



# The Department of Electrical Engineering and Information Technology

at the University of Applied Sciences Munich  
Lothstraße 64  
80335 Munich, Germany

see also: <http://www.ee.hm.edu/>

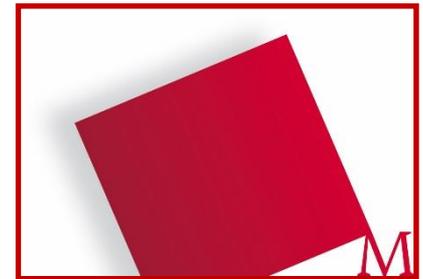
# Munich University of Applied Sciences – MUAS

## ■ Largest University of Applied Sciences in Bavaria

- 18300 students, 500 professors, 660 employees, 800 visiting lecturers
- 42 bachelor, 43 master
- 5000 beginners

## ■ 4 Main Areas of Education

- |                                       |       |
|---------------------------------------|-------|
| - Engineering, science and technology | 66,6% |
| - Economy and business administration | 19,4% |
| - Social sciences                     | 11,3% |
| - Design                              | 2,7%  |



## ■ Organized in 14 Departments („Fakultäten“ FK)

- FK01: Department of architecture
- FK02: Department of civil engineering
- FK03: Department of mechanical, automotive and aeronautical engineering
- FK04: Department of electrical engineering and information technology
- ....
- FK14: Department of tourism management



# Department – Overview

## ■ Department Structure

- approx. 1300 students / 340 freshman/year
- 45 fulltime professors
- 30 other employees (lab and admin)
- 50 visiting lecturers (about 30 each semester)
- about 32 laboratory facilities for teaching and research



## ■ Bachelor Programs

- Bachelor „Electrical Engineering and Information Technology“ (EI)
- Bachelor „Renewable Energy - Power Engineering“ (RE)
- Bachelor „Electrical Engineering - Electromobility“ (EM)

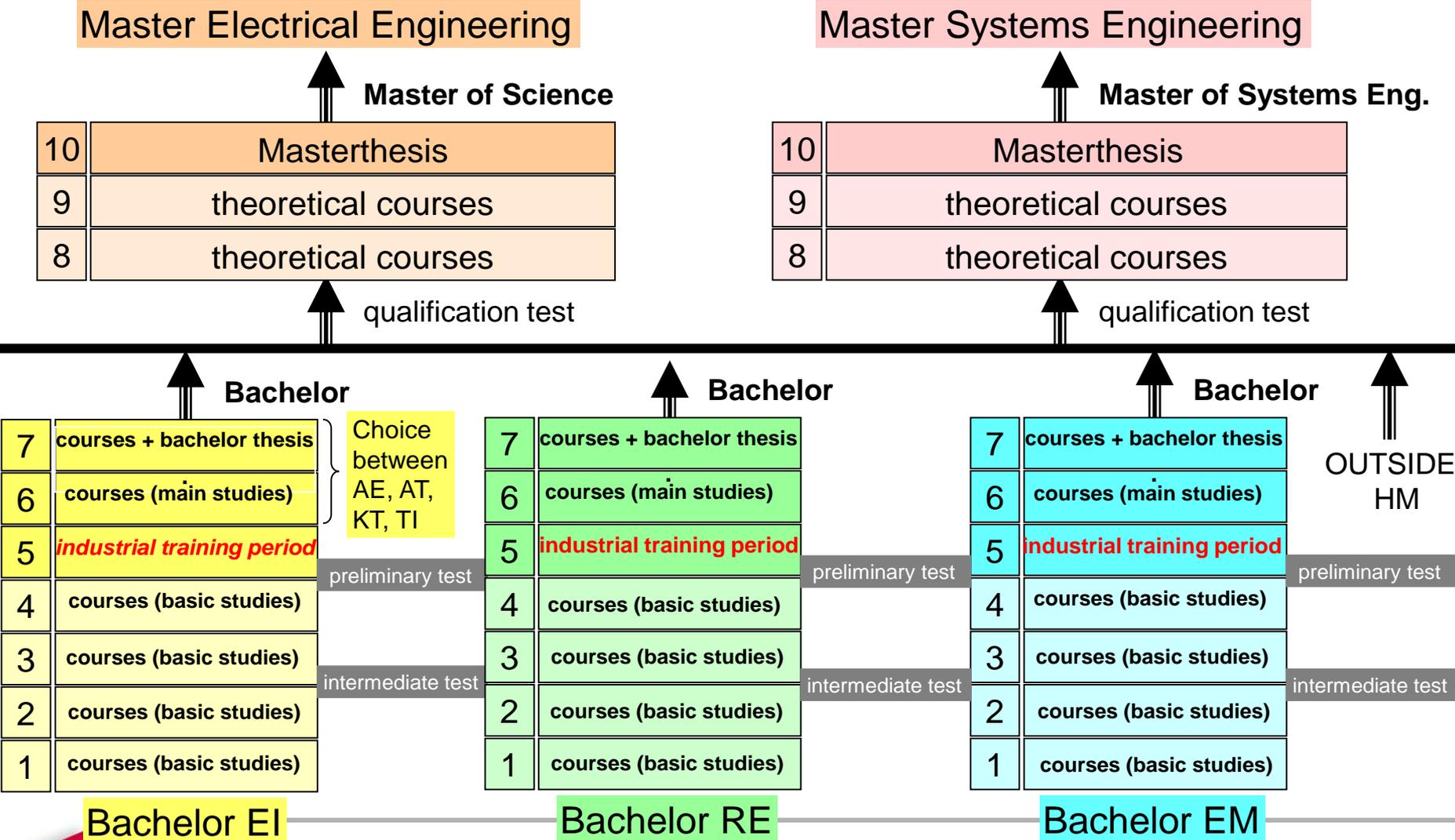


## ■ Master Programs

- Master „Electrical Engineering“ (ET)
- Master „Systems Engineering“ (SE)



# Structure of Bachelor- and Masterprograms



# HM Dual Study program

- We offer so called dual studies opportunities in cooperation with the consortium *university dual bavaria* and with numerous industrial partner companies.
- There are two basic types:
  - studies and vocational training in combination
    - Duration 4,5 years
    - Dual degree: Bachelor degree and certificate from Chamber of Commerce and Industry
  - studies with intensive industrial internship periods
    - Bachelor: duration 3,5 years
    - Master: duration 1,5 years
    - Student is during his studies funded by and bounded by contract to industrial partner
    - Bachelor – Master degree



ARRI®

BR

infineon



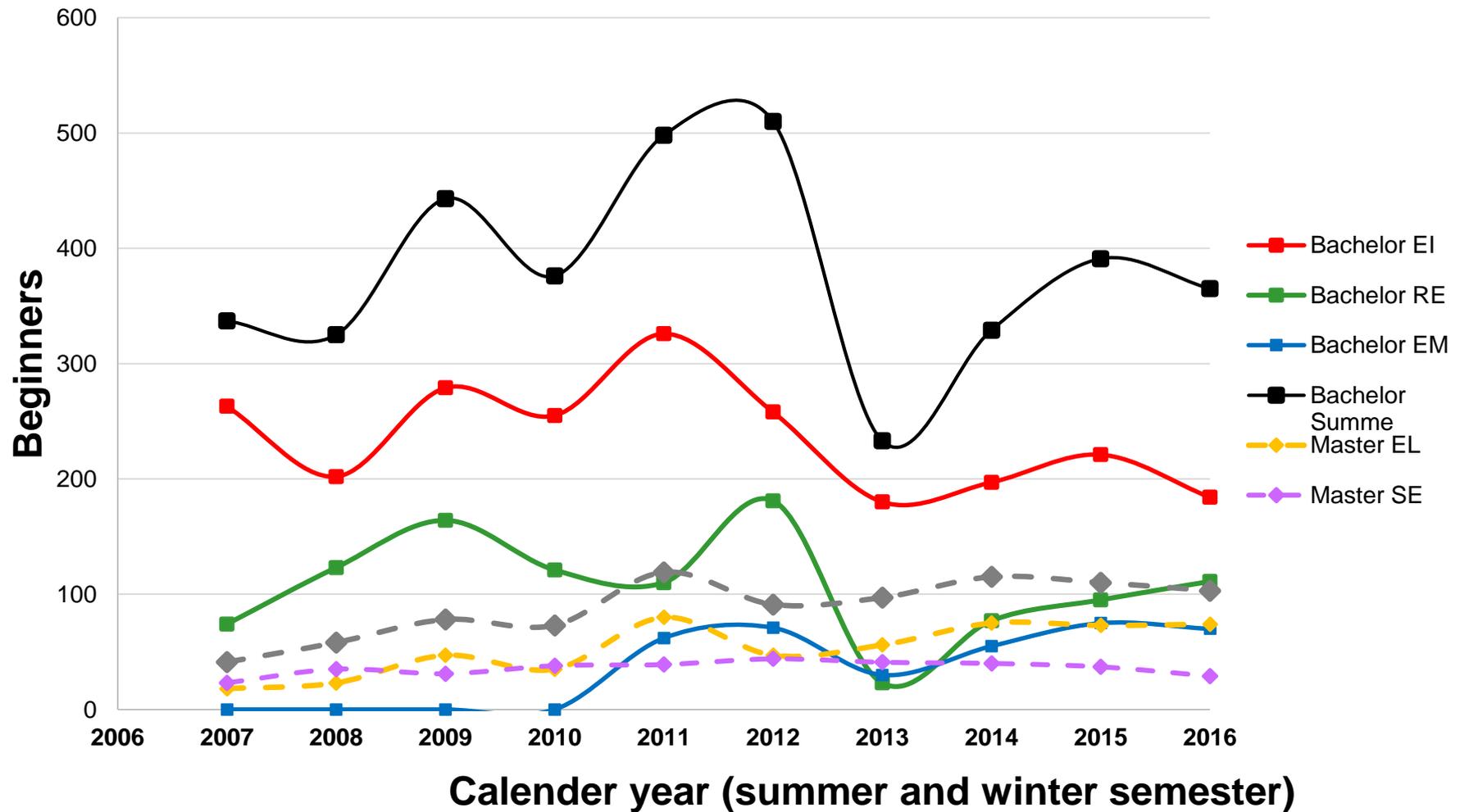
SIEMENS



Giesecke &amp; Devrient



# Statistic Beginners



# Long-term student projects

- Shell Eco Marathon →



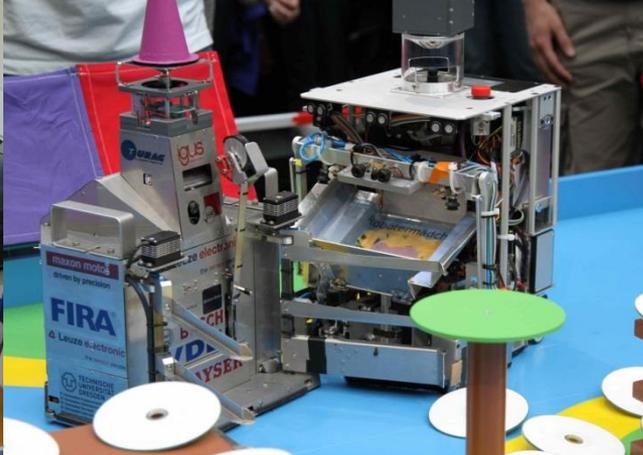
- ← Formula Student Electric  
<https://www.munichmotorsport.de>



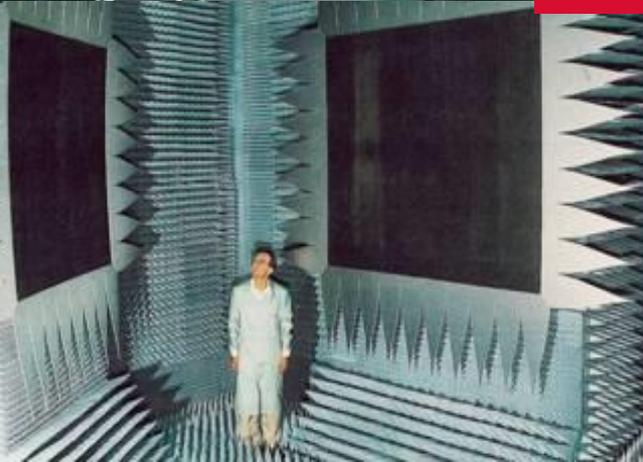
- ← Formula Student driverless

- ProCK →





# Research and Development



# List of Laboratories (for Teaching and/or Research)

- Packaging of Integrated Circuits
- Realtime Operation Systems and Programming
- Computer Networking
- Digital Technologies
- Electrical Engines and Machinery
- Electrical Measurement Technology
- Electronics
- Fundamentals of Electric Engineering
- High-Frequency Techniques
- High Voltage Engineering
- Power Electronics
- Mechatronics
- Microcomputer
- Microcomputer Systems
- Microelectronics
- Microwave Techniques
- Multimedia Applications
- Pattern Recognition & Artificial Intelligence
- Communication Satellites (Compact Range)
- Optical Communications
- Computer Applications
- Control Theory and Technology
- Analog Circuit Technology
- Analog Signal Processing
- Software Development
- Solar Techniques und Energy Systems
- Systems Engineering
- Material Science
- Communication Transmission
- Computer-Kicker
- Robotics Laboratory
- Workshop fine mechanics



# Applied Research: Sensors

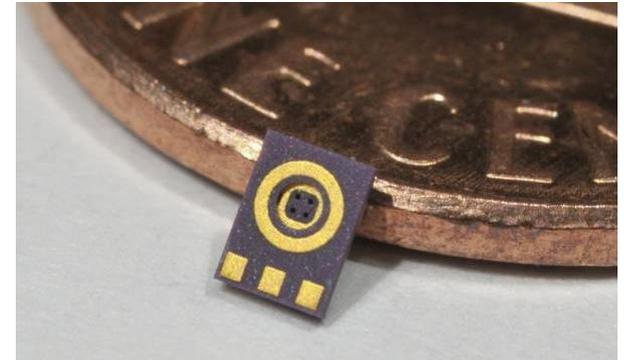
**Project SimuSens:** Development of a framework for the simulation of the thermomechanical stress in sensors.

Project Partner: EPCOS, a TDK company

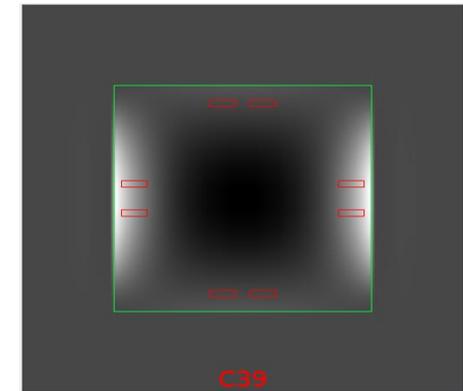
Funded by the German Ministry of Research

Tasks of the UAS:

- Development of material models for solder and polymers
- Simulation of pressure sensors and microphones
- Verification of the simulations by measurements
- Development of low stress packages



MEMS-Microphone 2 x 3 mm<sup>2</sup>



Stress on a pressure sensor chip

Prof. Dr. G. Feiertag



# Applied Research: High frequency components

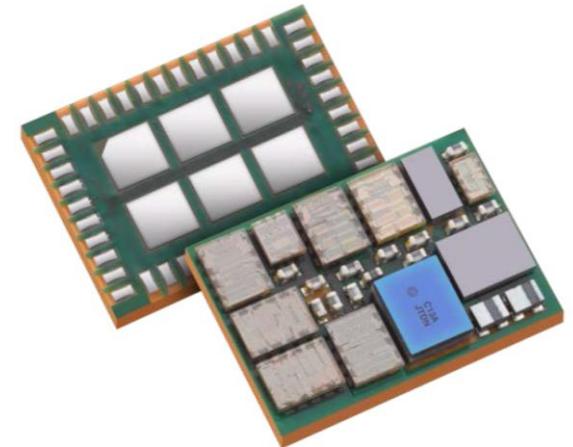
**Project MoMiFi:** Miniaturization of high frequency modules for mobile phones.

Project partners: RF360, a Qualcomm/TDK Joint Venture, ASM, Christian Koenen GmbH

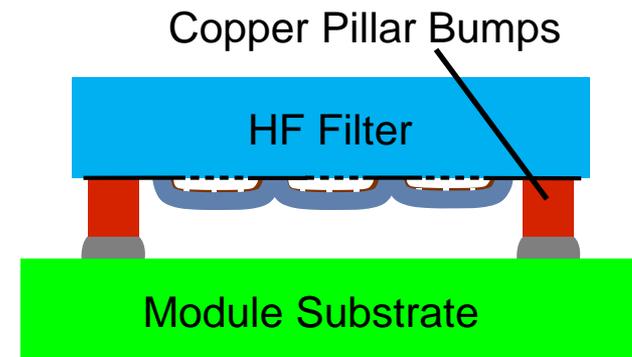
Funded by the Bavarian Ministry of Economics

Tasks of the UAS-Munich:

- Development of copper pillar bumps as an replacement for solder bumps for micro-acoustic components
- Assembly of test modules, reliability testing, analysis and optimization of process and design



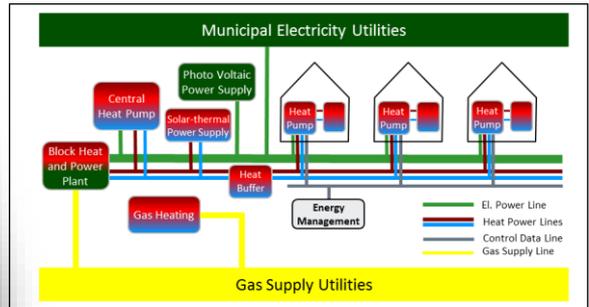
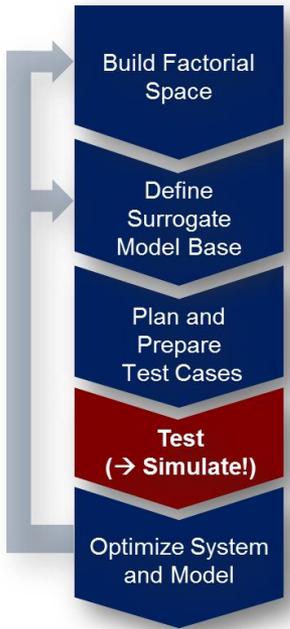
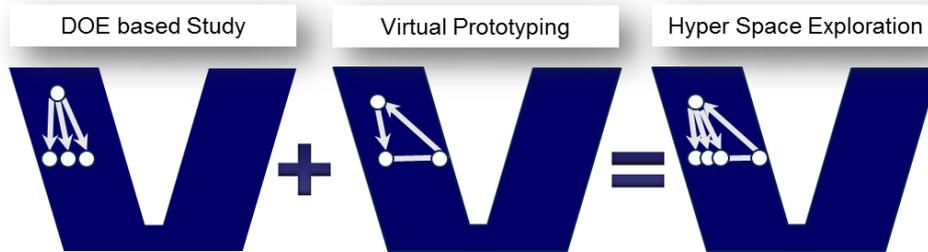
HF-Module, ca. 3 x 4 mm<sup>2</sup>



Prof. Dr. G. Feiertag



# Applied Research: Engineering of Complex Systems



- Entering new technologies involves:
  - Large amount of unknown solutions
  - Lack of „proof-of-concept“
- Extending the V-Model allows to manage related uncertainties
- „Hyper Space Exploration“ is a multi-criterial trade-off-analysis making use of:
  - Design of (virtual) experiment
  - Surrogate modelling
  - Model-driven system optimization
- Our applications:
  - Sustainable energy systems
  - Automotive top-level design (FEVs)
  - Complex Controller Design

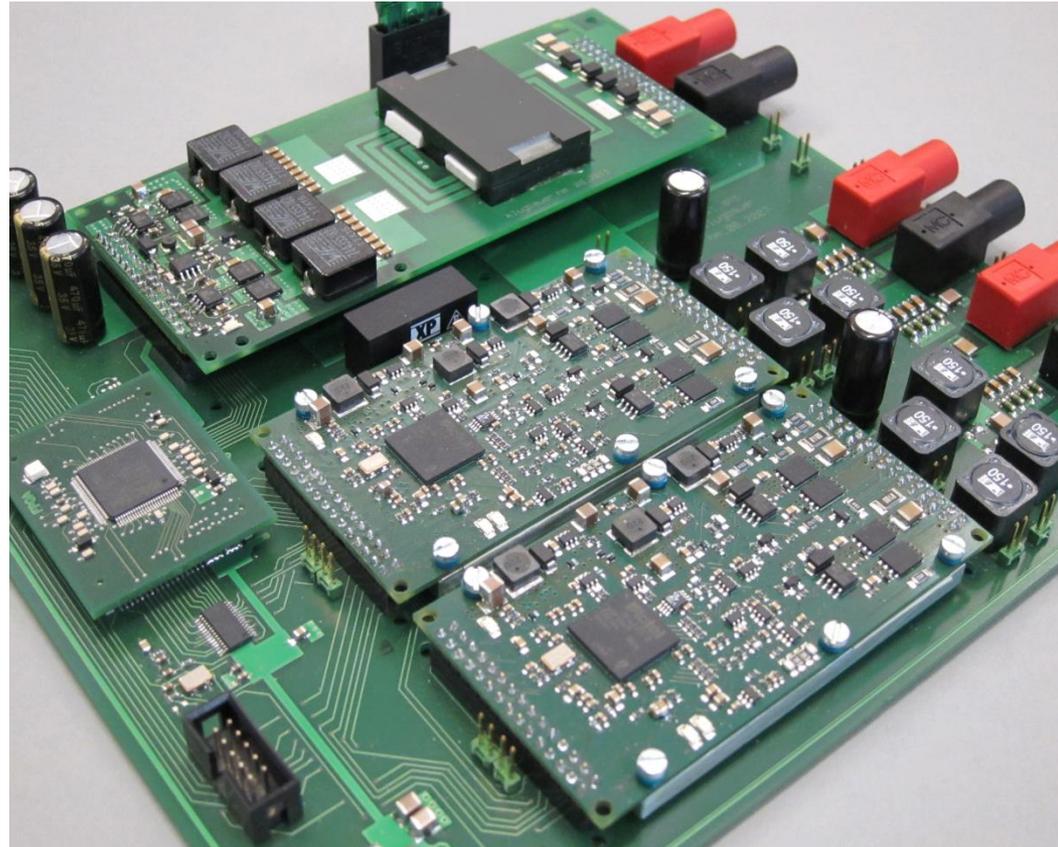
Prof. Dr. H. Palm



# Applied Research: Energy Efficient Class-D Amplifiers for ELA

**Topic:** Energy-efficient 100V system amplifier for ELeetroacoustic infrAstructure (ELA)

- 100V system amplifier for ELA without line transformer
- Up to 400 W with 97% efficiency without fan or heat sink
- Module size only 9 cm x 5 cm x 1 cm
- High efficiency under all load conditions due to integrated variable supply voltage concept (patented)
- Switched-mode power supply using low-cost planar transformer
- Continuous self-test of the whole system



Josef Klugbauer, Prof. Dr. C. Mürker



Department of Electrical Engineering (EE) and Information Technology (IT)  
see also additional information on <http://www.ee.hm.edu/>

09.04.2018

13

# Applied Research: Digital Filter Design Tool *pyFDA*

**Topic:** User-friendly open-source tool for design, analysis and synthesis (VHDL and Verilog) of discrete-time fixpoint filters

**Application Areas:** Digital signal processing and FPGA design for R&D and education

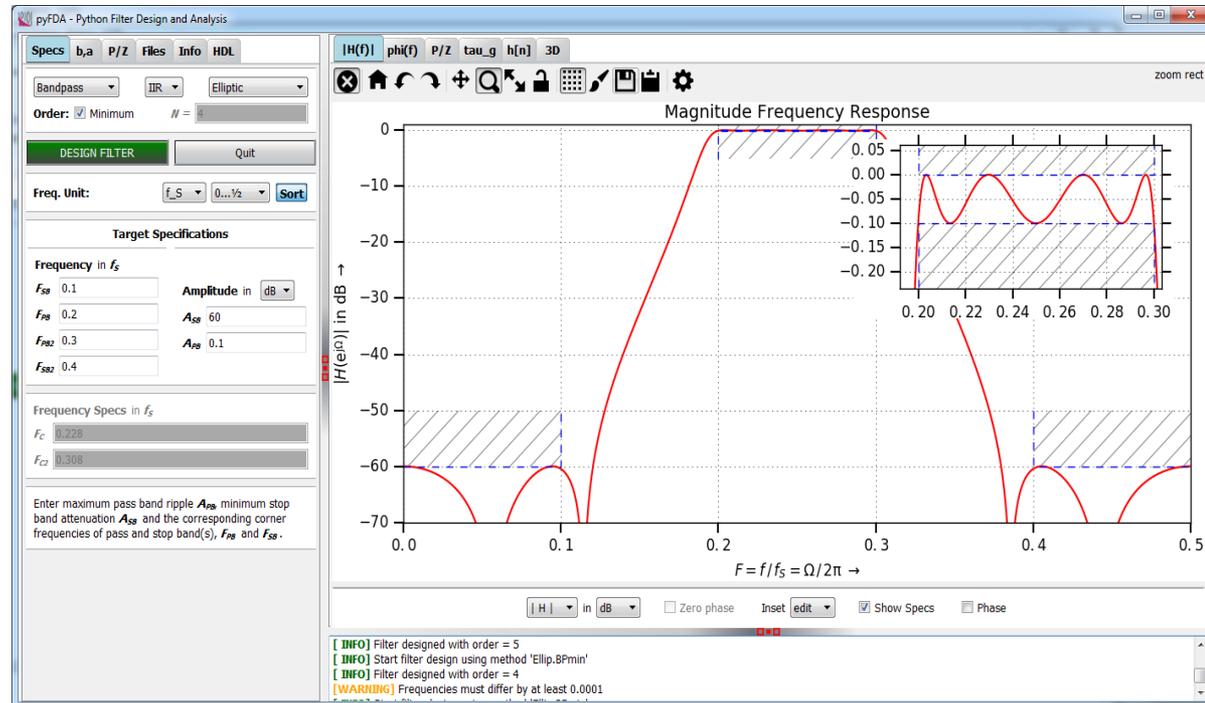
**Open-Source:** Developed with Python and Qt-Widgets ([github.com/chipmuenk/pyfda](http://github.com/chipmuenk/pyfda))

**Modular architecture** for fast development of new filters and analysis modules

**Google Summer of Code 2018:**

- Link pyFDA and myHDL ([www.myhdl.org](http://www.myhdl.org)) for easy VHDL and Verilog code generation
- Implement more complex (a.o. systolic FIR) filters and synthesize them

Prof. Dr. C. Mürker



# Applied Research: Fault-tolerant and efficient mechatronic and regenerative energy systems

Large-scale WTS



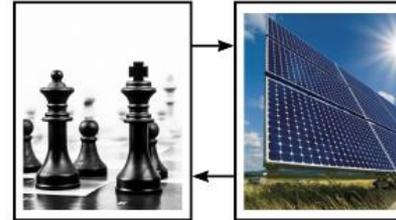
Efficiency+Reliability

Small-scale WTS



Reluctance SM

Model predictive control for RES



Real-time applicability

Airborne Wind Energy



Fault-tolerant control

Geothermal energy



Fault-tolerant control

Wave energy (SinnPower)



Efficiency+Reliability

Electric vehicles (BMW)



Efficiency+Reliability

Electrical power system

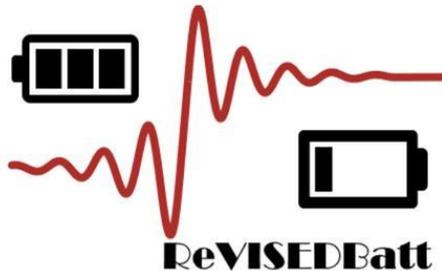


Three-phase four-wire system dynamics

Prof. Dr.-Ing. Christoph M. Hackl



# Applied Research: Detection & Localization of mechanically induced damages in lithium ion batteries (ReVISED Batt)

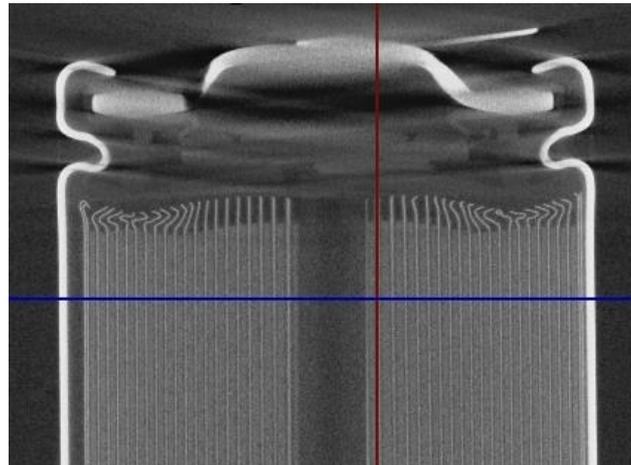


## Research:

- Realistic mechanical stresses, such as shocks, vibrations and external forces
- Damages in cell and module components
- Effects on operational and aging behavior
- Detection methods

## Objectives:

- Knowledge of damage mechanisms
- Development of novel early detection methods
- Online application in battery management systems



## Project:

- Project period: 2017/09 – 2020/09
- Staff at HM: one research fellow, student workers

Supported by:

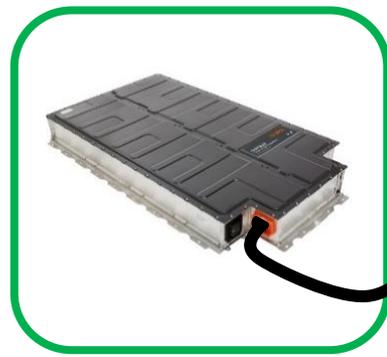


on the basis of a decision  
by the German Bundestag

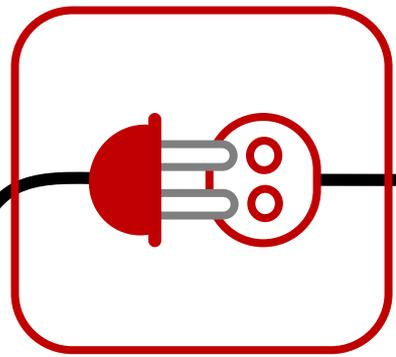


# Applied Research: Universal connection of automotive traction batteries for stationary applications (UnABESA)

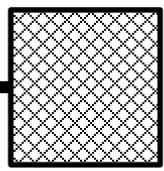
Second-Life applications for traction batteries



Plug & Play coupling element



AC-Grid



### Research objectives

- Universal architecture for different batteries and applications
- Highly efficient power electronics with innovative control
- Optimized power flow in heterogeneous battery systems

### Applications

- Frequency regulation
- Peak shaving
- Decentralized storage

### Challenges

- No standardized design
- Different battery properties
- Costs

### Project:

- Project period: 2017/06 – 2020/06
- Staff at HM: two research fellows, student workers

Supported by:



on the basis of a decision by the German Bundestag



Department of Electrical Engineering (EE) and Information Technology (IT)  
see also additional information on <http://www.ee.hm.edu/>

4/9/2018

## PIONIERNETZ

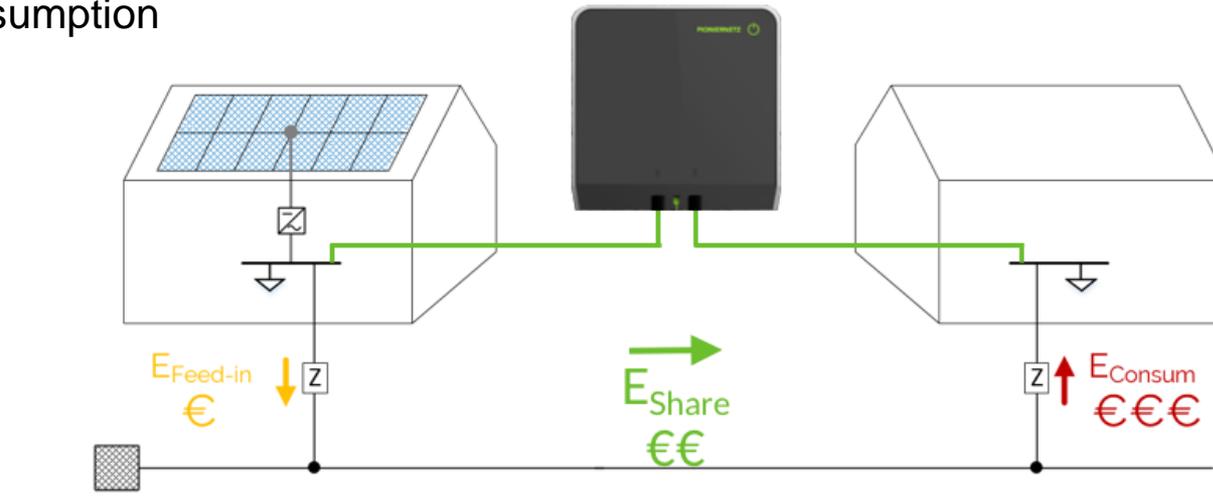
DEINE ENERGIE.

### Hard Facts

- Mains parallel
- Galvanic isolated
- Surplus energy transferred
- Depending on energy production and - consumption

### Customer Value

- PV plant is more profitable
- economic benefits for producer and receiver
- more people get access to renewable energy.
- contribution to a successful energy revolution



Prof. Dr. S. Schramm

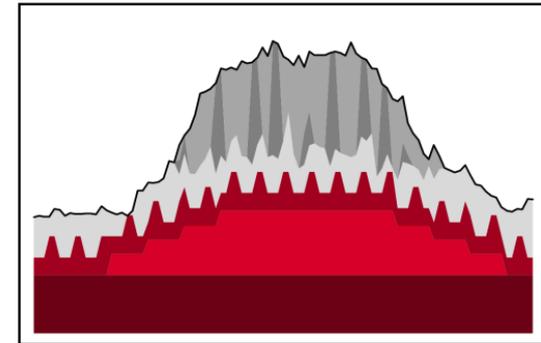
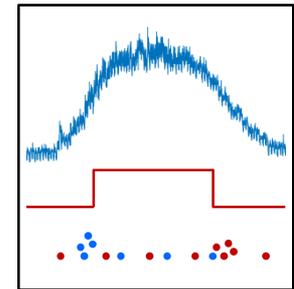


# Applied Research: Analysis of complex energy systems

**Goal:** Development of a process for automated and data-based analysis of complex energy systems and identification of (essential) consumers

## Research Interests:

- Which parameters influence energy consumption in complex energy systems?
- How can this data be captured and utilized?
- In which resolution and measuring accuracy are these data needed?
- Which methods of data analysis (big data, machine learning, NILM) can be applied to the data?
- How can consumers (types) be recognized?
- How can changing structures be recognized during operation?



Prof. Dr. S. Schramm



# Applied Research: Industrial Projects



**CRONIMET**  
Power Solutions GmbH

**Werner Schmelmer**  
Dipl.-Ing. GmbH & Co. KG



- **Renewable Energy Grid Integration**, e.g. Development of a Modular Voltage Regulator, Grid Interaction of Renewable Generation, Declaration of Conformity
- **Energy Transition – “Energiewende”**, e.g. Smart Distributed Reactive Power Compensation, Systematic Design of Sustainable Energy Cells
- **Renewable Energy for Developing Countries**, e.g. PV-Hybrid System Design and Analysis, Sky Imager for Irradiation Forecast



# Applied Research: E-Scooter

Partner: UAS-Munich, Auswall



## Tasks of UAS Munich

- development of electronics for motor control
- development of innovative motor control algorithms
  - using new non-contact torque sensing (magnetostriction)
  - using heart-rate sensors to determine required motor torque (rehabilitation)
  - development of “Pedelec-Mode“ for E-Scooter to avoid requirement for numberplates and to wear helmets for vehicles with motor support above 6km/h

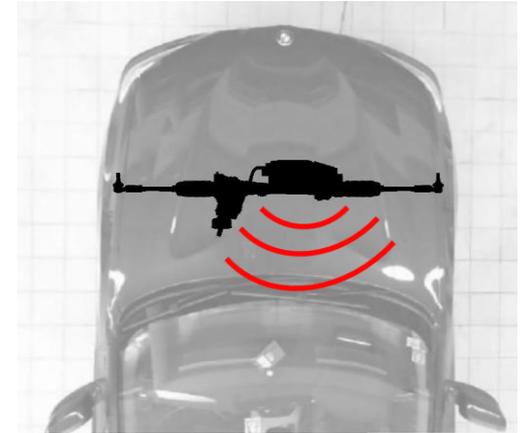
Prof. Dr. S. Hecker



# Applied Research: ASG and ANC using existing Electric Drives

Partner: UAS-Munich (FK03+04), BMW, MdynamiX AG  
also supported by BMWi (ZIM)

Idea: Using existing electric drives (e.g. steering motor) in passenger cars as loudspeaker for



- Active Sound Generation (ASG) for electric cars
  - outside warning sounds for pedestrians (without additional outside loudspeaker)
  - company typical branding of motor sound
- Active Noise Cancellation (ANC) for combustion and electric cars
  - suppressing tonal noise (e.g. cavity noise from tires or combustion motor noise) inside the car without using microphones and loudspeakers
  - avoid expensive active and passive damper systems (e.g. active engine mounts)

Prof. Dr. S. Hecker



# Applied Research: Anti-Pinch Protection for Sliding Roofs

Partner: UAS-Munich, Webasto AG



## Tasks of UAS Munich

- Development of adaptive algorithms for correction of Hall sensor errors
- Development of a multi-rate observer for exact motor speed estimation
- Development of observer based fault detection algorithms for anti-pinch system
- Development of robust motor speed controller for improved roof acoustics

Prof. Dr. S. Hecker



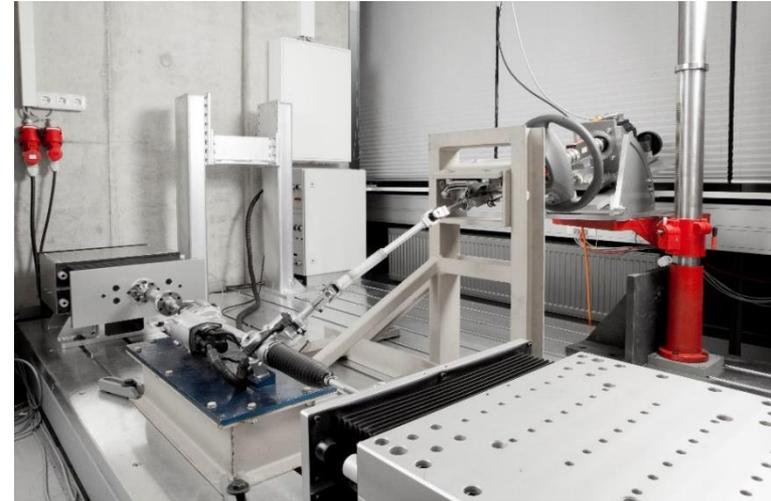
# Applied Research: Multi purpose HiL-Testbench

Partner: UAS-Munich (FK 03+04), MdynamiX AG,  
TU Vienna

Idea: development of high performance hardware  
in the loop testbench for automotive components

## Tasks

- Development of robust, model predictive, multi-input, multi-output control algorithms
- Allow HiL-tests for automotive components (e.g. steering system, engine mounts, active dampers) with bandwidths up to 40 Hz
- Real-time simulation of remaining vehicle dynamics and environment to allow driver in the loop testing



Prof. Dr. S. Hecker

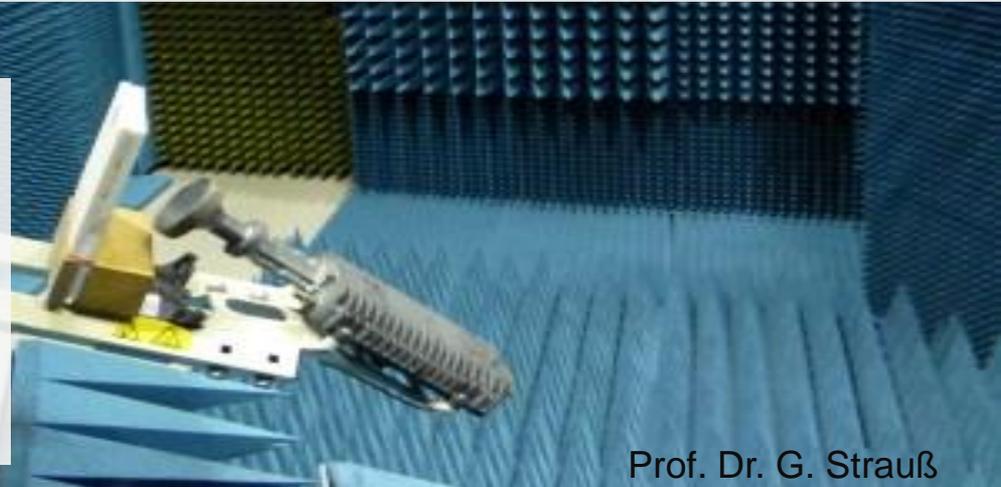


# Frequency Selective Plate [FSP] for Multiplex Use of a Parabolic Antenna for TV und Internet



- Direct order from Eutelsat S. A. (Paris) worldwide third biggest provider of satellite communication services .
- HM has the leadership in conception, development and qualification
- Rollout of FSP actual in Greece, total volume 1 Million terminals (Europe, North Africa and Mead east)
- Patent: Inventor is HM  
Owner is Eutelsat

- Follow up project starts in 2015, runtime 3 years
- one PHD Student, several student assistants
- Direct competition with European enterprises and universities



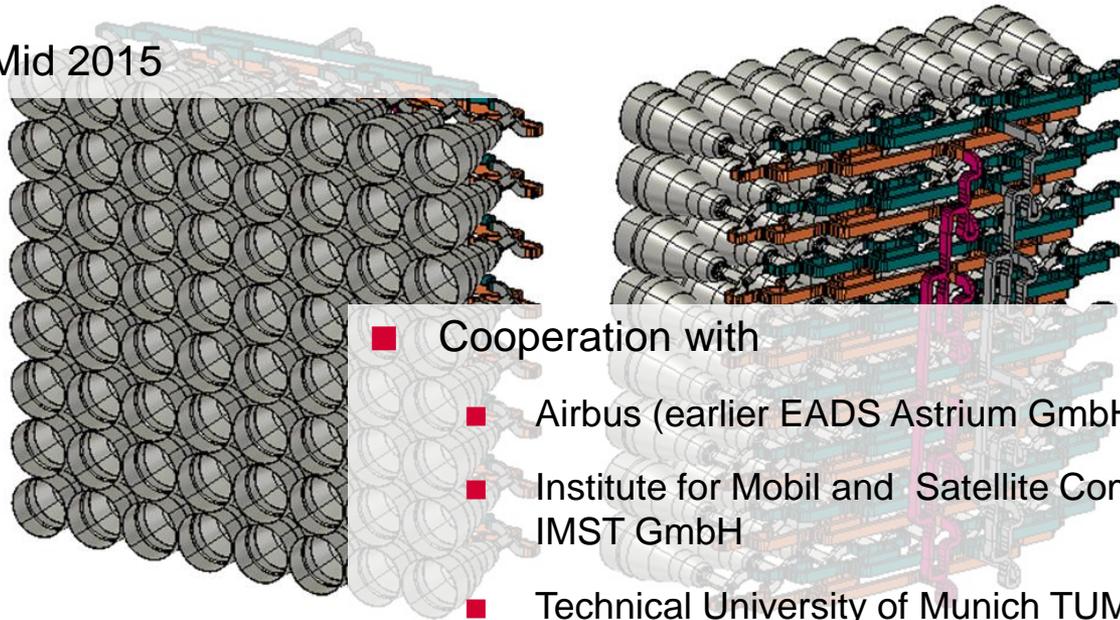
Prof. Dr. G. Strauß



# LISA MS+

**Target:** Development of an antenna system for very high data rates between low orbit satellites

- Development for „SatCom on the Move”
- Space approval Mid 2015



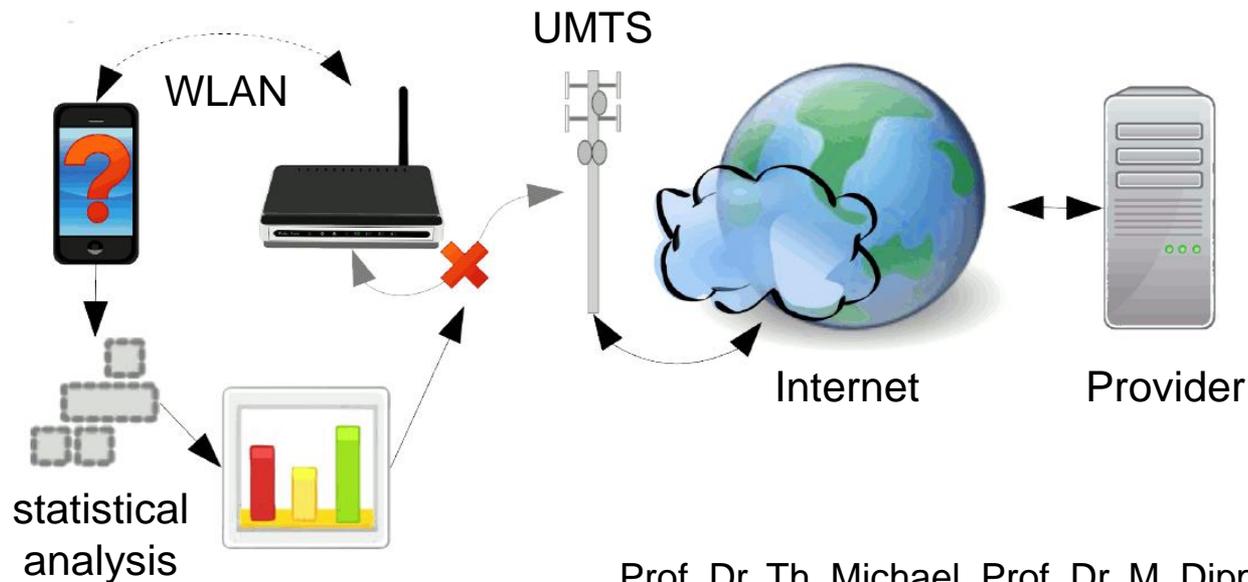
- Cooperation with
  - Airbus (earlier EADS Astrium GmbH)
  - Institute for Mobil and Satellite Communication IMST GmbH
  - Technical University of Munich TUM, Institute for light weight construction
  - Deutsches Zentrum für Luft- und Raumfahrt DLR



# Applied Research: NetQoS

**Issue:** Classification of QoS-/QoE issues and assignment to sub networks in heterogeneous communication networks.

- Cooperation with MINcom GmbH, Rohde & Schwarz Vertriebs GmbH, Keynote SIGOS GmbH, Fraunhofer ESK
- BMBF project – volume: 270 k€
- Statistical models of the network parts using Hidden Markov Models

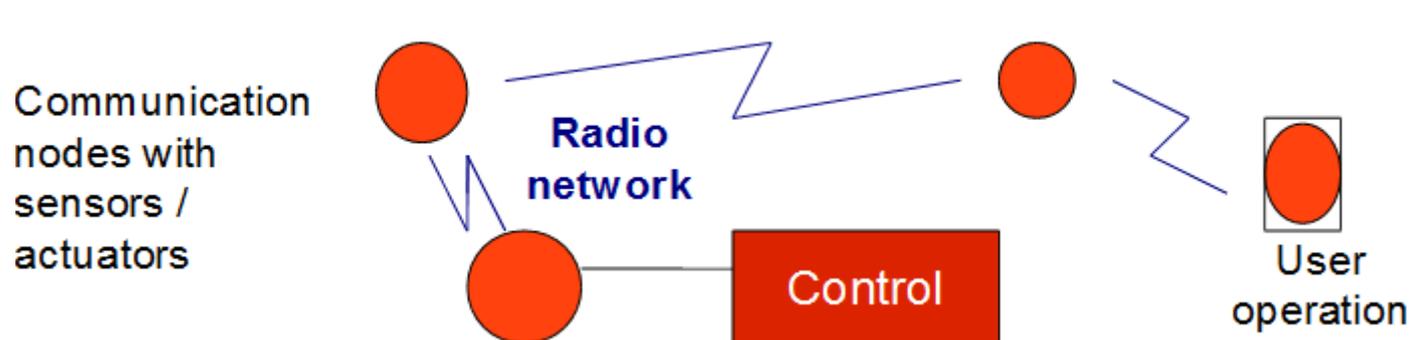


Prof. Dr. Th. Michael, Prof. Dr. M. Dippold, Prof. Dr. M. Paul

# Applied Research: E min

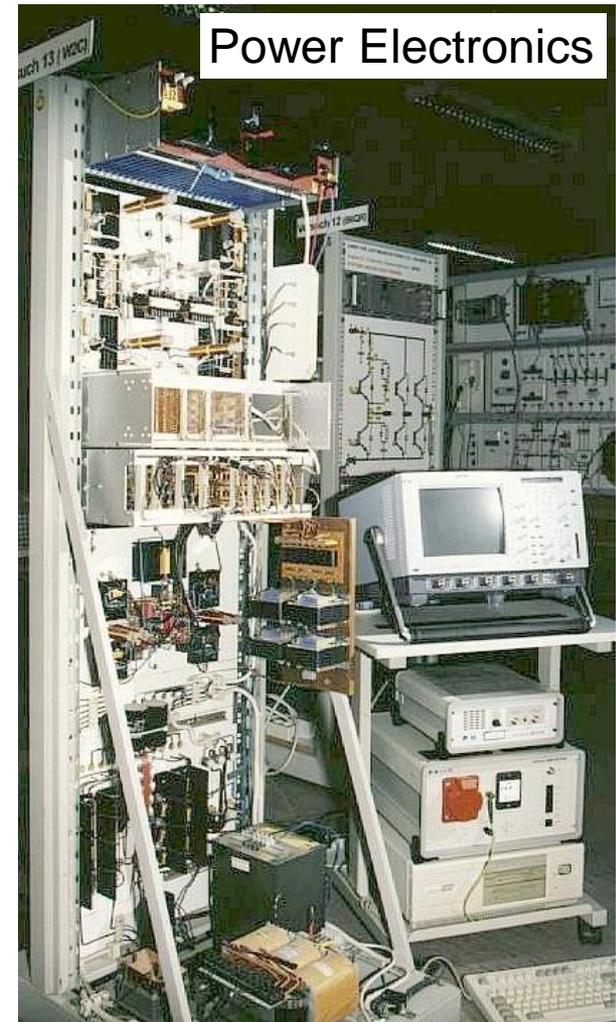
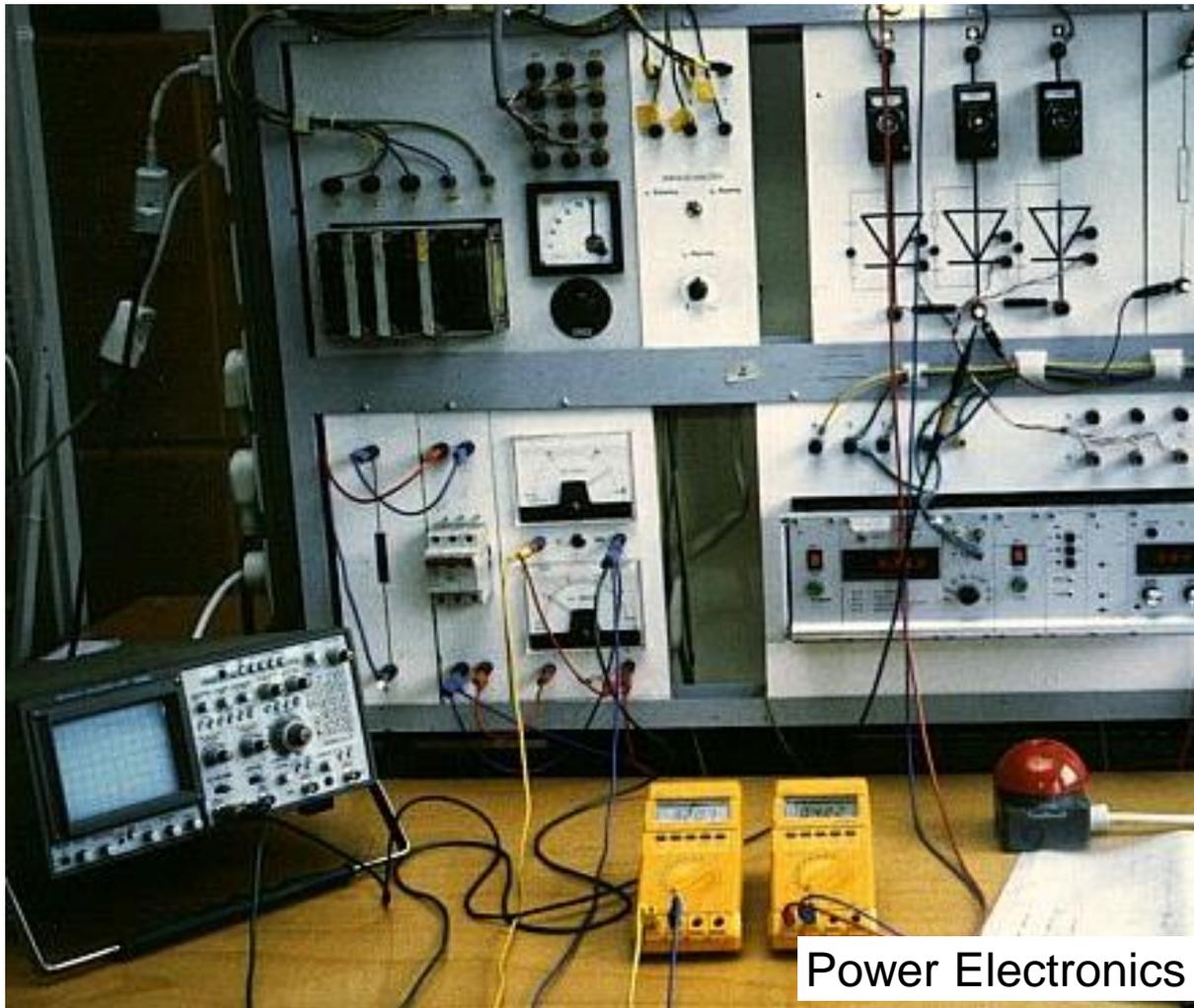
**Issue:** Optimization of In-house Communication for Minimizing the Power Consumption in Buildings

- Starting grant Hochschule München
  - Sensor network for wireless communication
  - Optimization of sensor network for minimum energy supply
  - Operation strategies for minimum electrical power
  - Operation strategies for minimum heating power



Prof. Dr. T. Michael, Prof. Dr. M. Dippold

# ...some impressions of our labs



....more...



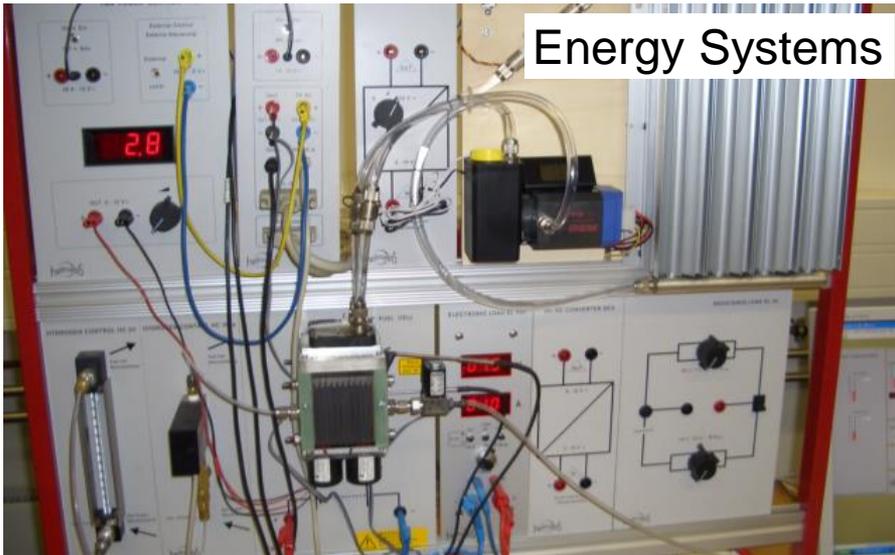
Microelectronics



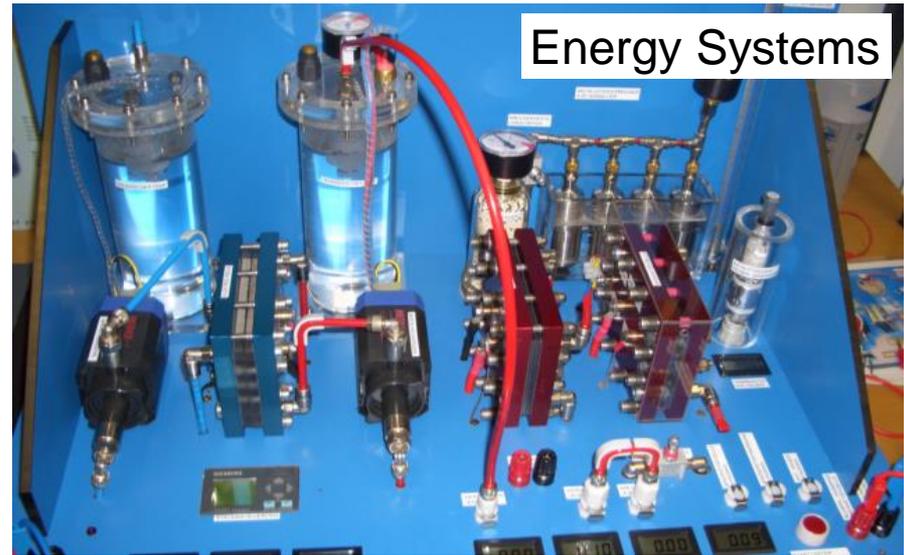
Microelectronics



....and more ...



Energy Systems



Energy Systems



Operating Systems  
and Programming

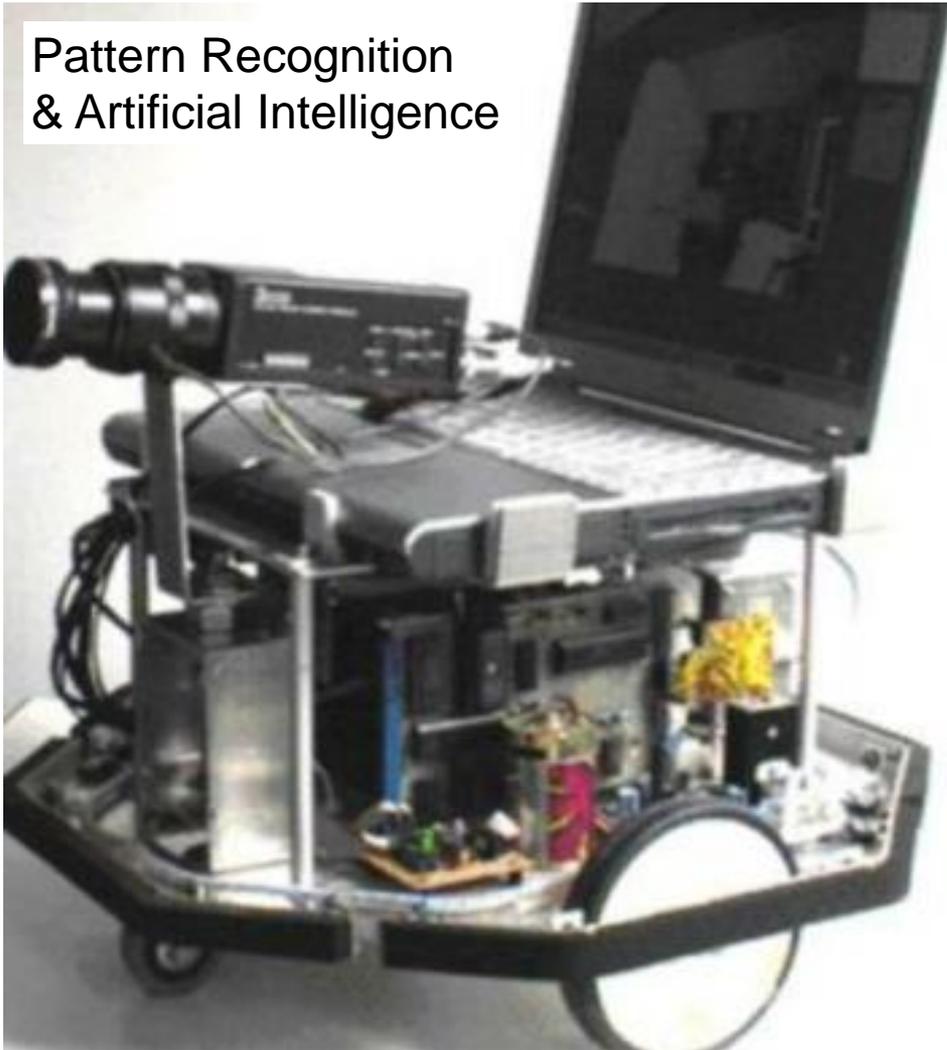


High-Voltage  
Engineering

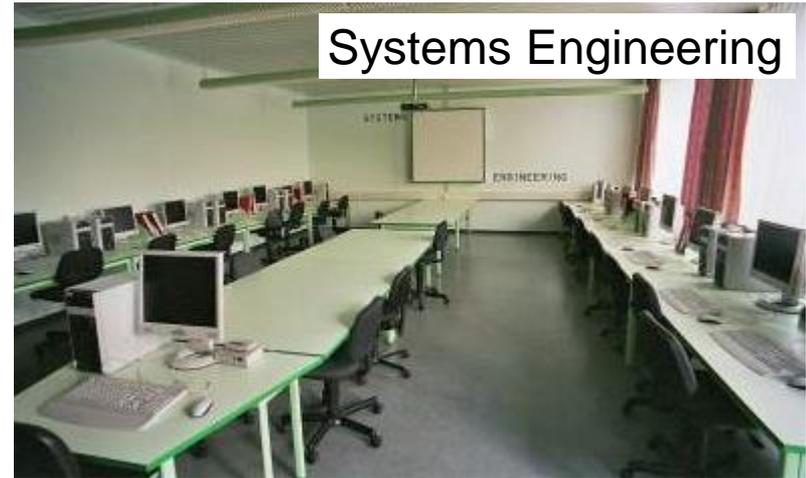


# ....and even more ...

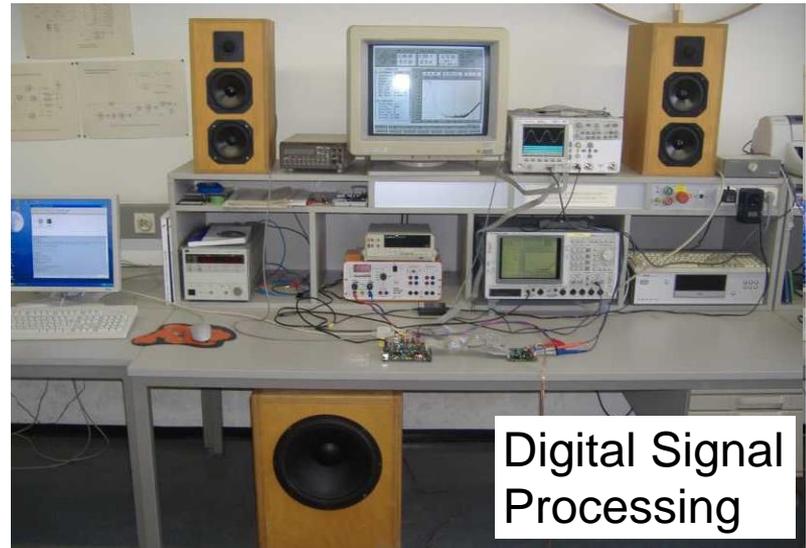
Pattern Recognition  
& Artificial Intelligence



Systems Engineering

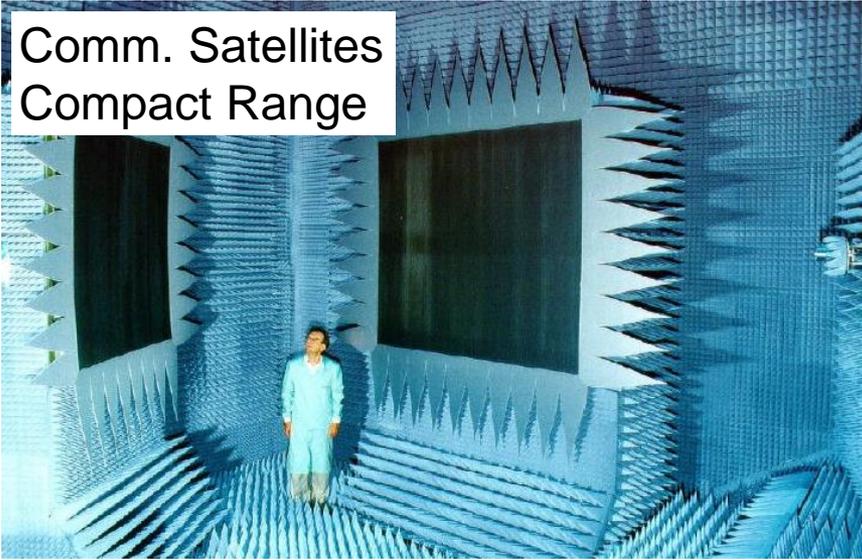


Digital Signal  
Processing

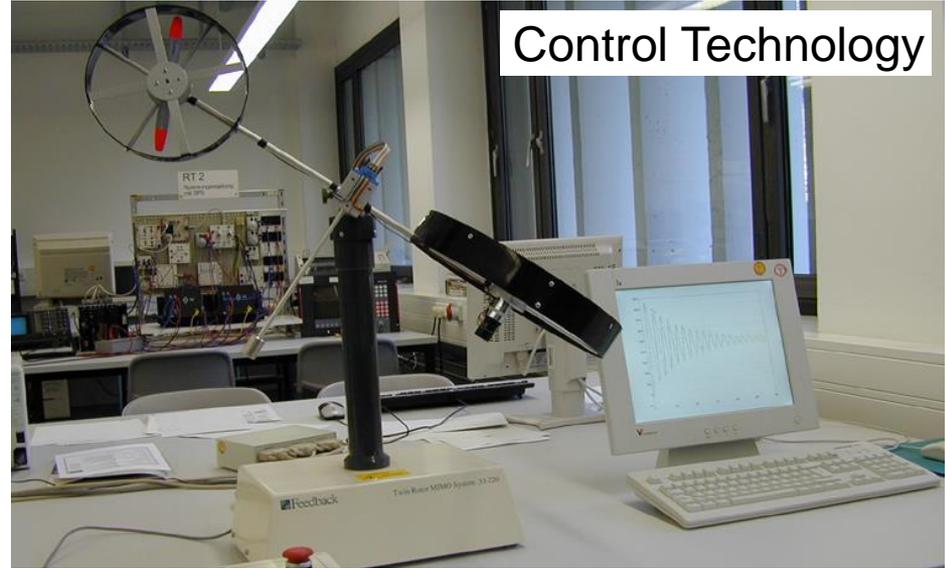


# ...the end

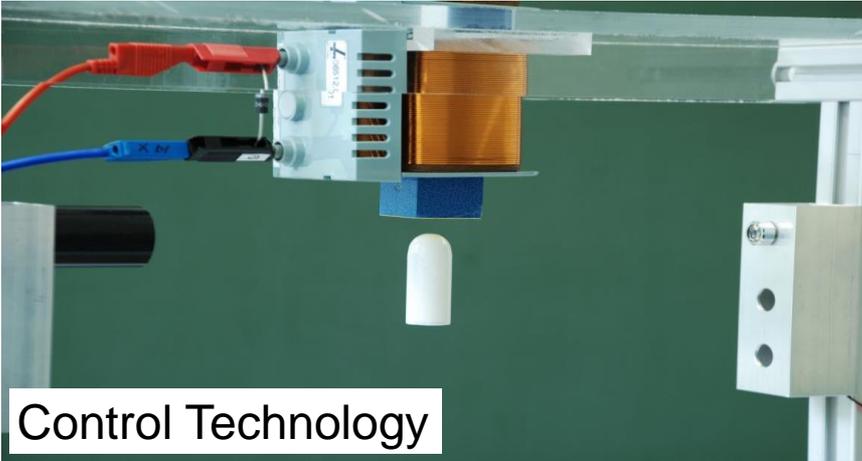
Comm. Satellites  
Compact Range



Control Technology



Control Technology



Analog Circuit Technology

