TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Electrical Engineering and Information Technology Chair of Electrical Machines and Drives

Research and Teaching
at
Department for Electrical Machines and Drives
at TU Dresden

W. Hofmann

Member of Staff

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Scientific staff:	**5**
Non-scientific staff:	**2 + (2)**
Scientific tutorial assistant	**1**
Scientific staff (third party funds):	17
PhD students:	2
External PhD students	10
Tutorial assistants:	5
Diplomates:	12
Students in seminar projects:	10
Trainees:	20

Laboratory Equipment

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Areaway (354m²)

- Heavy-duty area
- 8 Machinery framings
- Installed load up to 300 kW,
- Incoming supply3 x 400 V, 3 x 600 V;
- sinusoidal, controlled three-phase system up to 500 Hz,
-

7 Research labs (400m²)

3 Labs for teaching and practical training (112m²)

1 PC-Pool

Focuses of Research

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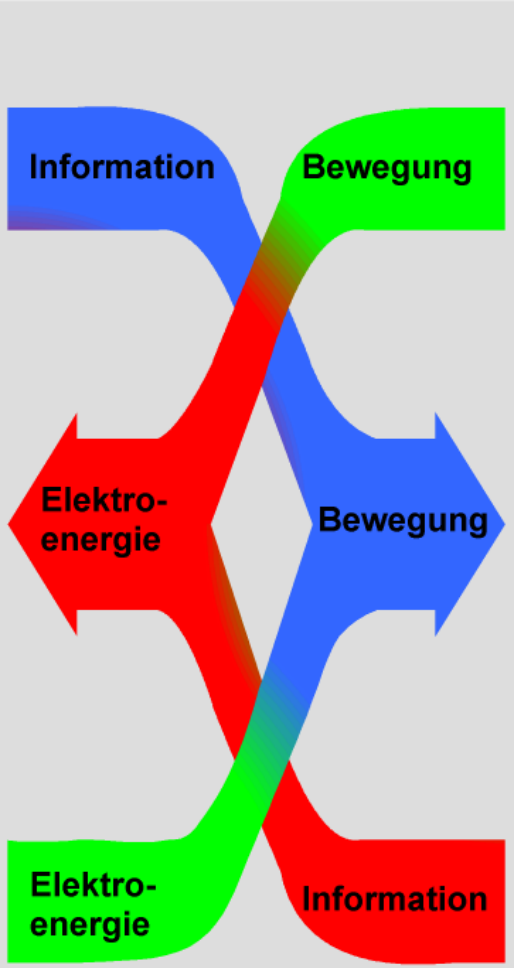
Energy Conversion



Fundamentals

A	Methods, Modeling, Simulation, Design-Tools for Machines and Drives
B	Industrial Electronics – Converter - Control

Applications

C	Regenerative Energy Sources
D	Magnetic Bearings - Mechatronics
E	Electric- and Hybrid Vehicles

F	Cooling of electrical Machines

Focus of Research

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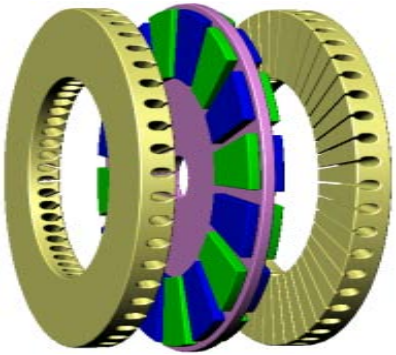
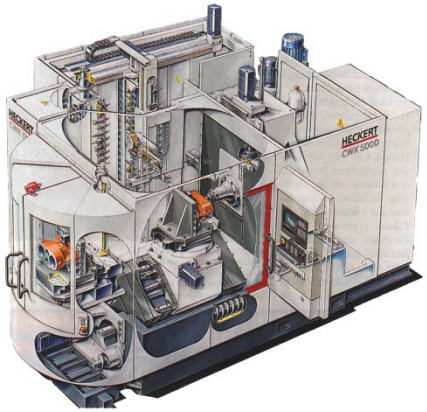
A Methods, Modeling, Simulation, Design Tools for Machines and Drives

- **Methods** for modeling, design and dimensioning, as well as for control and optimization of single components of machines and inverters and also of the complete energy conversion system



- **Solutions** for individual questions of consturction and design of electrical machines; especially PM-Machines stand thereby in the focus.



- These strongly **method-oriented** work will support also by co-operation with **enterprises in the regional surrounding** field of the university and within the **international framework**

Example: Design of Machines

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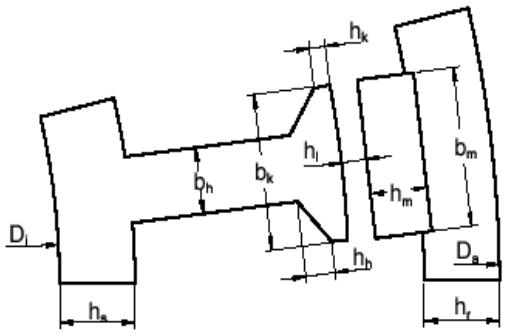
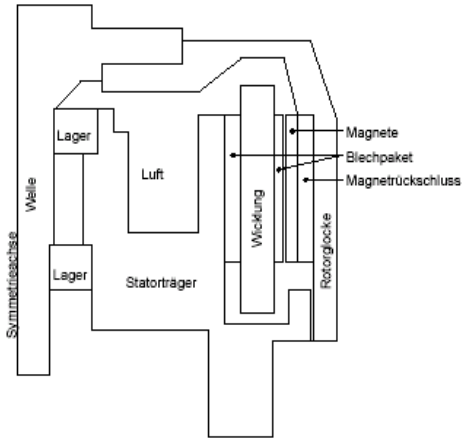
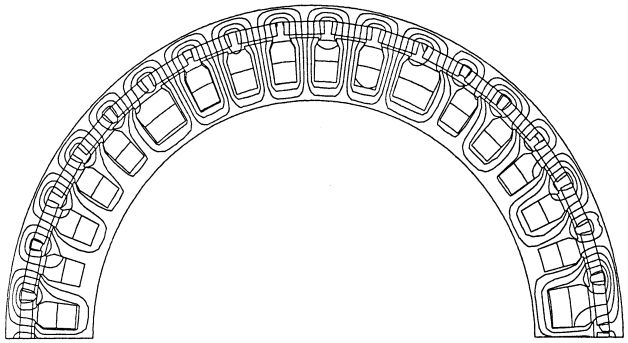
Magnetic field simulation

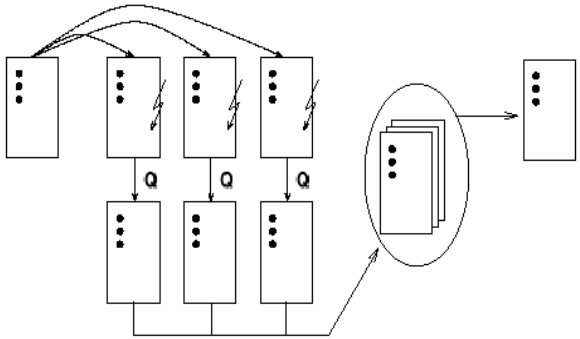


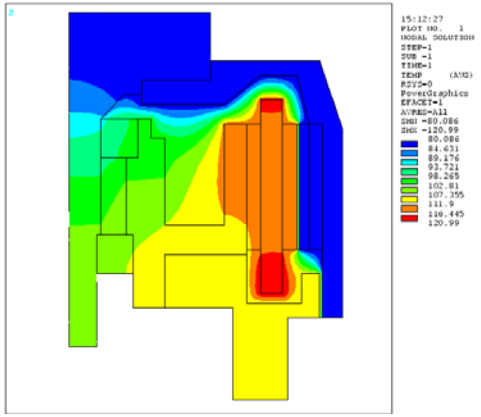
Evolutionary Optimization

Temperature field simulation









Example: Energy Efficiency

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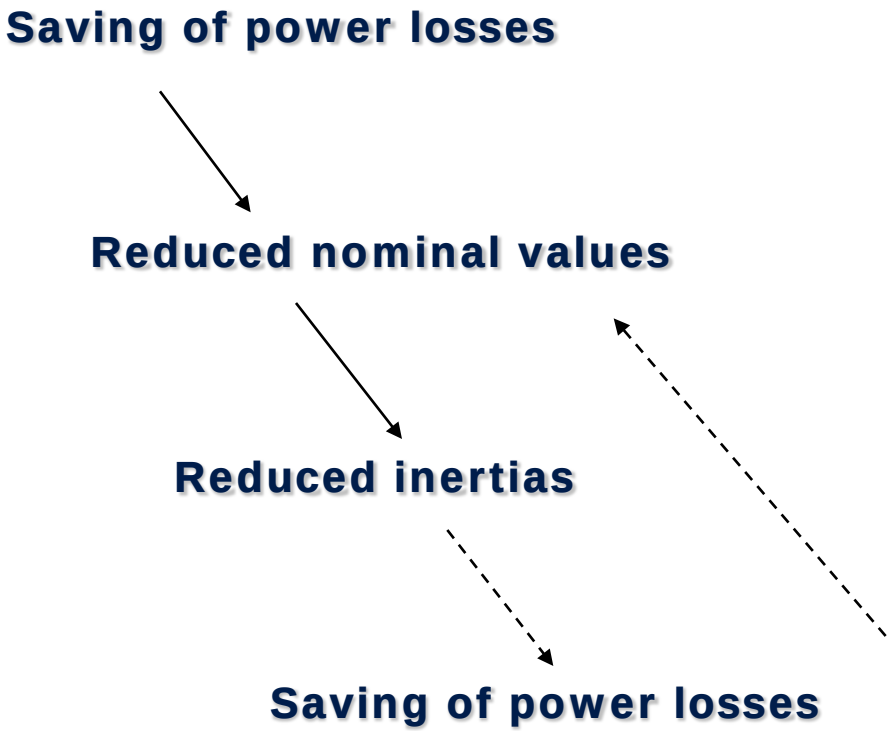
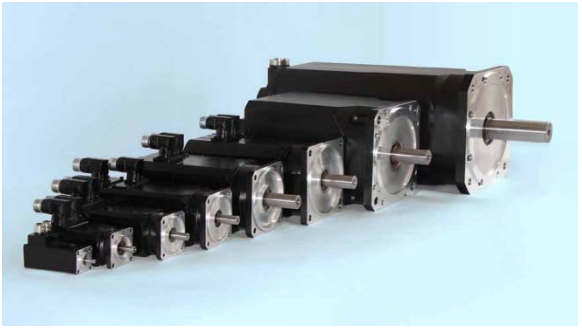
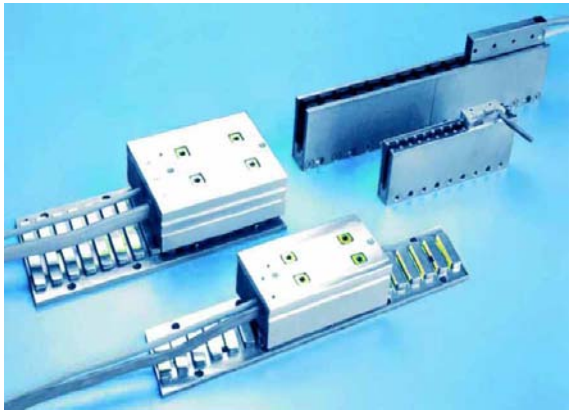
Chain of reduction for an energy-optimal control





AC-Servo motors (source: ESR Pollmeier GmbH)



AC-Linear motors (source: ESR Pollmeier GmbH)

Focus of Research

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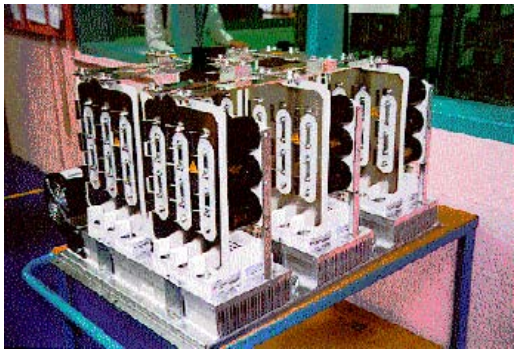
B Industrial Electronics – Converters – Control

- research in the field of industrial electronics is focused on converter technology as well as control of energy transducers (motors, generators)

- the investigation, development an special application of energy efficient converter topologies, based on modern semiconductor devices are placed in the center of interest

source: Lenze

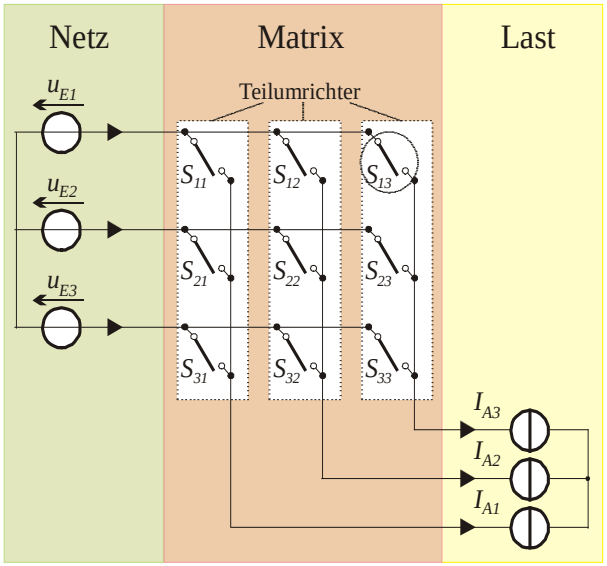


source: IDS AG

Example: Drive-Converter

Minimum-step commutation policies

Bidirectional switches with RB-IGBTs



CMV-minimized control methods and converters

Simplified matrix converters

Z-Source Inverter

Sensor-based commutation

Direct control of matrix converters

Bidirectional switches with semiconductors based on SiC

Focus of Research

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C Regenerative Energy Sources, in particular Wind Energy

- A further main application field concentrates on **regenerative electromechanical energy converters in particular for wind energy plants**
- It goes with priority thereby around **generators** with reduced losses and masses, efficient energy converting methods by the application of special **inverters** and **control methods** as well as around a appropriate **supply connection**.
- Research works diagnostic and state estimation of **slip ring systems**.

Quelle: Voith Turbo

Quelle: TU Chemnitz

Example: Wind Energy

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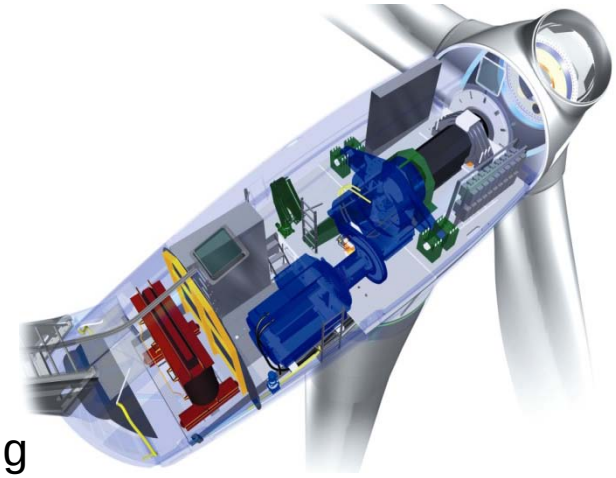
Optimal design of double feed asynchronous generators

Torque and power factor control

Generators with hydro-dynamic torque converter



Energy optimal control

Synchronous operation of double feed three-phase generators

Diagnostic for slip ring systems

Electronic compensated PM-Generator

Lagerstromreduktion und -diagnose

Direct power control

Focus of Research

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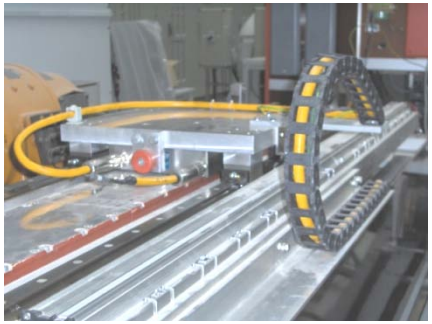
D Magnetic Bearings - Mechatronics

- Research in Magnetic Bearings will focus on reducing rotor losses caused by hysteresis and eddy currents in high speed drives and on improving precision considerably.
- Work is in progress for improving overall system efficiency of direct drives (both linear motor and torque motor), which is still lower than in geared drives.
- Since both active magnetic bearings and direct drives are operated with speed and/or position control loops, position sensors are very important.

Source: Levitec



Example: Magnetic Bearings

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Time-optimal control

Voltage controlled magnetic bearings

Soft magnetic composites in active magnetic bearings

Unbalance force compensation with neuronal networks

Integrated position and angular measurement

Bearingless switched reluctance machine

Direct position measurement with Kalman filter

Bearingless drives with concentrated windings

Focus of Research

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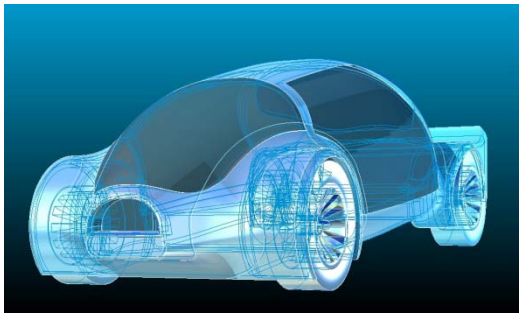
E Electric- and Hybrid Vehicles

- The focus of improvement lies on the development of electromechanical transducers and **traction motors** with a reduced inertia and high torque as well as the design of a capable **control method**.
- Since the technology of hybrid drives is only a necessary step to the technical solution of **pure electrical drives** consisting of battery or fuel cell and traction motor, projects to energy management of fuel cells that already started are expanded to automotive applications.

Source: FhG IVI



Source: ZEOS

Example: Electric- und Hybrid Vehicles

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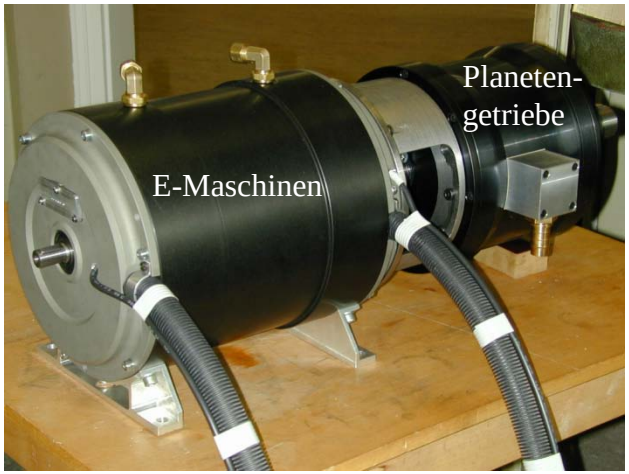
Continuous power-split transmission in hybrid vehicles

Sensitivity analysis of PM-synchronous machines in hybrid vehicles



Satellite gear for auxiliary drives in cars

Generator for hybrid trolleys

Design program for servo-motors in cars

Compact traction motor for AUTOTRAM

Focus of Research

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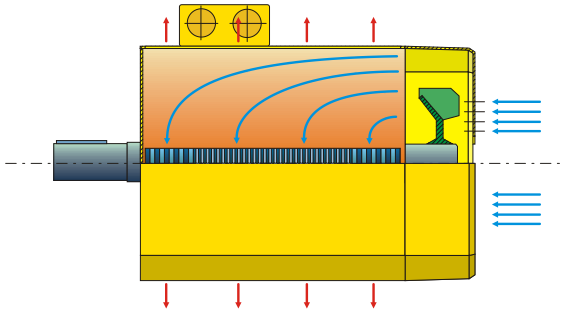
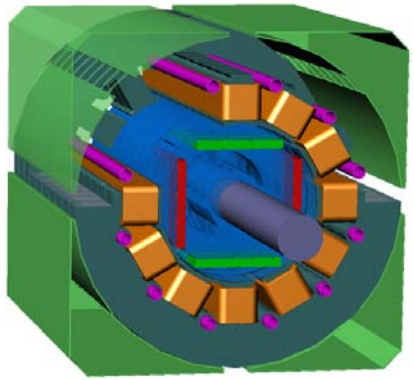
F Cooling of Electrical Machines

- Based on new simulation and development tools (3D-modeling, multiphysics modeling) it is the ambition:

- to develope efficient air cooling techniques for compact machines that substitute water cooling

- to lead new possibilities of designing electrical machines (circumferential cooling or heat pipes) to the state-of-the-art of engineering





Co-operation

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Industry

Baumüller
Bosch
DaimlerChrysler
FhG IVI
Gebhardt
IAV
Levitec
Renk
Semikron
SGL Carbon
Siemens
Toyota
VEM Sachsenwerk
Voith Turbo, Voith Siemens
Wittur

Universities

Nagoya Institute of Technology, Japan

COPPE – Univers. Fed. do Rio de Janeiro

UFMG - Federal University of Minas Gerais

TU Darmstadt

CENEDIT Guernavaca - Mexico

Universität Jekaterinenburg

Université de Lille 1 (USTL)

Indian Institute of Technology, Dehli

TU Hanoi

HTW Dresden

HTW Zwickau