

Faculty of Computer Science, Electrical Engineering and Mathematics

Department of Electrical Engineering and Information Technology

Theoretical Electrical Engineering Group

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Summer School 2019:

lecture "Concept of optical waveguides and their application" (Prof. Förstner)
project: "Simulation of photonic crystal waveguides"

Research topics:

Computational Optoelectronics and Photonics

- Novel plasmonic/dielectric waveguide concepts
- Optical nanoantennas
- Electromagnetic metamaterials
- Photonics crystals and microdisk resonators
- Semiconductor excitation dynamics, quantum dots/wells
- Modelling of Electron Loss Spectroscopy (EELS)
- E.m. scattering of interplanetary/atmospheric dust/ice particles

Numerical techniques

- Time domain discontinuous Galerkin method for e.m. field simulation
- FIT/FDTD, BEM, etc
- Programming of HPC accelerators

Educational offer:

Master courses:

- Fields & waves
- Theoretical electrical engineering (Antennas, waveguides, etc)
- Modeling & simulation
- Electromagnetic field simulation
- The discontinuous Galerkin method for field simulation
- Optical waveguide theory

Faculty of Computer Science, Electrical Engineering and Mathematics

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Computer Engineering Group

Head: Prof. Dr. rer. nat. habil. Sybille Hellebrand

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Summer School 2019:

lecture: "Faster-than-at-speed test" – A remedy for early life failures?" (Prof. Hellebrand)

Research topics:

Test and diagnosis of integrated circuits and systems

- Built-in self-test and embedded test, in particular test data compression and test response compaction
- Built-in solutions for small delay test (faster-than-at-speed test)
- Volume diagnosis
- Diagnosis of intermittent faults
- Built-in memory test and repair
- Design for test and synthesis for test

Fault-tolerant design

- Verification of fault-tolerance properties
- Fault tolerant yield and quality binning

Educational offer:

Bachelor courses:

- Digital Design
- Computer Architecture
- Hardware Verification and Fault Tolerance

Master courses:

- VLSI Testing
- Algorithms and Tools for Test and Diagnosis of Systems-on-Chip
- Design of Robust Systems (Project)
- Introduction to Algorithms

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Cognitive Systems Engineering Group (GET Lab)

Head: Prof. Dr.-Ing. Bärbel Mertsching

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Summer School 2019:

lecture "Cognitive Technical Systems for Robot Rescue Operations" (t.b.d.)
project: "Introduction to Mobile Robot Motion Control"

Research topics: **Computer Vision**

- Spatial visual attention
- Object recognition
- Optical flow and motion segmentation

Mobile Robotics

- Bio-inspired robotic mapping
- Visual SLAM
- Development of robotic platforms
- RoboCup Rescue

Didactics of engineering

- E-learning for student support and practical experience
- Wikis for Robotics and Fundamentals of Electrical Engineering
- Generation of teaching videos

Educational offer: **Master courses**

- Digital Image Processing I and II
- Robotics
- Advanced Topics in Robotics
- Cognitive Systems Engineering
- Project groups Rescue Robots / Disaster Response Robots

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Communications Engineering

Head: Prof. Dr.-Ing. Reinhold Häb-Umbach

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Summer School 2019:

lecture "Signal processing and machine learning for speech and Audio" (t.b.d.)
project: "Algorithmic Differentiation for Machine Learning"

Research topics:

Speech signal processing

- Speech enhancement
- Acoustic beamforming
- Blind source separation
- Dereverberation
- Robust automatic speech recognition

Machine learning

- Supervised and unsupervised learning techniques
- Deep learning
- Applications in speech processing and other areas

Wireless indoor localization

- WiFi-based localization and tracking

Educational offer:

Master courses:

- Statistical signal processing
- Statistical and machine learning
- Topics in pattern recognition and machine learning
- Optimal and adaptive filters
- Digital speech signal processing

Faculty of Computer Science, Electrical Engineering and Mathematics

Department of Electrical Engineering and Information Technology

Electrical Energy Technologies Group

Head: Prof. Dr.-Ing. habil. Stefan Krauter

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Summer School 2019:

lecture+lab: "Photovoltaic power supply - potential and conversion devices" (Prof. Krauter)

Research topics:

- Wind- and solar irradiance measurements and data analysis
- Prediction and improvement of electrical energy yield
- Optimization of energy supply, considering:
 - Intelligent use of complementarity of volatile energy sources
 - Use of flexibility options, incl. demand side management
 - Real and virtual energy storage options, incl. sector coupling
- Increase of lifetime of energy system systems by analysis and modification of components and operation conditions
- Autonomous energy systems (incl. self-optimization of load management, storage and backup operation)
- Micro-grids for rural electrification in Africa and South America
- Efficient use of energy in industry processes and for domestic use
- Energy in human habitat (buildings, infrastructure, transport)

Center for Sustainable Energy Technology (KET): Research, teaching, transfer of technology in the area of environmentally friendly and innovative energy generation, transformation and utilization.

Educational offers: Master courses:

- Energy system transition
- Solar electric energy systems
- Intelligent grid control

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Measurement Engineering Group

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Summer School 2019:

project: "Design of a measurement system based on capacitive sensors"

Research topics:

Acoustics

- Ultrasonic sensors (flow, level, distance, density, viscosity, concentration)
- Non-destructive testing (polymers, fiber composites)
- Acoustic material characterization (solids, liquids)
- Modelling & simulation
- Sound field visualization
- Sensor interface electronics

Optical measurement technique

- NIR material moisture measurement

Data analysis

- Complex industrial processes

Educational offer:

Master courses:

- Theoretical acoustics
- Ultrasonic measurement technique
- Environmental measurement technology
- Biomedical measurement technique
- Cognitive sensor systems

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System and Circuit Technology

Head: Prof. Dr.-Ing. Christoph Scheytt

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Summer School 2019:

lecture+lab: "Introduction to VLSI design" (Dr. Wolfgang Müller)
project: "Analog IC Design and Simulation"

Research topics:

Chip Design

- Design of Analog and Mixed-Signal ICs
- Electronic-Photonic ICs
- Digital ICs

Wireline Communications

- High Data Rate Wireline Communication up to 100 GHz BW
- Fiber-optic Communication up to 400 Gb/s per wavelength
- Silicon photonics

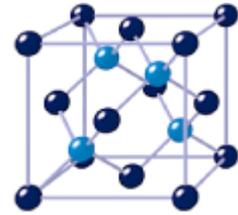
Wireless Communication

- Ultra-High Frequency Wireless ICs for Communication and Sensors from 10 GHz to 300 GHz
- Energy-Efficient Wireless ICs below 10 GHz

Educational offers:

Master courses

- Circuit and System Design
- Advanced VLSI Design
- ICs for Wireless Communication
- Fast Integrated Circuits for Wireline Communication



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Sensor Technology Group

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Summer School 2019:

lecture+lab: "Micro-Electromechanical Systems for Wireless Sensors" (Prof. Hilleringmann)

project: "PECVD layers for MEMS applications"

Research topics:

Silicon technology

- MEMS sensors and actuators
- Nanoscale particles for electronic devices
- Integrated optics on silicon
- Flexible electronics
- Organic electronics

Applications of micro controllers

- Sensor readout and data displays
- Flight control in solar powered model aircraft
- Industry 4.0 RFID sensor applications

Sensor devices

- Surface acoustic wave sensors
- Autonomous humidity sensors
- UV-A/B/C illumination sensors
- Vibration sensors

Educational offer:

Master courses:

- Principle and applications of PLL circuits
- Processing of nanoscale integrated circuits
- RFID tags and readers

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Signal & System Theory Group

Head: Prof. Peter Schreier, PhD.

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Summer School 2019:

lecture "Data Science in Biomedicine and Medical Technology" (Prof. Schreier)

project: "Emotion recognition based on EEG and signal processing"

Research topics:

Correlation analysis in high-dimensional data

- Identification of coupled effects in high-dimensional data with very small sample support
- Applications to bio medicine, e.g. fusion of medical imaging data

Medical image processing of X-ray images

- Segmentation of bone structures
- Detection of medical devices
- Deep learning and classical image processing algorithms

Wireless communications

- Improper Gaussian signaling schemes for interference-limited communications
- Detection of cyclostationarity with applications to cognitive radio

Educational offer:

Master courses:

- Statistical signal processing
- Topics in signal processing
- Projects (e.g. brain sensing with EEG and signal processing)