consider end effects
- Special analytic tools to represent the whole frequency spectrum

**Eddy current losses in high permeable materials**
- Design of numerical models for efficient loss calculation on low depth of penetration
- Implementation in ANSYS models
IMAB Fundamental Research: High Speed Drives, > 20,000 rpm

- Power Increase
  - 100 kW, 6000 rpm
  - 200 kW, 16000 rpm

- Reduction of volume, weight
  - 100 kW, 16000 rpm
Power Electronics, Converter Design

Specifications:
- Bidirektional multiphase DC/DC-converter for supply of DC voltage link \( (V_2 = 400 \text{ V}) \) out of HV-battery \( (V_1 = 180..270 \text{ V}) \)
- Nominal power: max. 100 kW
- Very low current ripple

Advantages:
- Low current load of IGBTs
- Low input current ripple
- Scaleability
Project

New Materials for Motor Design – SMC

B-H Curves

STZ_Somaloy500_N2
STZ_Somaloy500_Normalatmosphäre
STZ_Somaloy500_2_Normalatmosphäre

Linear Actuators

Statorjoch (Eisen, SMC)
Statorspulen in Nuten
Translatorjoch (Eisen)
Eisenzähne
Permanentmagnete (Erregung)
Partners (InDrive):
IAV Berlin
TU BS IMAB
TU BS IFR
TU Berlin IKMM

Research Target:
Development of a new innovative tool for simulation and design of complex powertrains in real vehicle operation

Data:
Basis: VW T5 Allrad
E-Drive: 3 x ASM 150 kW / 370 Nm
HV-Battery: LiFePo, $V_{\text{nom}} = 520$ V
Weight: 3.5 t
**Project**

**PRIMOVE: Induktive Charging of Busses, 160 kW**

**Partners:**
Braunschweiger Verkehrs-AG,
BS|ENERGY, Bombardier,
TU Braunschweig (IMAB, Prof. Meins)
TU Braunschweig, elenia, IVA

**Funded:**
Bundesministerium für Verkehr,
Bau und Städteplanung

**Time:** 6/2012 – 12/2013

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**22 kW Induktive Power Transfer**
IMAB Testbeds for Electrical Drives

Test bay – Test beds:

- typical 100 ... 250 kW load
- up to 600 kW possible
- max. torque up to 850 Nm directly
- up to 10 kNm via gear
- max. speed 10.000 1/min directly
- up to 30.000 1/min via gear
- machine cooling/ conditioning up to 250 kW cooling power

Measuring Equipment:

- Power analyzer (Currents 3x1000 A)
- torque measuring up to 3 kNm
- vibration measurement
- thermographie camera

HV-Battery Emulation:
up to 1000 V, 1000 A, 350 kW

Div. DC Power supply
- up to 1000 V
- power up to 500 kW