MASTER’S PROGRAMMES
EE, S&C AND EMSYS

MAARTEN KORSTEN
CONTENT

- Faculty of Electrical Engineering, Mathematics & Computer Science
- Research (Centres)
- Master programmes
• Electrical Engineering

• Mathematics

• Computer Science
MASTER'S PROGRAMMES EEMCS

Disciplinary
- Electrical Engineering
- Applied Mathematics
- Computer Science

Interdisciplinary
- Embedded Systems
- Systems and Control
- Human Media Interaction
- Telematics
- Business Information Technology
RESEARCH INSTITUTES

- CTIT  Telematics & Information Technology
  - Including Robotics & Mechatronics

- MIRA  Biomedical Technology

- MESA  Nanotechnology

- ITC  Institute for Geo-Information Science and Earth Observation

- SBE  Science Based (Mechanical) Engineering
## RESEARCH IN THE ELECTRICAL ENGINEERING GROUPS

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
<th>Institute</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biomedical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomedical Signals &amp; Systems</td>
<td></td>
<td>MIRA</td>
<td>Veltink</td>
</tr>
<tr>
<td>Biomedical and Environmental Sensor systems</td>
<td></td>
<td>MESA/MIRA</td>
<td>Van den Berg</td>
</tr>
<tr>
<td><strong>IC-design and Computer Architecture</strong></td>
<td></td>
<td></td>
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<tr>
<td>Computer Architectures for Embedded Systems</td>
<td></td>
<td>CTIT</td>
<td>Smit</td>
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<tr>
<td>Integrated Circuit Design</td>
<td></td>
<td>CTIT</td>
<td>Nauta</td>
</tr>
<tr>
<td><strong>Measurement, Control and Mechatronics</strong></td>
<td></td>
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<tr>
<td>Robotics and Mechatronics</td>
<td></td>
<td>CTIT</td>
<td>Stramigioli</td>
</tr>
<tr>
<td><strong>Telecommunication</strong></td>
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<tr>
<td>Design and Analysis of Communication Systems</td>
<td></td>
<td>CTIT</td>
<td>Haverkort</td>
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<tr>
<td>Telecommunication Engineering</td>
<td></td>
<td>CTIT</td>
<td>Leferink</td>
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<tr>
<td><strong>Micro and nanosystems</strong></td>
<td></td>
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<tr>
<td>Biomedical and Environmental Sensor systems</td>
<td></td>
<td>MESA/MIRA</td>
<td>Van den Berg</td>
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<tr>
<td>Nano-electronics</td>
<td></td>
<td>MESA</td>
<td>Van der Wiel</td>
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<tr>
<td>Semiconductor Components</td>
<td></td>
<td>MESA</td>
<td>Schmitz</td>
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<tr>
<td>(Integrated) Optical Systems</td>
<td></td>
<td>MESA</td>
<td>Herek</td>
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<tr>
<td>Transducers Science and Technology</td>
<td></td>
<td>MESA</td>
<td>Krijnen</td>
</tr>
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</table>
SELECTED RESEARCH TOPICS
BIOMEDICAL SIGNALS & SYSTEMS
SELECTED RESEARCH TOPICS
BIOMEDICAL AND ENVIRONMENTAL SENSORSYSTEMS

Nanofluidics

Biomedical Microdevices

Electrochemical sensors and sensor systems

Cells-on-chip
SELECTED RESEARCH TOPICS
ROBOTICS & MECHATRONICS

Topics

- Modeling
- Control
- Imaging
- Design
- Embedded Systems
SELECTED RESEARCH TOPICS
TELECOMMUNICATION ENGINEERING

Topics

• Electromagnetic Compatibility
• (Short Range) Radio
• Sensor networks
**SELECTED RESEARCH TOPICS**

INTEGRATED CIRCUIT DESIGN (NAUTA)

Central theme
- Integrated transceivers in CMOS technology
- For portable, fast and energy efficient communication systems

Topics
- Frequency synthesizers, radio frontends, RF beamforming and cognitive radio

*RF Network Analysis Set Up (ICD laboratory)*
What is an Embedded System?

- **Signal Processing** in Hardware and/or Software for an application
- **Application**
  - mobile phone, audio/video processing, cars, robots, production machines
- **Software**
  - User interface
  - Data processing
  - Machine control
- **Hardware**
  - I/O
  - ASIC, DSP, FPGA
- **Strong demands**, e.g.
  - Real time
  - Maintainability
  - Costs
A modern car contains many embedded systems

- Motormanagement
- Cruise control
- ABS/Traction control
- Variable power steering
- Navigation
- Airco
- Airbag
- Intelligent parking system
- …
Application of Sensor networks

Chair Pervasive Systems

- Coral reef (Australia)
  - A sensor measures temperature, salinity, ...
    - Important events (e.g. raise of temp) are reported
    - Due to a position system the sensor knows its position
- Sensors communicate with each other in a wireless network
- Cause, and early detection, of coral bleaching possible
The Boderc project focuses on distributed embedded real-time controllers of complex systems.

- Modelling
- Hardware
- Software

Boderc; Beyond the Ordinary: Design of Embedded Real-time Control
New generation of self-repairing multi-cores
Chair Computer Architecture for Embedded Systems

CMOS chip design by CAES, Recore, NXP, ATMEL
(> 1.2 M transistors)

software for real-time repair!
Functional language used to control a setup
Positioning Master Embedded Systems

Chairs
- RaM (Robotics and Mechatronics)
- ICD (Integrated Circuit Design)
- SCS (Service, Cybersecurity and Safety)
- CAES (Computer Architecture for Embedded Systems)
- DACS (Design and analysis for Communication Systems)
- FMT (Formal Methods and Tools)
- PS (Pervasive Systems)

More information on the chairs: http://www.utwente.nl/ewi/en/research/chairs/
Systems and Control Theory is concerned with problems related to dynamic phenomena in interaction with their environment. These problems include:

- Modeling. Obtaining a mathematical model that reflects the main features. A mathematical model may be represented by difference or differential equations, but also by inequalities, algebraic equations, and logical constraints.
- Analysis and simulation of the mathematical model.
- Prediction and estimation.
- Control. By choosing inputs or, more general, by imposing additional constraints on some of the variables, the system may be influenced so as to obtain certain desired behavior. Feedback is an important example of control.
Three Tracks

Control Theory (generic models, synthesis problems)

Robotics & Mechatronics: joint design of the mechanical, electronic, and control aspects of control systems such as robots

Bio Mechatronics: application to the human body, e.g., in rehabilitation
Mechatronic Systems
Robotics & Mechatronics (RAM)
Mechanical Automation & Mechatronics

- Automation and Control
- Design of Mechanisms and Robotics
- Applied Laser Technology

Development of piezo hardmounts for precision equipment
Biomechatronics (Biomedical Engineering)
Rehabilitation topics

- Surgical Robotics
- Tissue mechanics
- Neuro mechanics
- Movement mechanics

The Dampace with passive weight support and passive actuation
Control Theory

Subjects

- Signal processing
- Particle filtering
- Systems subject to constraints
- Hybrid systems
- Large-scale systems
- Dynamics and control of distributed parameter systems
SETUP OF THE MASTER’S PROGRAMME

- First year: courses
  - Compulsory specialisation courses
  - Non-technical course (Philosophy of Engineering)
  - Elective courses

- Second year: practical work
  - Internship
  - Master’s thesis
Programme Electrical Engineering

- First year: courses
  - 4 compulsory specialisation courses
  - 1 non-technical course (Philosophy of Engineering)
  - 7 elective courses
  - 5EC (European Credit) each

- Second year: practical work
  - Internship
  - Master’s thesis

- Specialisations
  - Each research group has its own specialisation
Programme Embedded Systems (3TU)

<table>
<thead>
<tr>
<th></th>
<th>Credits</th>
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<tbody>
<tr>
<td>Homologation (predefined for UT bachelor CS/EE, individual for others)</td>
<td>≤ 20</td>
</tr>
<tr>
<td>Compulsory (same in Delft and Eindhoven)</td>
<td>25</td>
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<tr>
<td>Internship (not for bachelor HBO)</td>
<td>20</td>
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<tr>
<td>Elective courses</td>
<td>Remainder ec’s</td>
</tr>
<tr>
<td>Individual project</td>
<td>10</td>
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<tr>
<td>Final project</td>
<td>30</td>
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<tr>
<td>Total</td>
<td>120</td>
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Final project in one of the chairs: RaM, ICD, SCS, DACS, CAES, FMT, PS
More detailed information: [http://www.utwente.nl/emsys/](http://www.utwente.nl/emsys/)
Program Systems & Control (3TU)

<table>
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<tr>
<th>Year 1</th>
<th>Introduction Project</th>
<th>4 EC</th>
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<tbody>
<tr>
<td>Compulsory Courses</td>
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<td>20 EC</td>
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<tr>
<td>Electives</td>
<td></td>
<td>26 EC</td>
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<tr>
<td>Research Oriented Courses specific to profile</td>
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<td>10 EC</td>
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<tr>
<th>Year 2</th>
<th>Traineeship</th>
<th>20 EC</th>
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<tbody>
<tr>
<td>Final Project</td>
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<td>40 EC</td>
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Differences between the programs

Electrical Engineering: Electrical and Systems

Systems & Control: Control and Mechatronics

Embedded Systems: Computer Engineering
### ADMISSION FOR AT

<table>
<thead>
<tr>
<th>EE</th>
<th>NE, SC, IOS</th>
<th>Science (AT9)</th>
<th>Device Physics (EE7)</th>
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<tbody>
<tr>
<td></td>
<td>BIOS, TST</td>
<td>Science (AT9)</td>
<td>Systems &amp; Control (EE6)</td>
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<td>RAM, BSS</td>
<td>Computer Systems (EE5)</td>
<td>Systems &amp; Control (EE6)</td>
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<tr>
<td></td>
<td>TE, ICD, CAES, SCS</td>
<td>Computer Systems (EE5)</td>
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<tr>
<td></td>
<td>DACS</td>
<td>Computer Systems (EE5)</td>
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<td>Signals and Noise (EE8)</td>
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<td>Computer Networks (EE7)</td>
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<tr>
<td>S&amp;C</td>
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<td>Systems &amp; Control (EE6)</td>
<td>Heat &amp; Flow (WB7) with preparation BSc (11EC)</td>
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<td>Dynamics 2 (4EC)</td>
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<tr>
<td>EMSYS</td>
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<td>Module 2.1 (CS/EE) Computer Systems</td>
<td>Module 3.2 (CS/EE) Cyber Physical Systems</td>
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<tr>
<td></td>
<td></td>
<td>Module 2.3 (EE) Network Systems (with C++)</td>
<td>Two of these modules</td>
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Further information Systems & Control

https://www.utwente.nl/en/education/master/programmes/systems-control/

Peter Breedveld, program advisor
Maarten Korsten, coordinator
Jan Willem Polderman, program director
Further information Embedded Systems


Bert Molenkamp, program coordinator
Further information Electrical Engineering

https://www.utwente.nl/en/education/master/programmes/electrical-engineering/

Maarten Korsten, coordinator

Mark Bentum, program director

Master Information Day: Friday 8 January 2016
Master Business & Information Technology

- 2-year programme
- International (in English)
- Current population: 55 students (8 international students)
- Supported by research groups in the areas of Business Administration and Computer Science
- Programme consists of a set of core courses followed by three alternative specialisations
BIT Master specialisations

Based on the roles a BIT professional may play

- **Enterprise Architecture**
  alignment of strategy, business processes and IT architecture (enterprise architect)

- **IT Management and Innovation**
  IT strategies to support business processes and services (IT manager)

- **Business Analytics**
  application of business intelligence and data analysis to support business decisions (business analyst, or even (big) data scientist)
Distribution of topics (courses) over specialisations

ICT Management
- ECommerce
- Design Science Methodology
- Business Process Integration Lab

IT Management
- Business Case Development for IT-projects
- Global Project Management
- Empirical Research & Data Analysis

Information Services
- Foundation of IS
- Implementation of IT in Organizations

Enterprise Architecture
- Architecture of Information Systems
- Software Management
- Specification of Information Systems

Simulation*
- Data Warehousing and Data Mining
- Managing Big Data

Business Intelligence
Cornerstones of the programme

- **Industrial Engineering and Business Information Systems (IEBIS)** group of the Faculty of Behavioural, Management and Social sciences (BMS)
- **Services, Cybersecurity and Safety (SCS)** group and **Databases (DB)** group of the Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS)
- These groups are active in research in the BIT-related areas applied to (amongst others) transportation, supply chain, logistics, healthcare and lifestyle and disaster management
- The groups have also strong collaboration with the industry
Jobs after the study

Typical positions
- Information specialist
- Information systems designer
- Consultant

With some more experience
- Information strategist
- ICT-manager
- Project leader in automation projects
- CIO

Research and Academia
- PhD position, lecturer

Researcher  Designer  Entrepreneur

Average of 0 months waiting time for find a job after the study!
Further information Business & Information Technology


Maarten Korsten, coordinator

Luis Ferreira Pires, program director