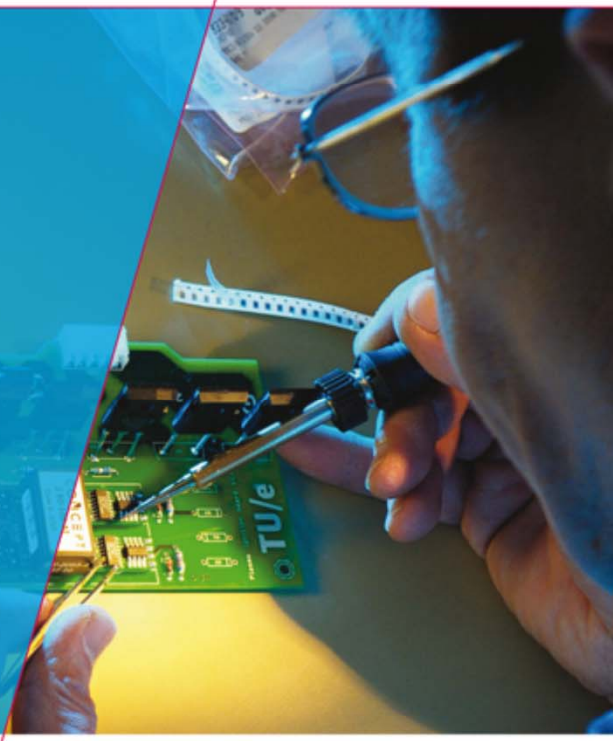
Explore your Master @ EM

dr.ir. Rob Mestrom

May 1, 2017



Technische Universiteit
Eindhoven
University of Technology

Where innovation starts

EM group: full and part-time professors

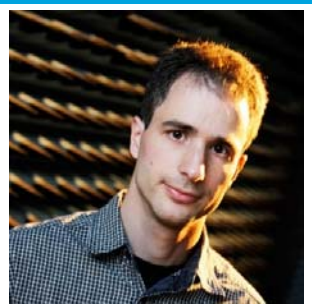
Anton Tijhuis

Bart Smolders

Huib Visser

Giampiero Gerini

EM group: associate and assistant professors



Martijn van Beurden

Bas de Hon

Ulf Johannsen

Vito Lancellotti

Rob Maaskant

Rob Mestrom

Anne Roc'h

Peter Smulders

CHALMERS

Core courses (see study guide)

	Complex Analysis (2DME30)	Discrete Mathematics (2DME10)	Non-linear Optimization (2DME20)	Semiconductor physics and materials (5CCA0)	Fundamental aspects of random signals (5CRA0)	Classical and Modern Physics (5CHA0)	Numerical Methods for Electrical Engineers (5CPA0)	Modeling Dynamics (5CSA0)
CS	◆		◆		✓		✓	◆
ECO	◆			◆	◆	✓	✓	✓
PHI				◆	◆	✓		
EES	✓		✓	◆	◆	◆	✓	◆
EPE	✓		✓	✓	✓	✓	✓	✓
EM	◆		✓	◆		◆	◆	
ES		◆	✓	✓	✓		✓	✓
MsM				◆	◆	✓	◆	✓
SPS	✓		◆		◆		✓	✓

◆ = Important

✓ = Preferred

Research themes – Specialization tracks

- **Involved in three research themes:**
  - **Care and Cure**
  - **The Connected World**
  - **Smart and Sustainable Society**

- **Taking part in Special Master's tracks:**
  - **Care & Cure**
  - **Broadband Telecommunication Technology**

Specialization paths EM

Application oriented

Theory oriented

Path	Code	Name	ECTS	Planning
EM-1	5SPA0	Advanced Electromagnetics and Moments Methods	5	Q2
	5SPB0	Microwave Engineering and Antennas	5	Q3
EM-2	5SPA0	Advanced Electromagnetics and Moments Methods	5	Q2
	5SPC0	Wavefield Representations	5	Q3

Education: Bachelor and Master courses

- Bachelor level
  - 3NBB0: Applied Natural Sciences
  - 5EPA0: Electromagnetics I
  - 5EPB0: Electromagnetics II
  - 5XTC0: Components in Wireless technologies
  - 5XPA0: Bioelectricity and EM effects
  - 5XSJ0: Automotive sensing
- Master level
  - 5CPA0: Numerical Methods for Electrical Engineers
  - 5SPA0: Advanced EM and MoM
  - 5SPB0: Microwave Engineering and Antennas
  - 5SPC0: Wavefield representations
  - 5LPA0: Wireless Communications
  - 5LPB0: Phased arrays and smart antennas
  - 5LPC0: EM Engineering

Experimental facilities

- Two antenna anechoic rooms
- Indoor propagation lab
- 60 GHz setup

- Other experimental facilities at partner sites

External partners

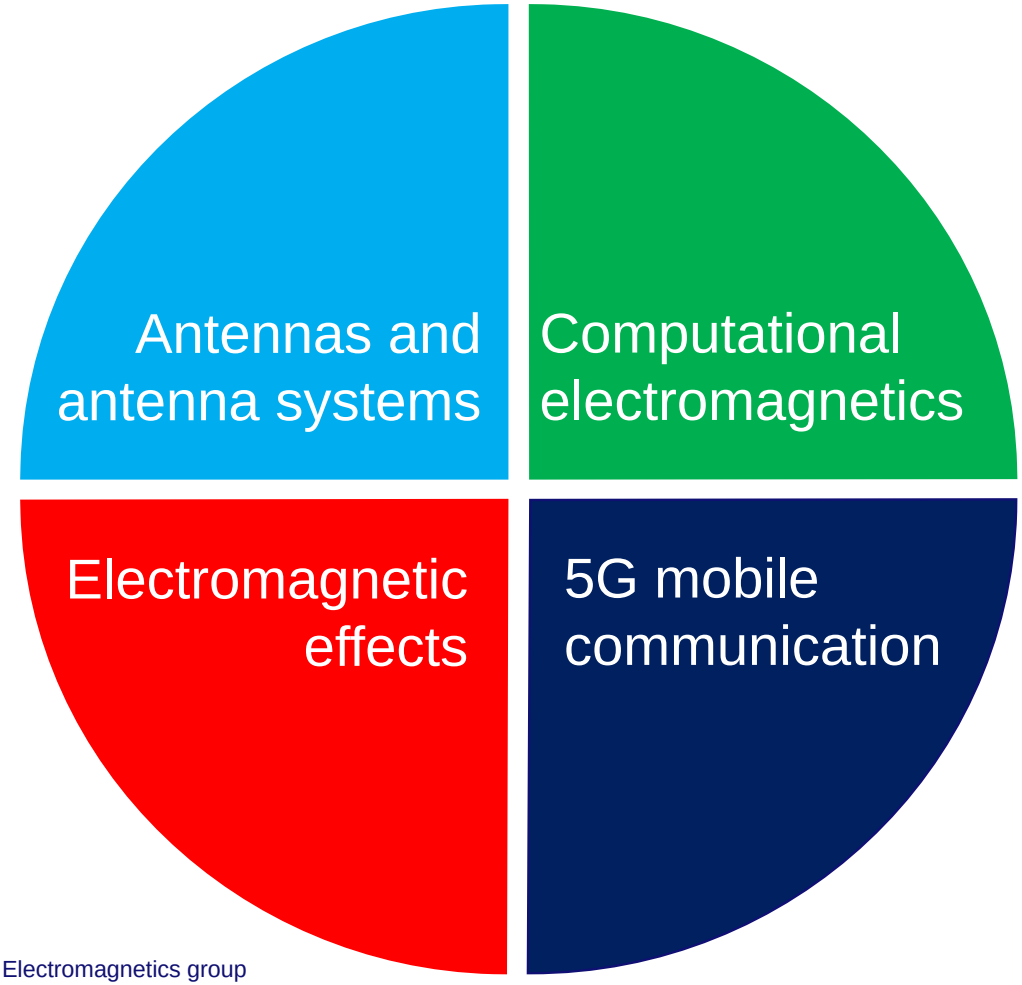
- ASML
- NXP
- Philips
- Thales NL
- Draka
- Océ
- KPN
- Tyco
- Agere
- Lucent
- TNO (DSS & ICT)
- Imec NL
- Astron

- Erasmus MC
- SRON
- ESA/ESTEC
- IMST (Kamp-Lintfort)
- ONERA (Toulouse)
- NIST (Boulder)
- Glasgow University
- Institut Fresnel (Marseille)
- University of Ghent
- Polytecnico di Torino
- UPNa (Pamplona)
- Kempenhaeghe
- and more…

Recent internship project for EM students

- NL:
  - NXP Nijmegen — 30 GHz base stations
  - Philips Healthcare — MRI system
  - Erasmus Rotterdam — Hyperthermia system
  - Thales — Radar system
  - Holst — Wireless power transfer
  - TNO — Metamaterials
  - ASML — Metrology for wafer-stepper
- Rest of the world
  - Chili: — Radio astronomy (60 GHz)
  - South Africa — Radio astronomy (1-2 GHz)
  - Australia — Radio astronomy (1-2 GHz)
  - Singapore — Nano-satellites
  - Boulder, Colorado — Propagation in reverberation chambers
  - Brazil — Wireless base stations

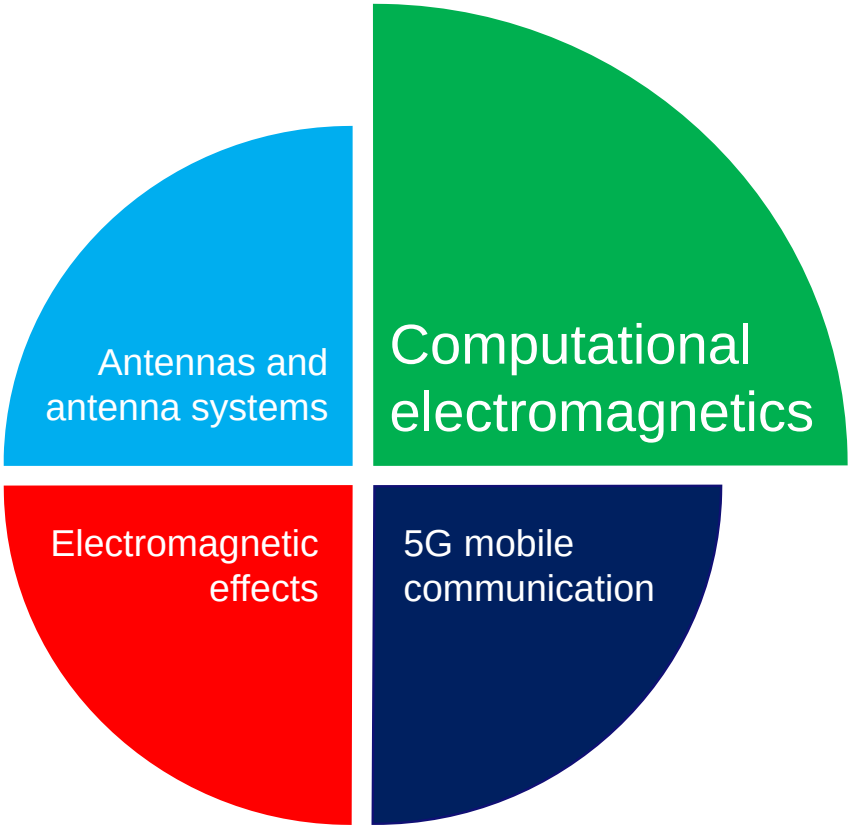
EM research clusters



Using:

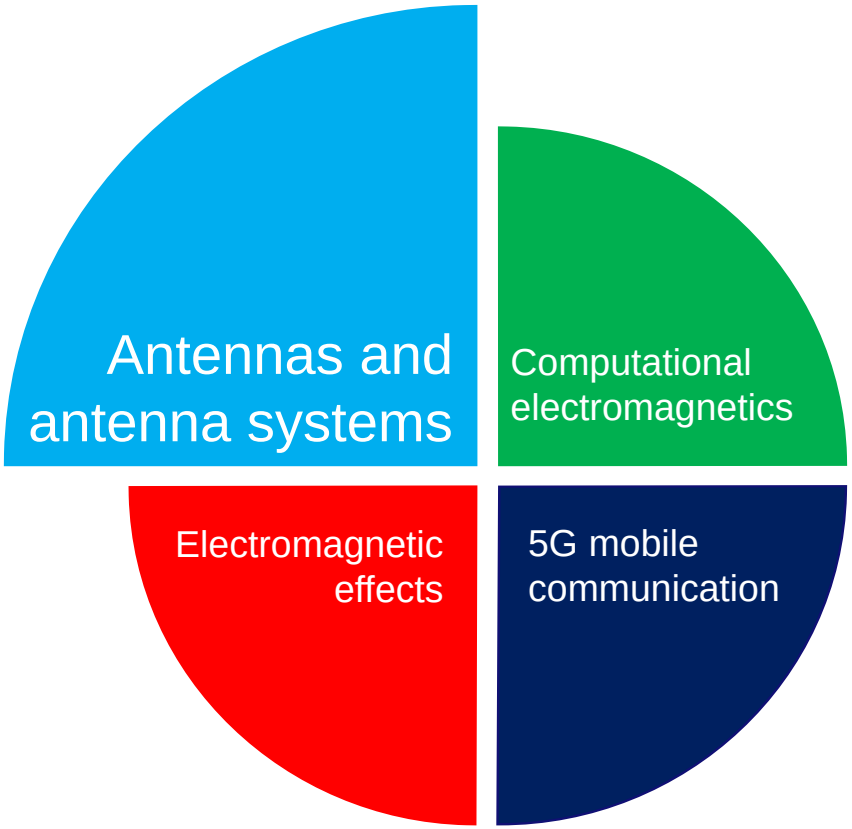
- **Modeling**
- **Simulation & design**
- **Experiments**

Computational Electromagnetics



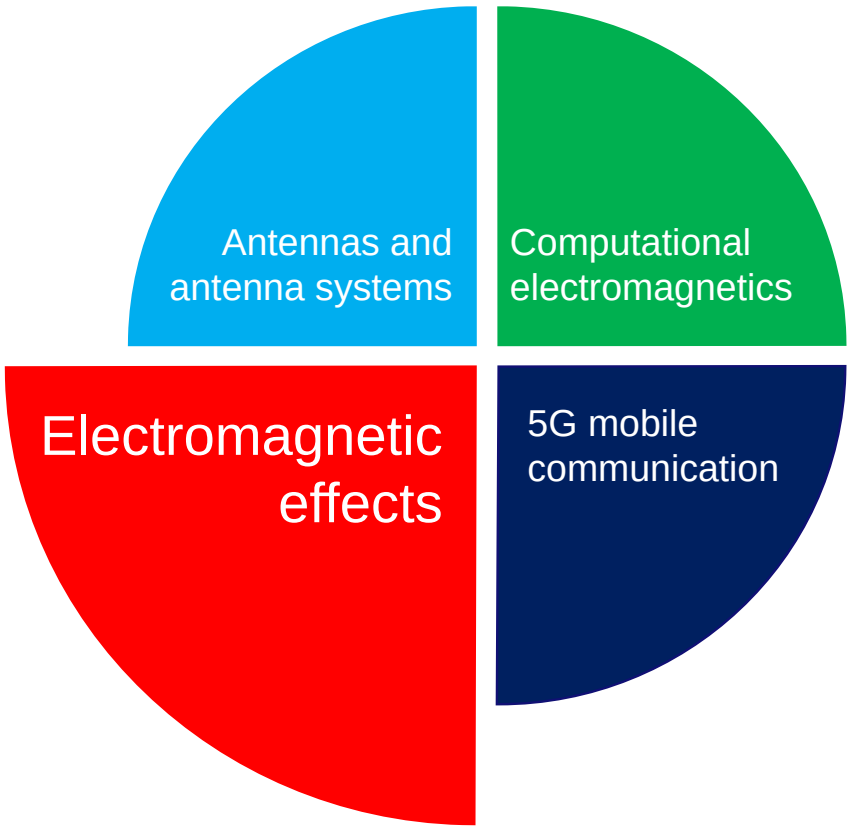
- **Modeling and optimization**
- **Analytical and numerical approach**
- **Periodic systems**
- **Optical fibers - waveguides**
- **Stochastic systems**

Antennas and antenna systems



- **Design of antennas and antenna systems**
- **60 GHz for wireless applications**
- **RF components**
- **Radar and radio astronomy**
- **Energy harvesting**

Electromagnetic effects



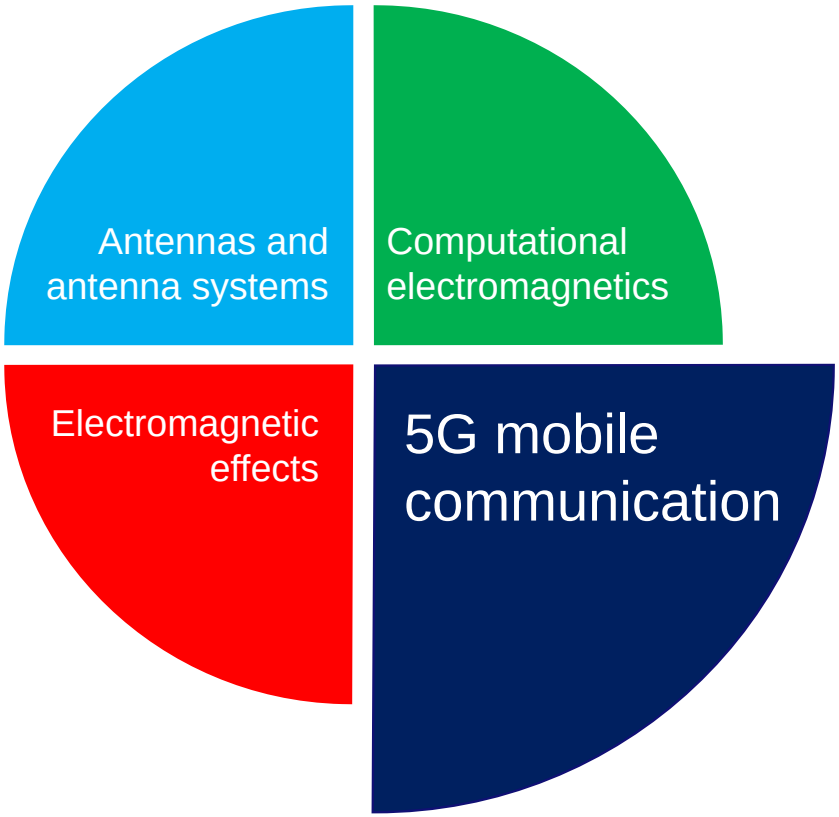
Medical EM

- Hyperthermia cancer treatment
- MRI
- Neurostimulation
- Detection principles

Electromagnetic Compatibility

- Predictive modeling
- Measurements

5G mobile communication

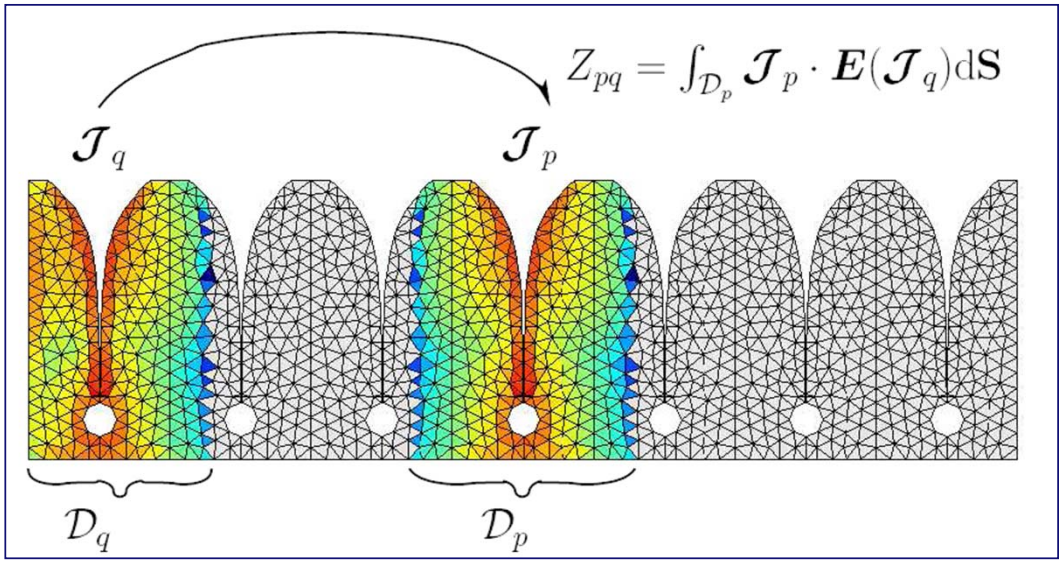


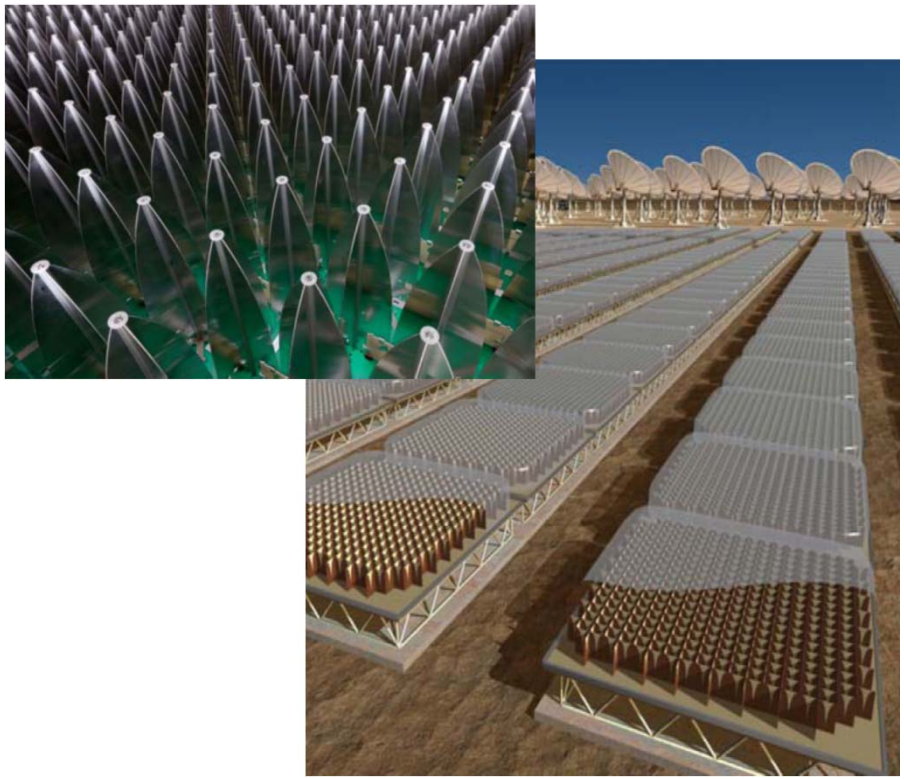
- **Base station architectures: many, many pico-cells**
- **Focal line/plane arrays**
- **Massive MIMO**
- **Propagation and channel characterization**

Computational EM: Characteristic Basis Functions

Approach

- *waveguide and Floquet modes*
- *computed basis functions*
- *eigenfunctions*
- *equivalence principle: LEGO*





ASTRON

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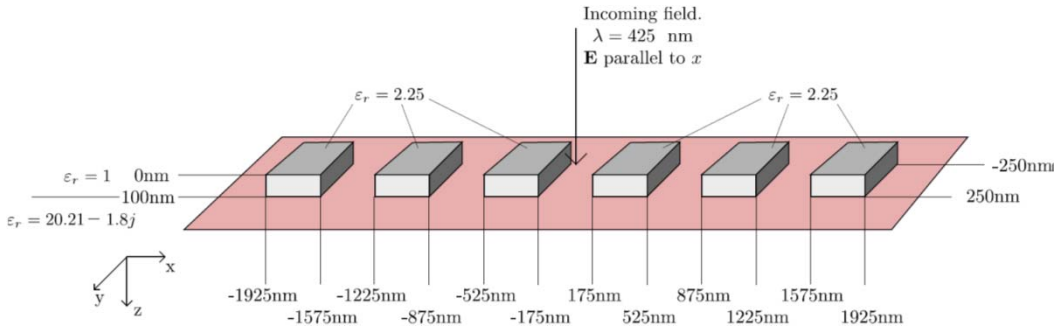
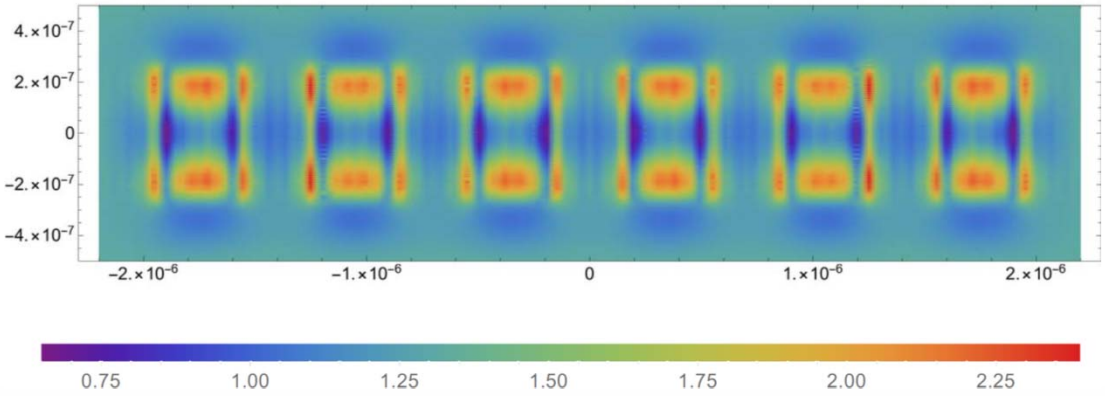
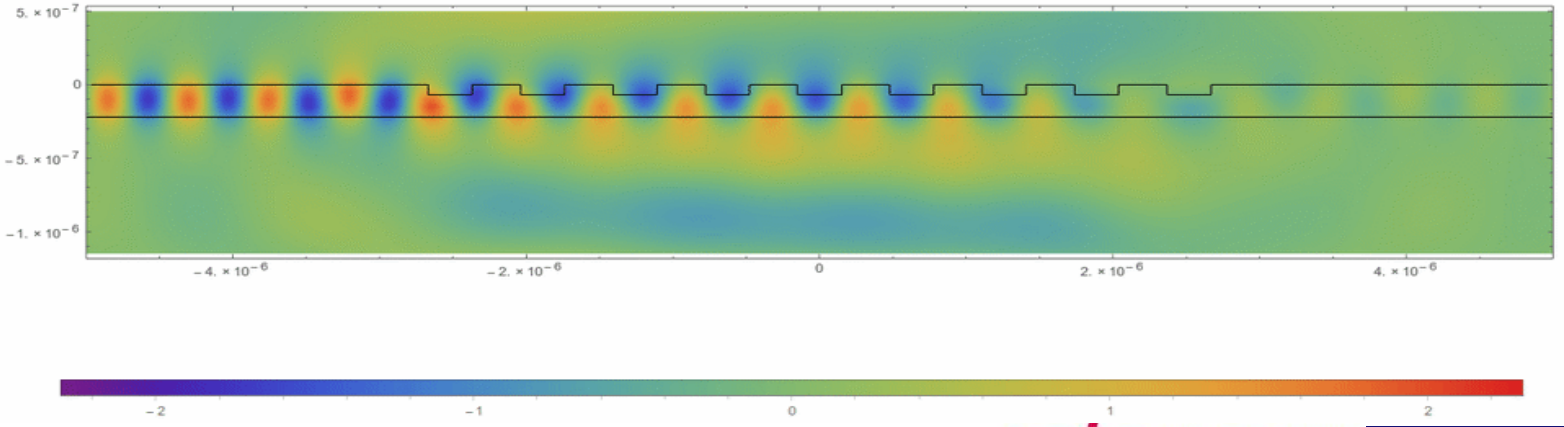
Maxwell-solvers for (finite) periodic structures



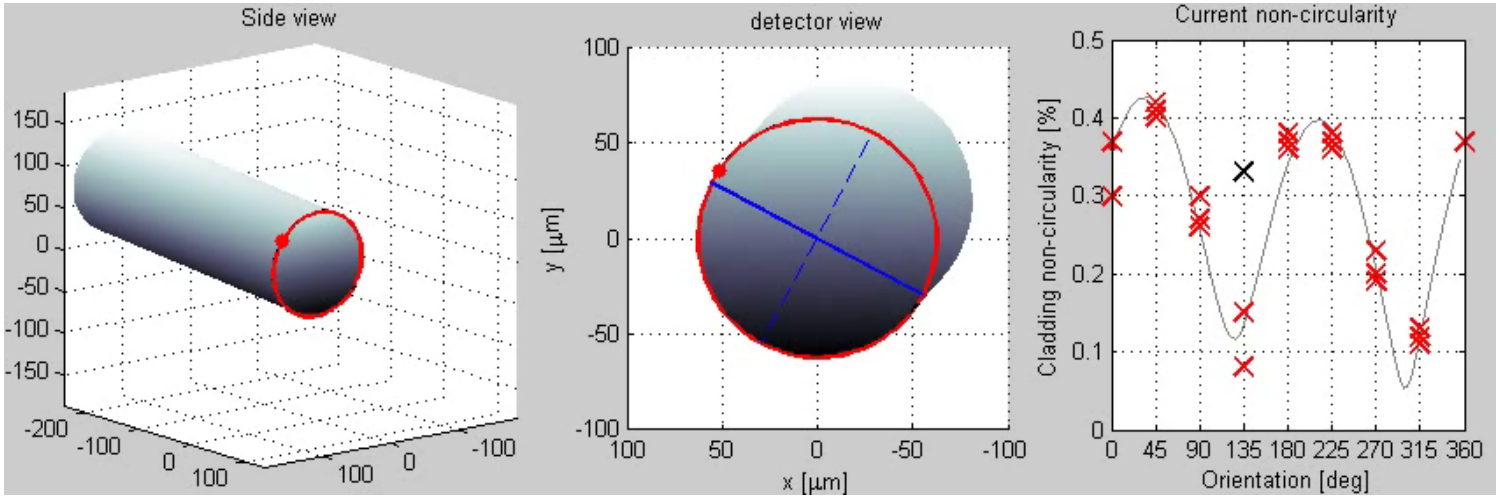


Applications

EM-solver for lithography, metrology and integrated photonics



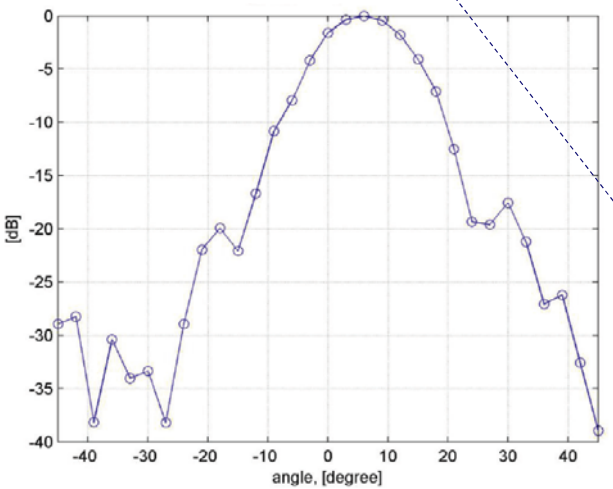
Optical fibre link simulations and experiments

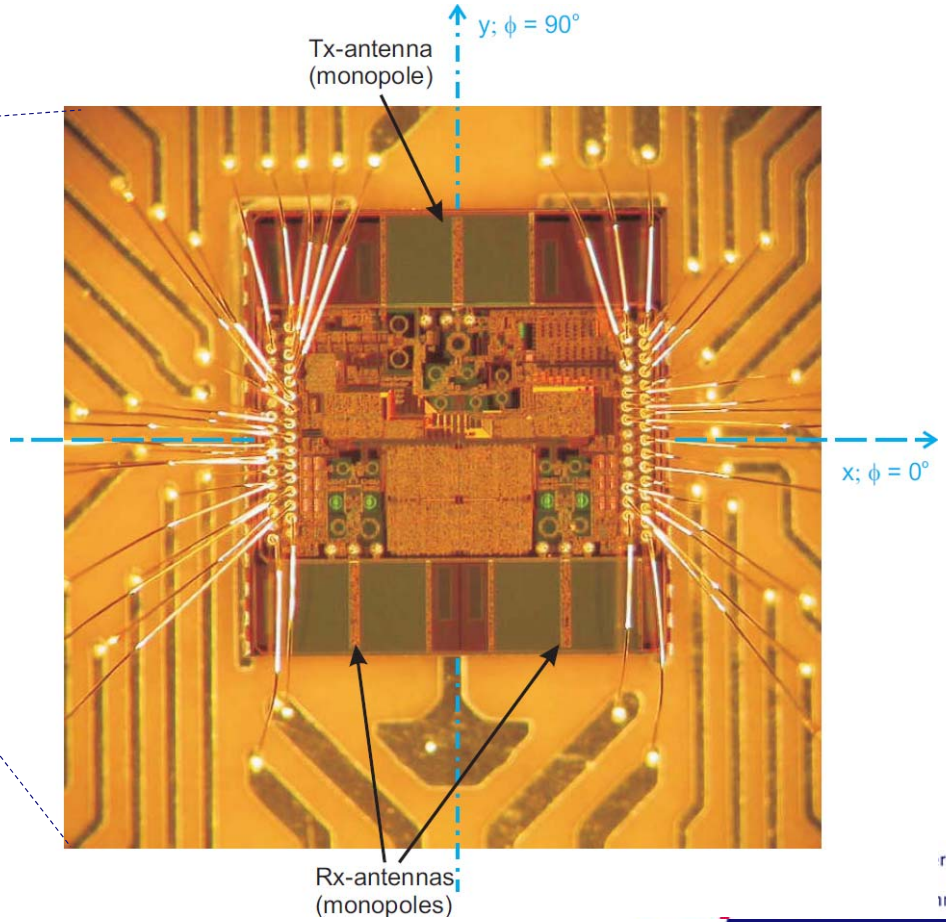


Optical wave guide

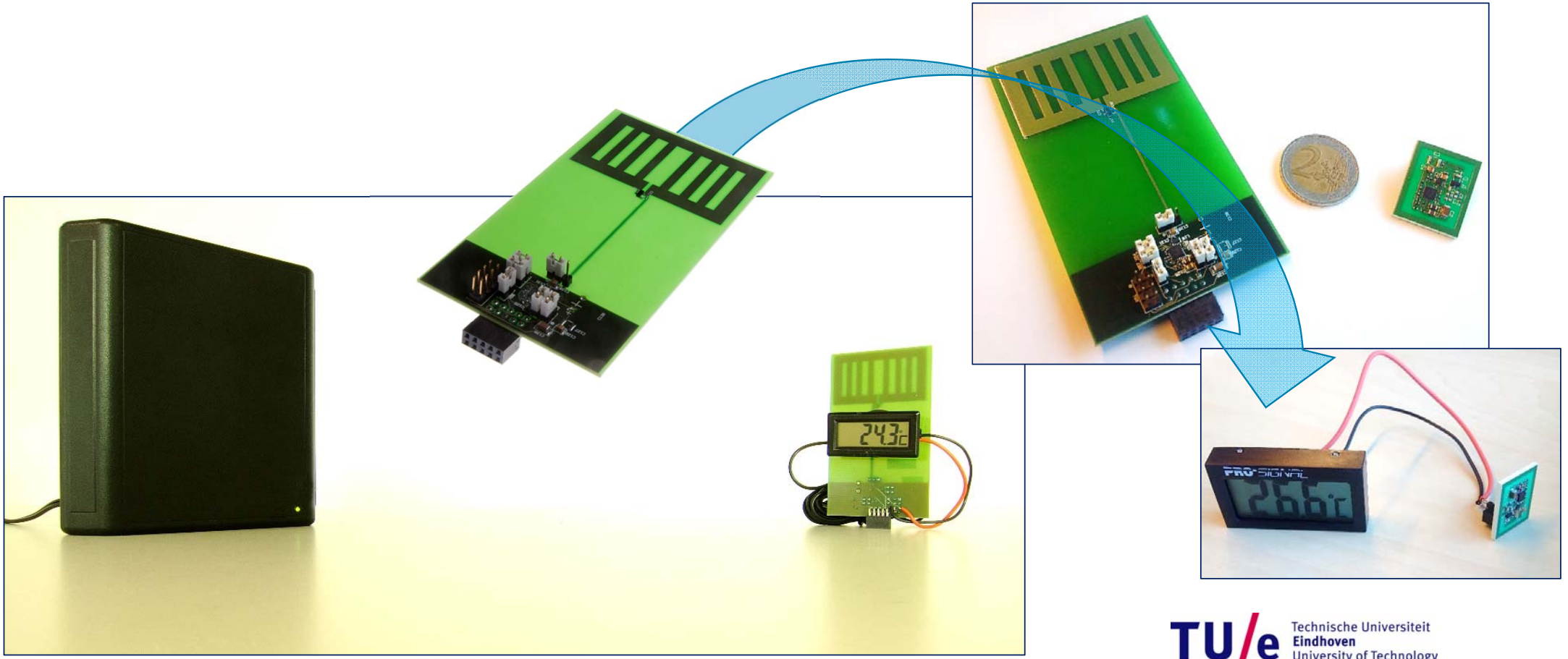
- *model fitted to measured data*
- *extraction of hidden parameters*

Single-chip 60 GHz radar (Omniradar)
BiCMOS

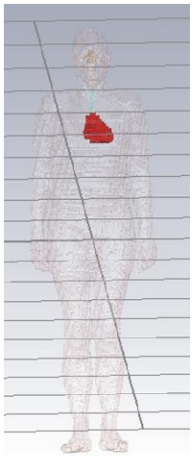


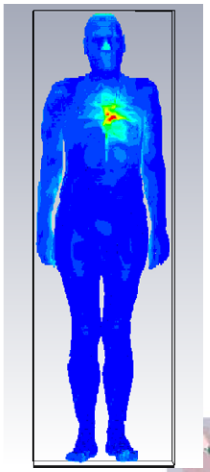


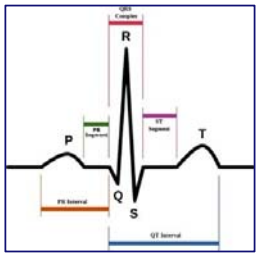
Far-Field Wireless Power Transfer



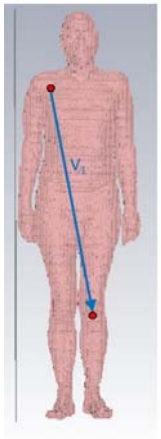
On/In-Body Electromagnetics

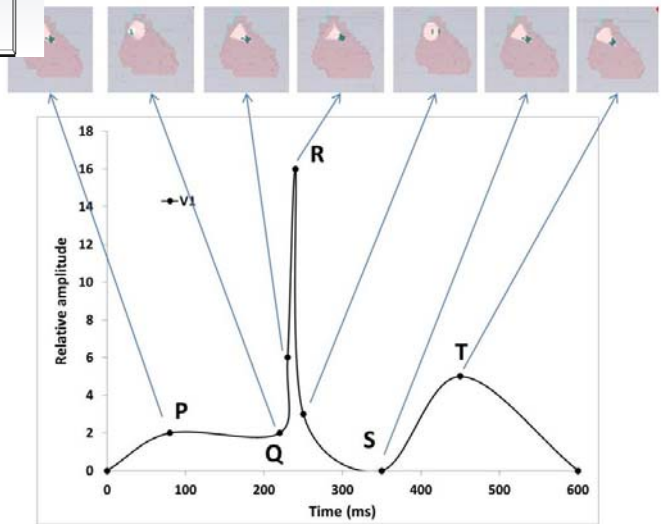


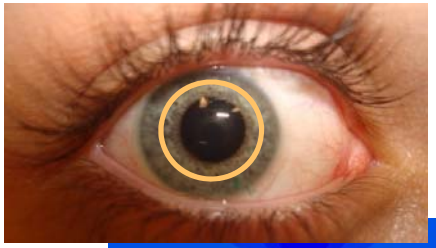




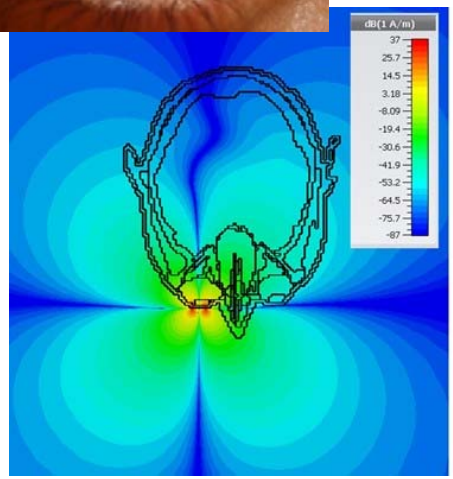
ECG modeling

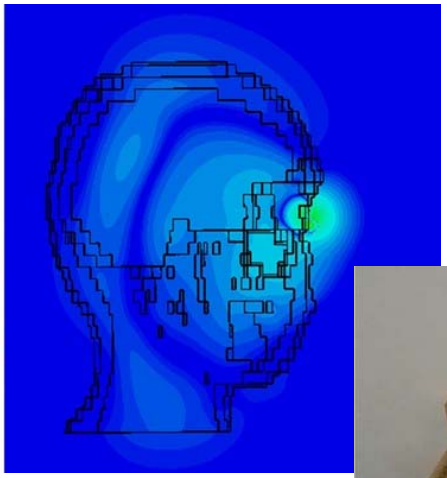






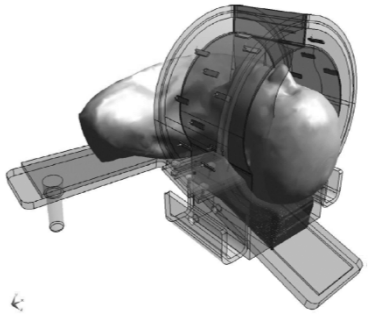
Contact Lens Antenna Design and Measurement

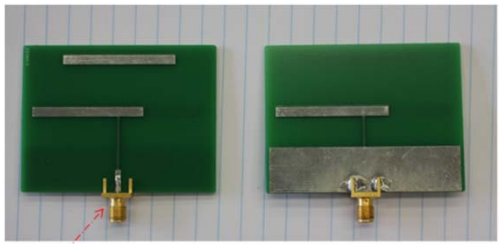


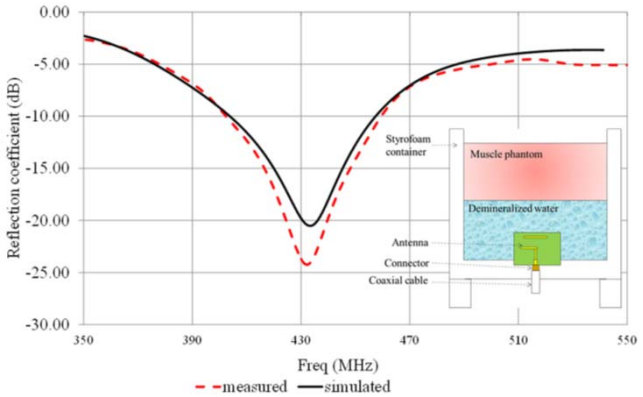


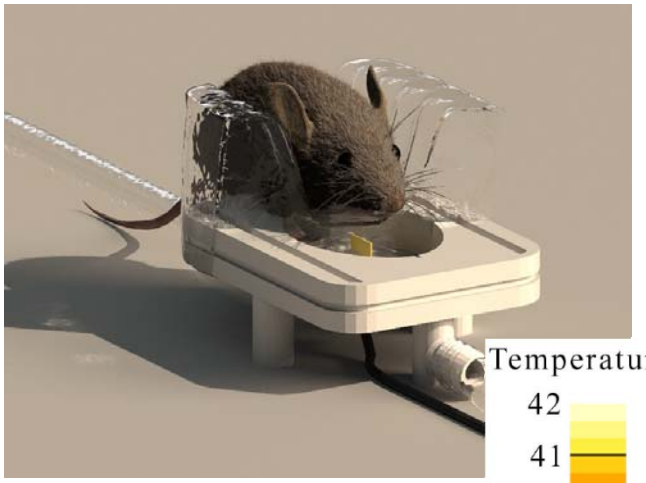
Medical applications: hyperthermia

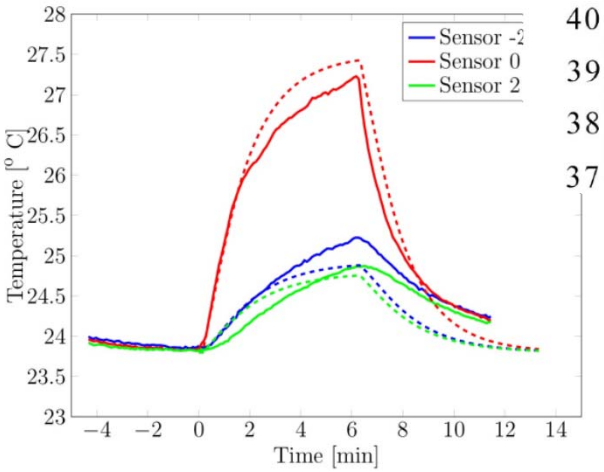
- *Hyperthermia RF antenna design*
- *Coupled EM–thermal simulations + control*

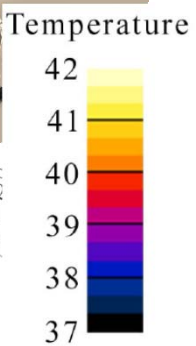


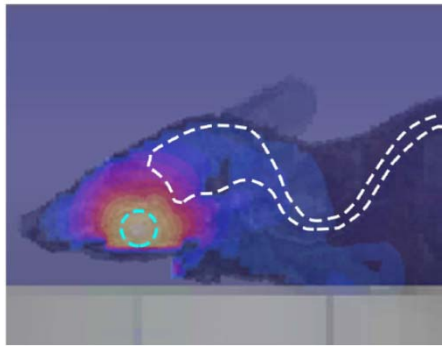










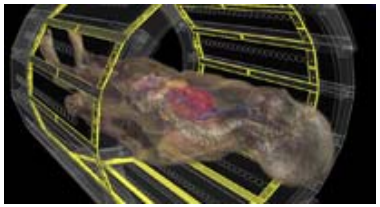


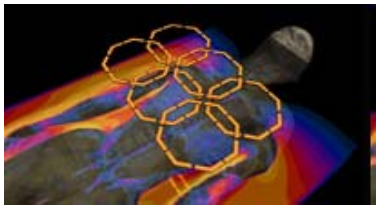
Erasmus MC
Universitair Medisch Centrum Rotterdam

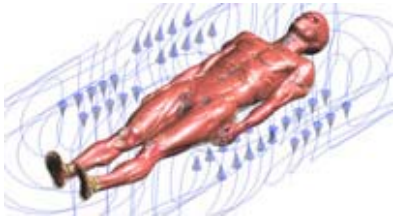
TU/e Technische Universiteit Eindhoven University of Technology

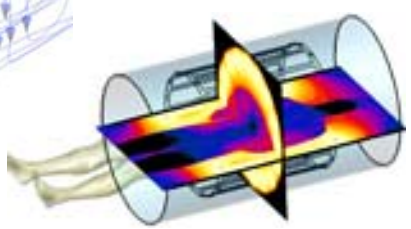
Medical applications: neurostimulation and MRI

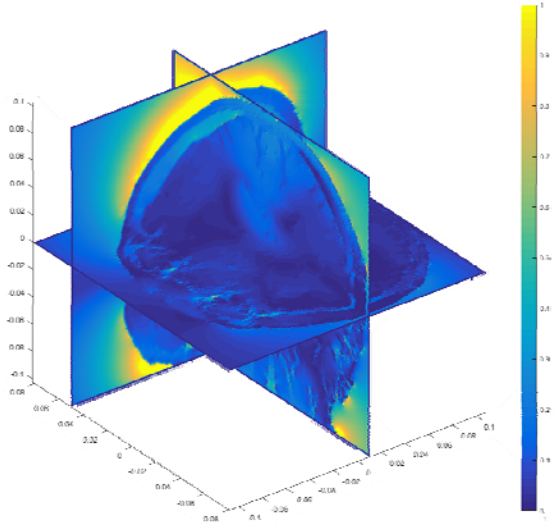
Neu^{3}CA

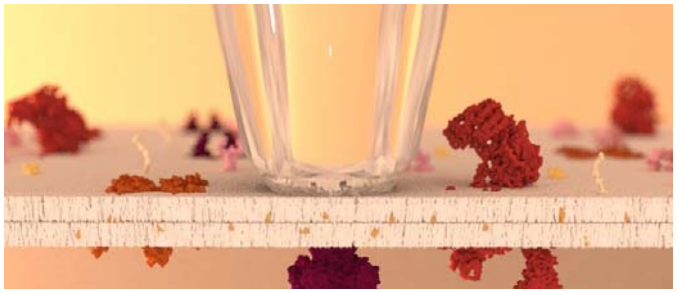












Neurostimulation

- *Excitation mechanisms*
- *Stimulation through TMS, VNS, tDCS*

MRI

- *body coil design*
- *RF shielding*

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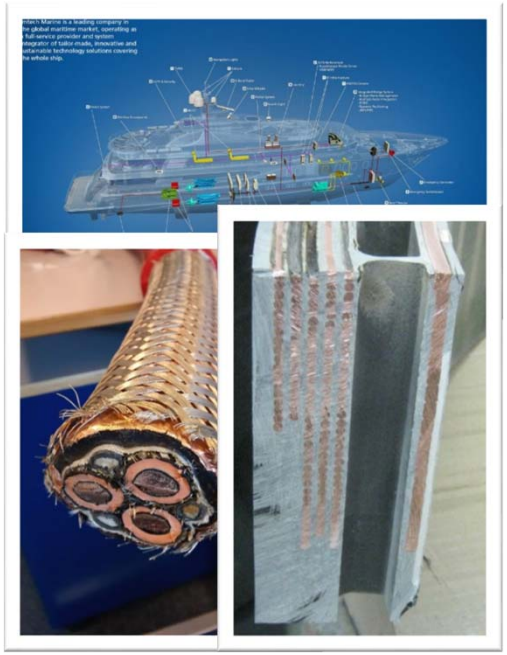
EMC (ElectroMagnetic Compatibility)

EMC in Industrial Installation

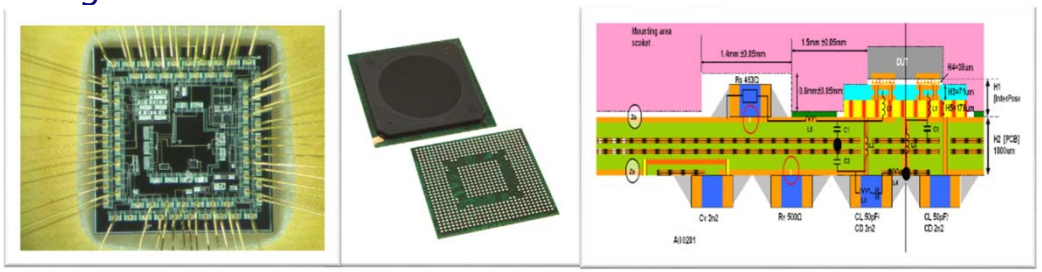
Maritime Installation



Medical Installation

Automotive

Integrated circuits



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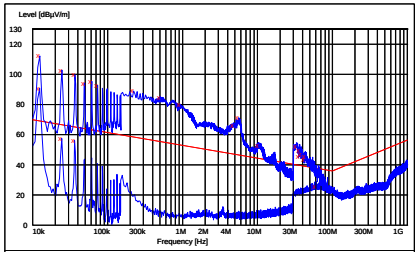
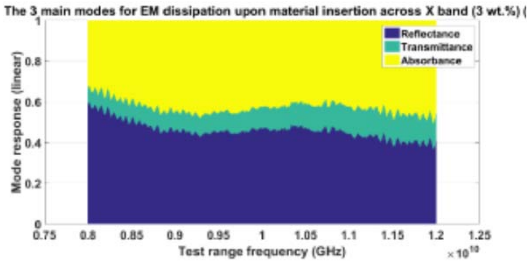
EMC (ElectroMagnetic Compatibility)

EMC Predicting Tools

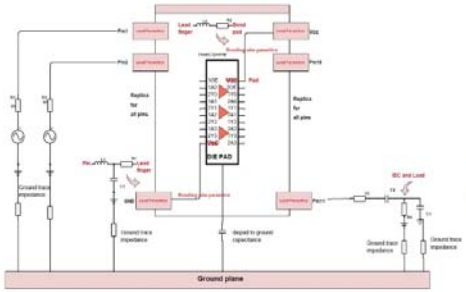
(Radiated) Emissions filtering

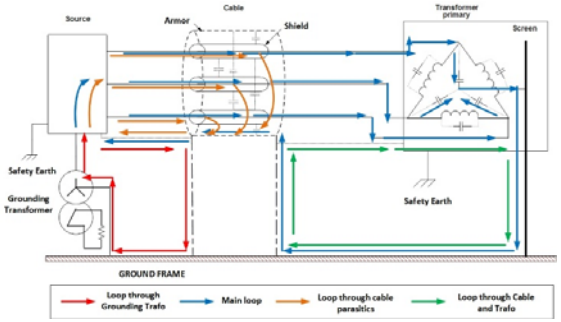


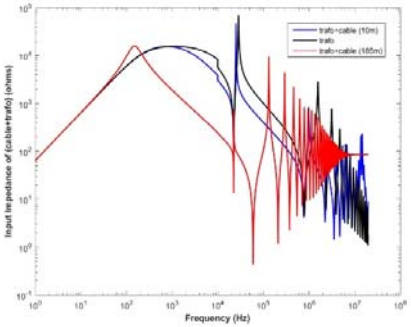
New material and shielding



Grounding and routing: from ICs to large systems



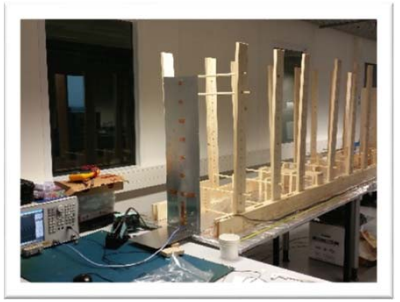




Measurements

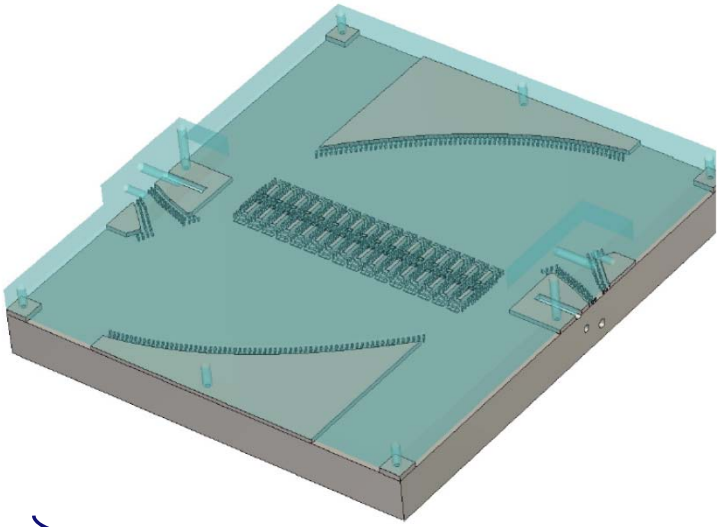
Anechoic Room

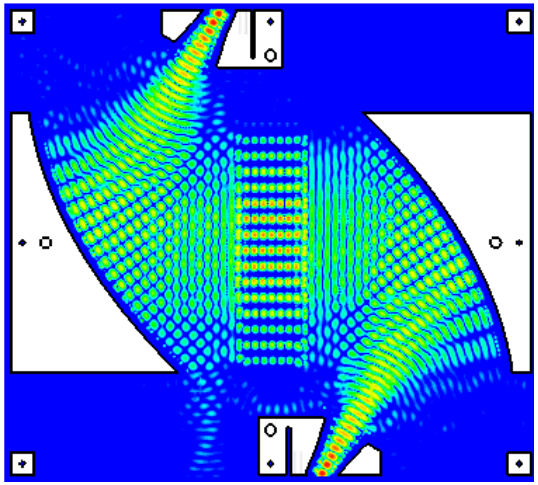
Test bench for cables

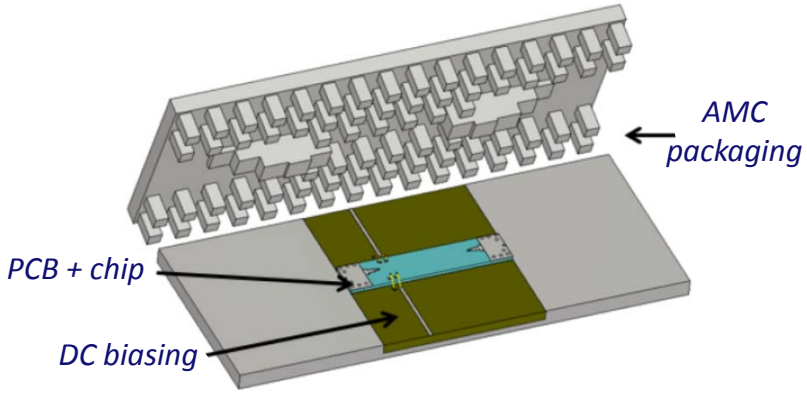


Reverberating Room

Spatial power combining, packaging, integration



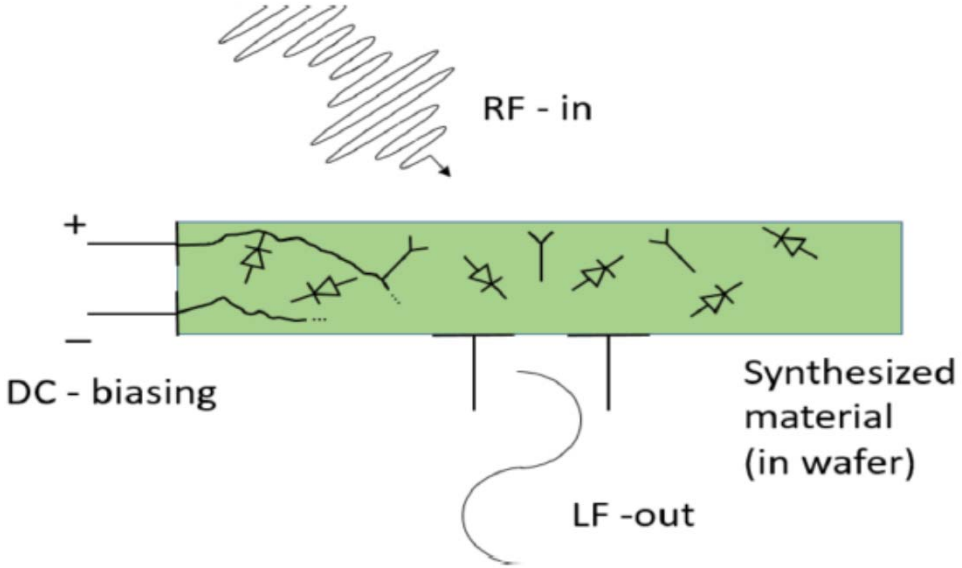


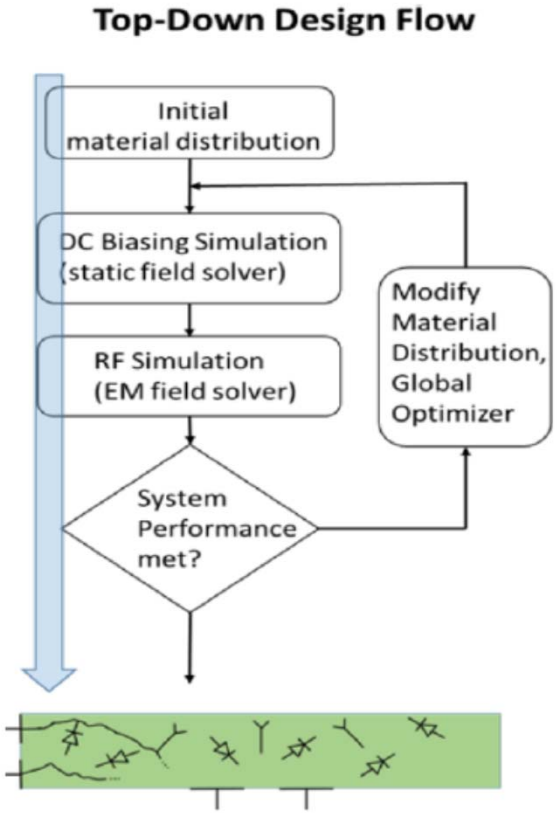


Spatial Power Combining

Packaging & Integration

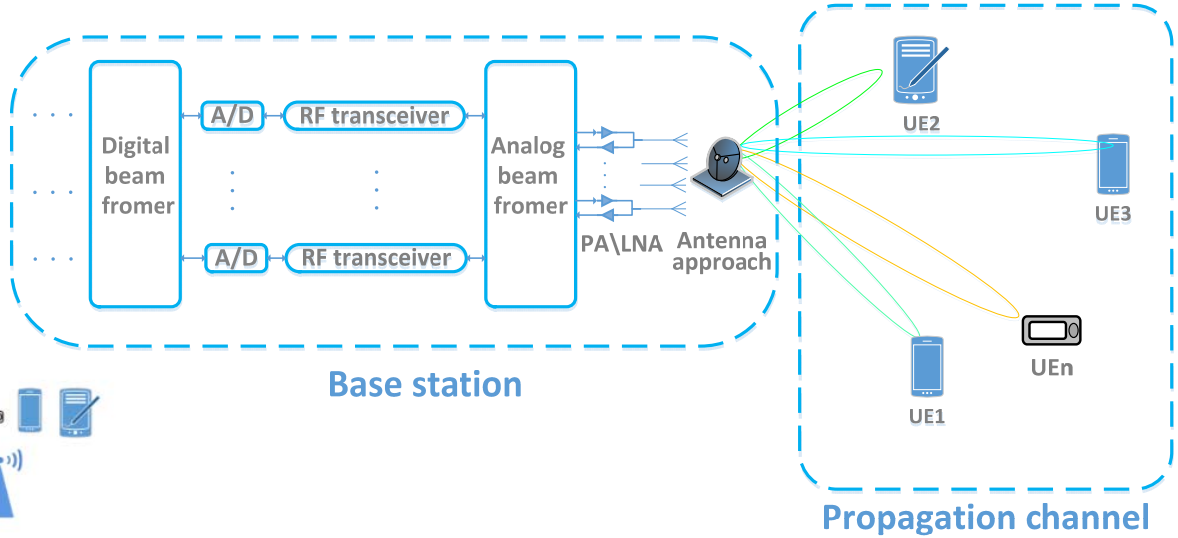
A Paradigm Shift: Deep Integration

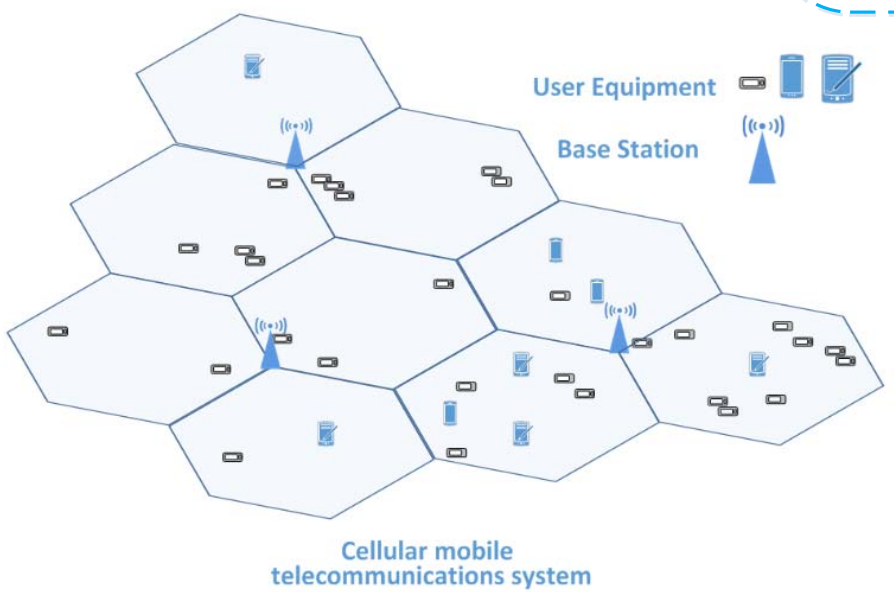




- *Fusion of EM and Circuit Theory*
- *Multi-functional multi-scale materials*

Integrated mm-Wave antennas for 5G base stations





- *Array-fed reflector antenna*
- *Silicon based massive MIMO FLA/FPA system*
- *Multi-user environment in Ka-band (28 GHz)*

Questions?

- **Our location:**
  - **Flux floor 9 (+ 7)**
  - **Flux floor 8: Labs**

- **There is much more to be explored @EM**

- **Contact us!**

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