UNIVERSITEIT GENT

FACULTEIT INGENIEURSWETENSCHAPPEN EN ARCHITECTUUR

Academiejaar 2014-15

Thesispresentaties 2015-16

WiCa onderzoeksgroep

WiCA

iMinds CONNECT.INNOVATE.CREATE

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+ 500 publicaties

+ 50 projecten

16 onderzoekers

WiCa

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OSI model


7 Toepassingslaag
6 Presentatielaag
5 Sessielaag
4 Transportlaag
3 Netwerklaag
2 Datalinklaag
1 Fysische laag

Onderzoeksdomeinen - Applicaties

- **Aanbevelingssystemen**
- **Personalisatie**
- **Human-computer interaction,**
- **Context-bewuste applicaties**
- **Big data**

- **Contact:**

Toon.DePessemier@intec.UGent.be
Kris.Vanhecke@intec.UGent.be

Onderzoeksdomeinen - Draadloos

- **Blootstelling aan elektromagnetische velden**
- **Medische toepassingen**
- **Green ICT**
- **Communicatie en propagatie voor draadloze netwerken**
- **Wireless body area networks**
- **Performantie van draadloze netwerken**

Low exposure

Energy efficient

Maximum coverage

Blootstelling aan elektromagnetische velden

Thesisvoorstel

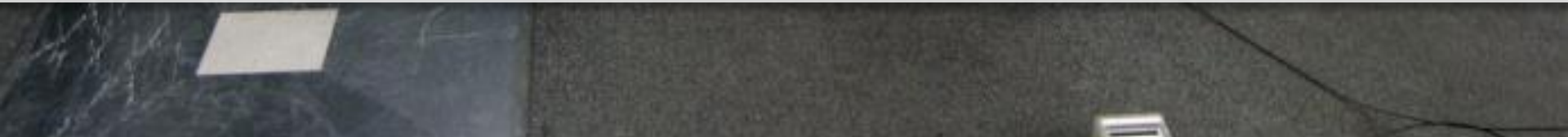
Studie van de absorptie veroorzaakt door de straling van poorten voor elektronische artikelbeveiliging

Promotoren

Prof Luc Martens, Prof Wout Joseph

Begeleider

Günter Vermeeren




Referentie niveaus soms overschreden
Doelstelling: Voldaan aan basisrestricties?

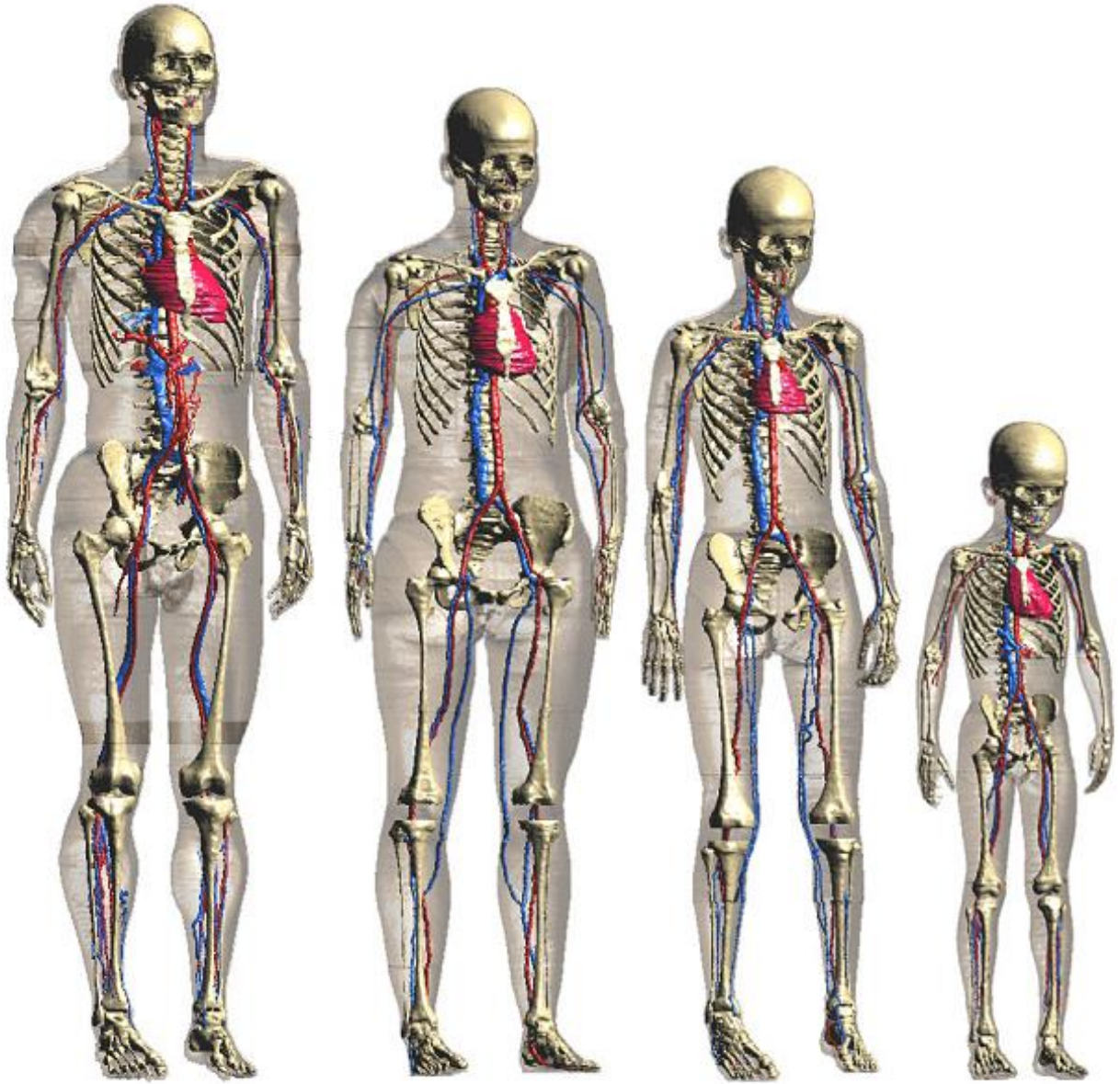
FDTD tool

3D electromagnetic solvers

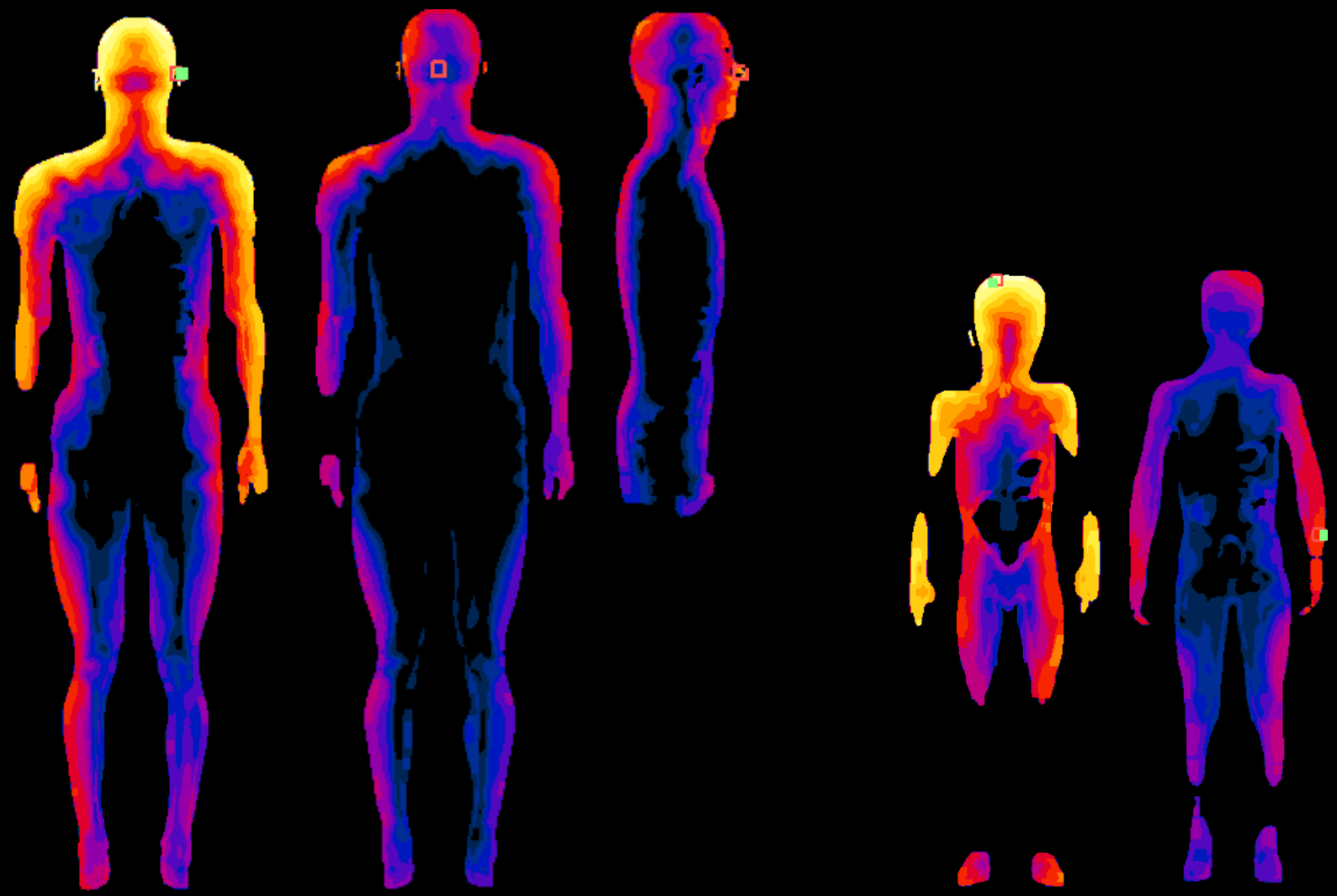
FEKO

Comprehensive Electromagnetic Solutions

Hybrid MoM/ FEM tool



Virtual Family models



EM absorptie in lichaam

gunter.vermeeren@intec.ugent.be

Thesisvoorstel

Blootstelling van een cameraman aan de elektromagnetische straling tijdens de draadloze overdracht van beeld

Promotoren

Prof Luc Martens, Prof Wout Joseph

Begeleider

Günter Vermeeren


vrt
vrt

Nabije-veld blootstelling

Blootstelling meerdere uren per dag

gunter.vermeeren@intec.ugent.be

Thesisvoorstel

Invloed van lichaamsbouw op de verstrooiing van radiofrequente elektromagnetische velden

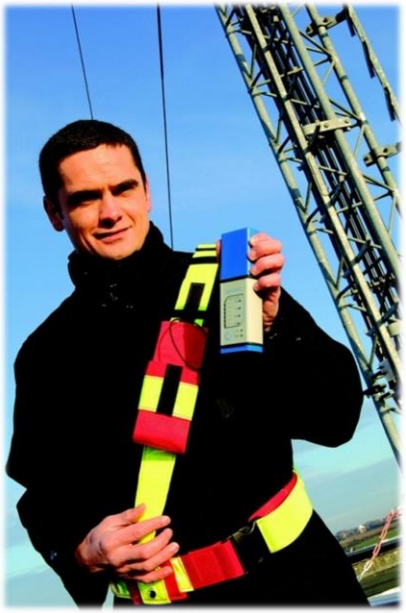
Promotoren

Prof Luc Martens, Prof Wout Joseph

Begeleider

Arno Thielens

Probleemstelling



Persoonlijke exposimeters

opmeten van

blootstelling aan radiofrequente elektromagnetische velden

meetonzekerheden

Morphologie testpersoon

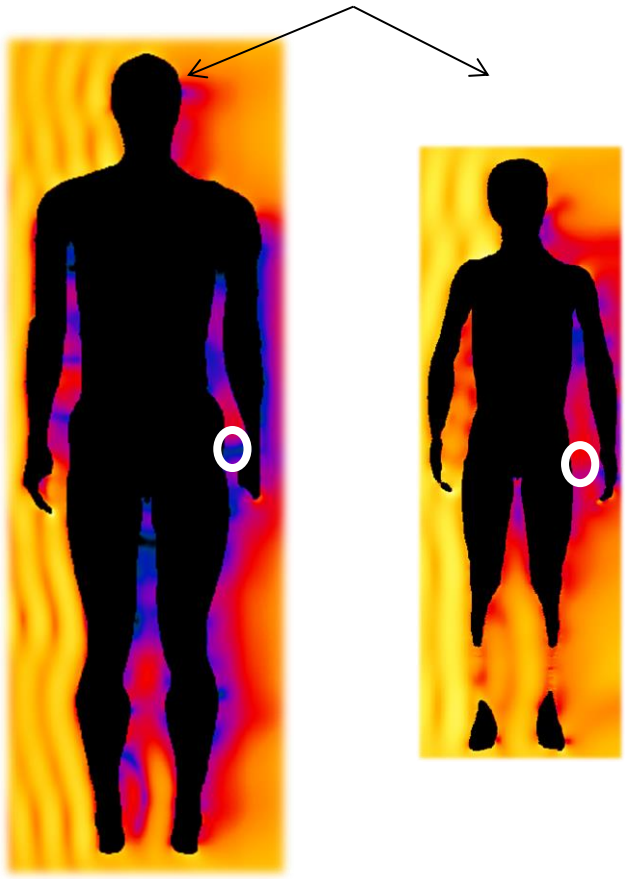
Positionering exposimeter

Invloed morfologie en plaatsing exposimeter

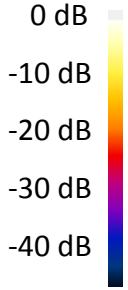
Meet een exposimeter wel hetzelfde op als hij op **verschillende mensen** geplaatst wordt?

Invloed morfologie en plaatsing exposimeter

Meet een exposimeter wel hetzelfde op als hij op **verschillende mensen** geplaatst wordt?



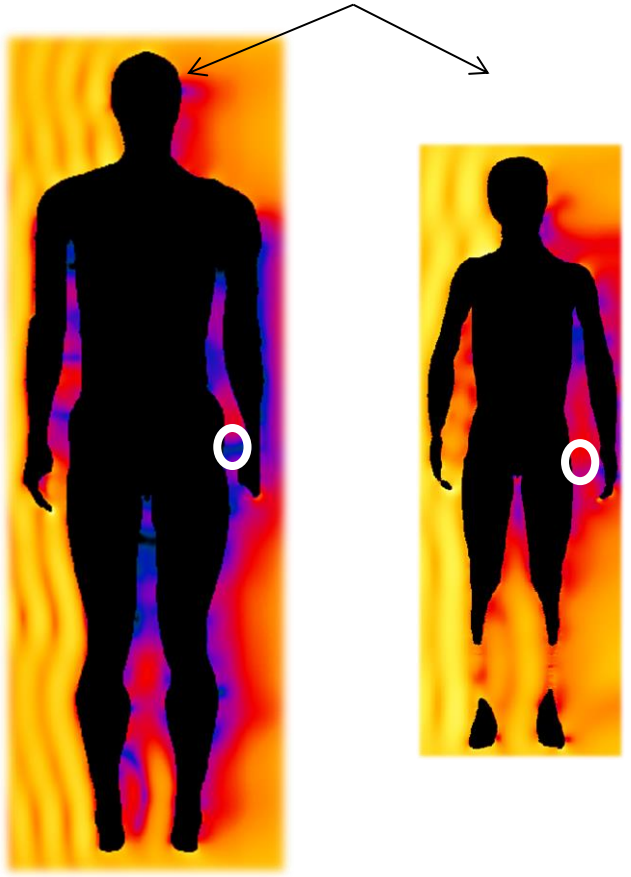
Verstrooide elektrische velden voor WiFi



Hoe groot is deze variatie en hoe kan deze verholpen worden?

Invloed morfologie en plaatsing exposimeter

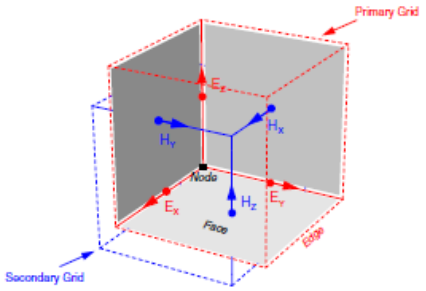
Meet een exposimeter wel hetzelfde op als hij op **verschillende mensen** geplaatst wordt?



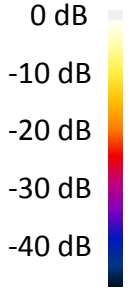
Metingen

Hoe groot is deze variatie en hoe kan deze verholpen worden?

FDTD simulaties



Verstrooide elektrische velden voor WiFi



Thesisvoorstel

Coöperatieve Exposimetrie voor Radiofrequente Straling

Promotoren

Prof Luc Martens, Prof Wout Joseph

Begeleider

Arno Thielens

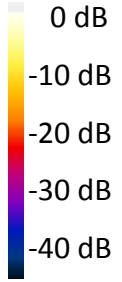
Probleemstelling

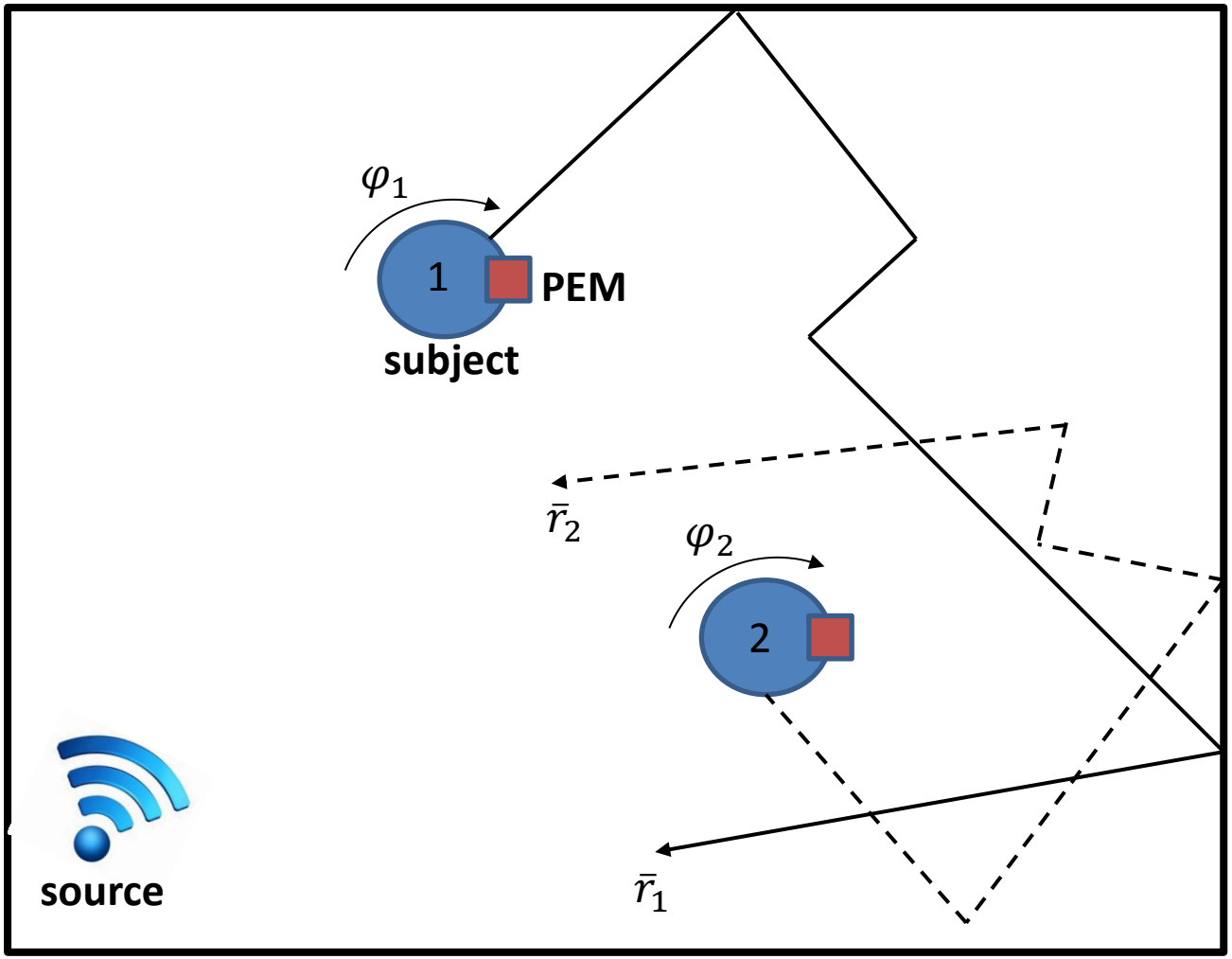
Persoonlijke exposimeters (PEMs) — opmeten van → blootstelling aan radiofrequente elektromagnetische velden

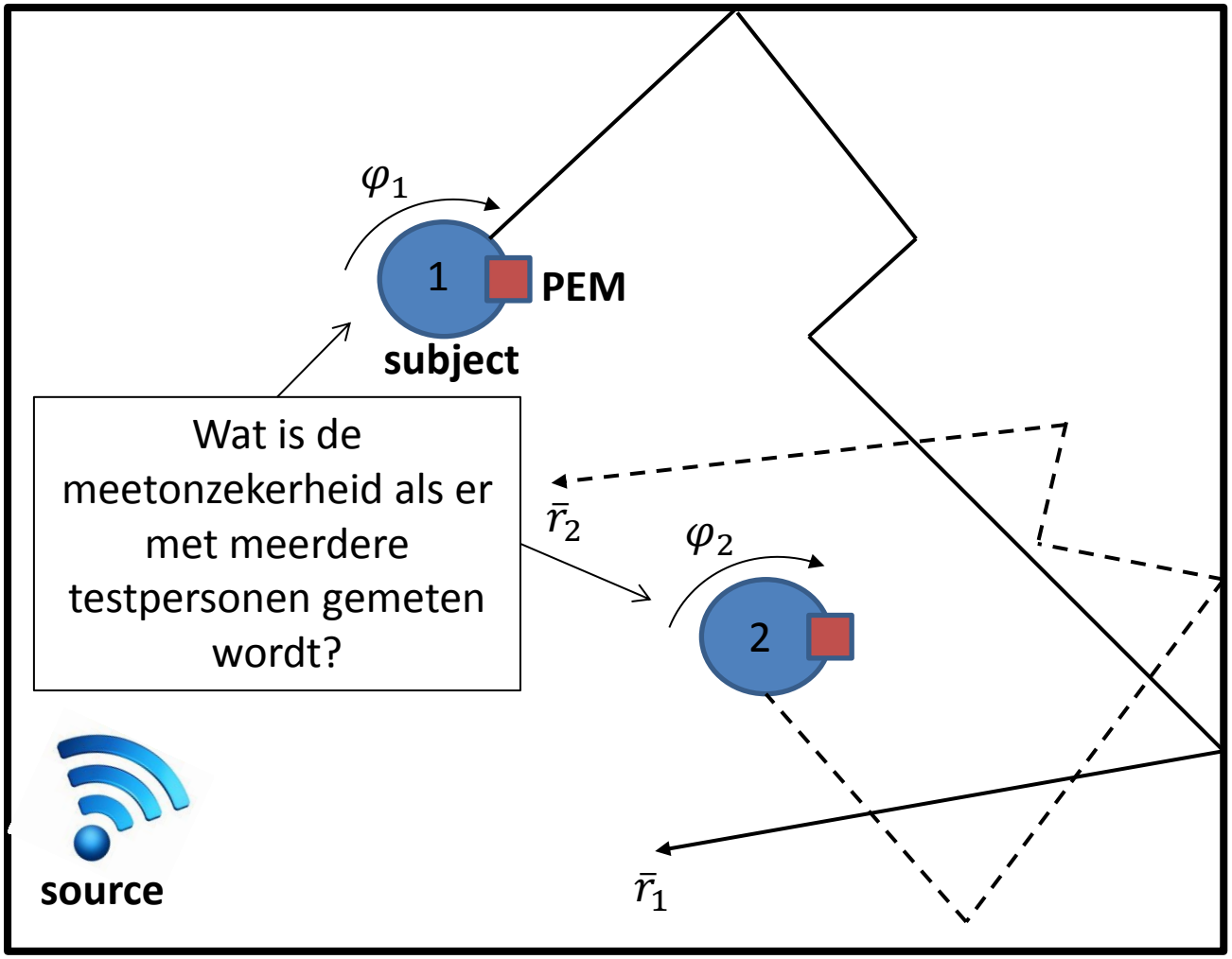
RF Elektromagnetische velden

bron

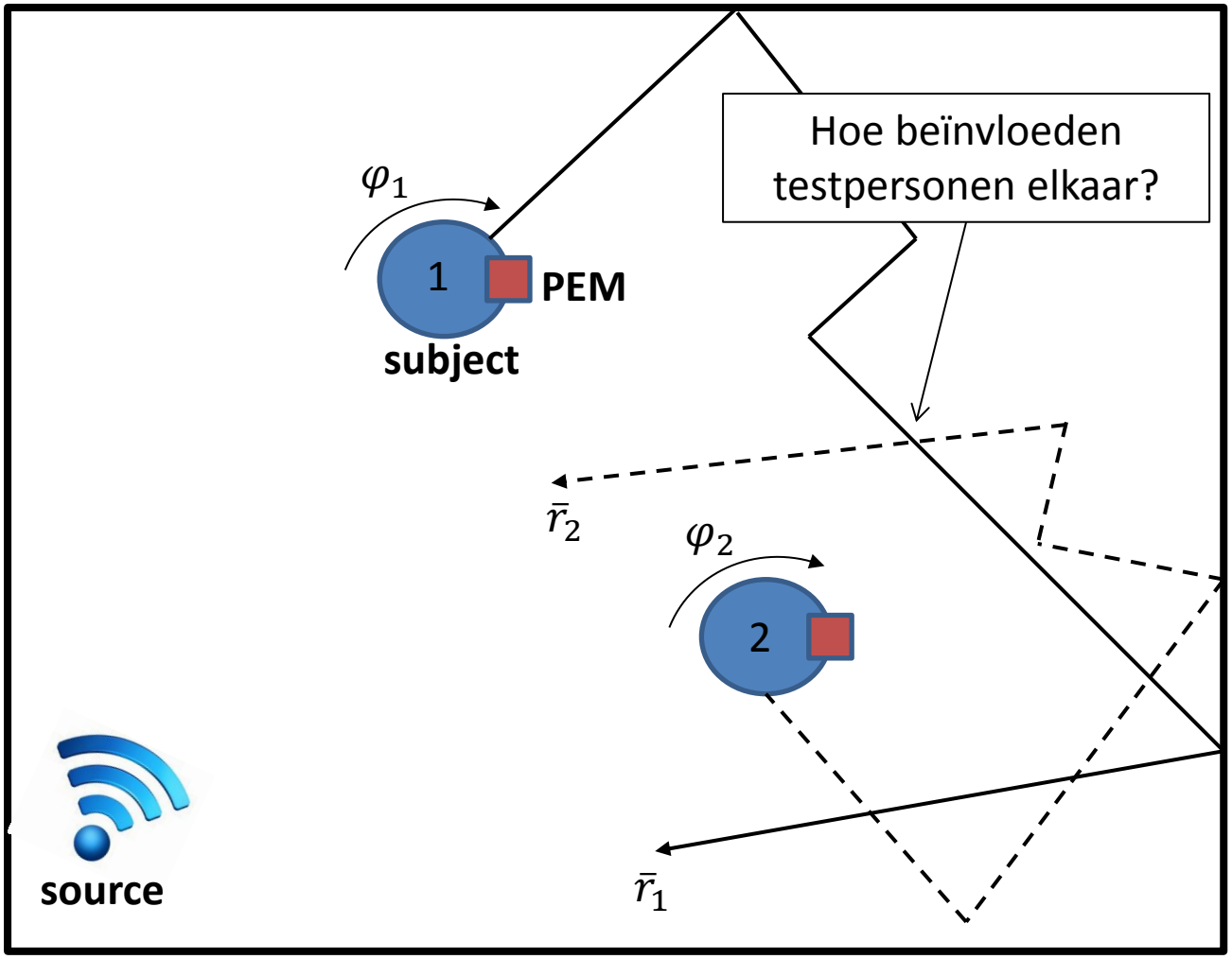
Grote **meetonzekerheden** op metingen met **1** testpersoon die **1** exposimeter draagt, hebben




φ_1
1
PEM
subject
$\bar{r}_2$
φ_2
2
source
$\bar{r}_1$


φ_1
1
PEM
subject
Wat is de meetonzekerheid als er met meerdere testpersonen gemeten wordt?
$\bar{r}_2$
φ_2
2
source
$\bar{r}_1$

Coöperatieve Exposimetrie



Thesisvoorstel

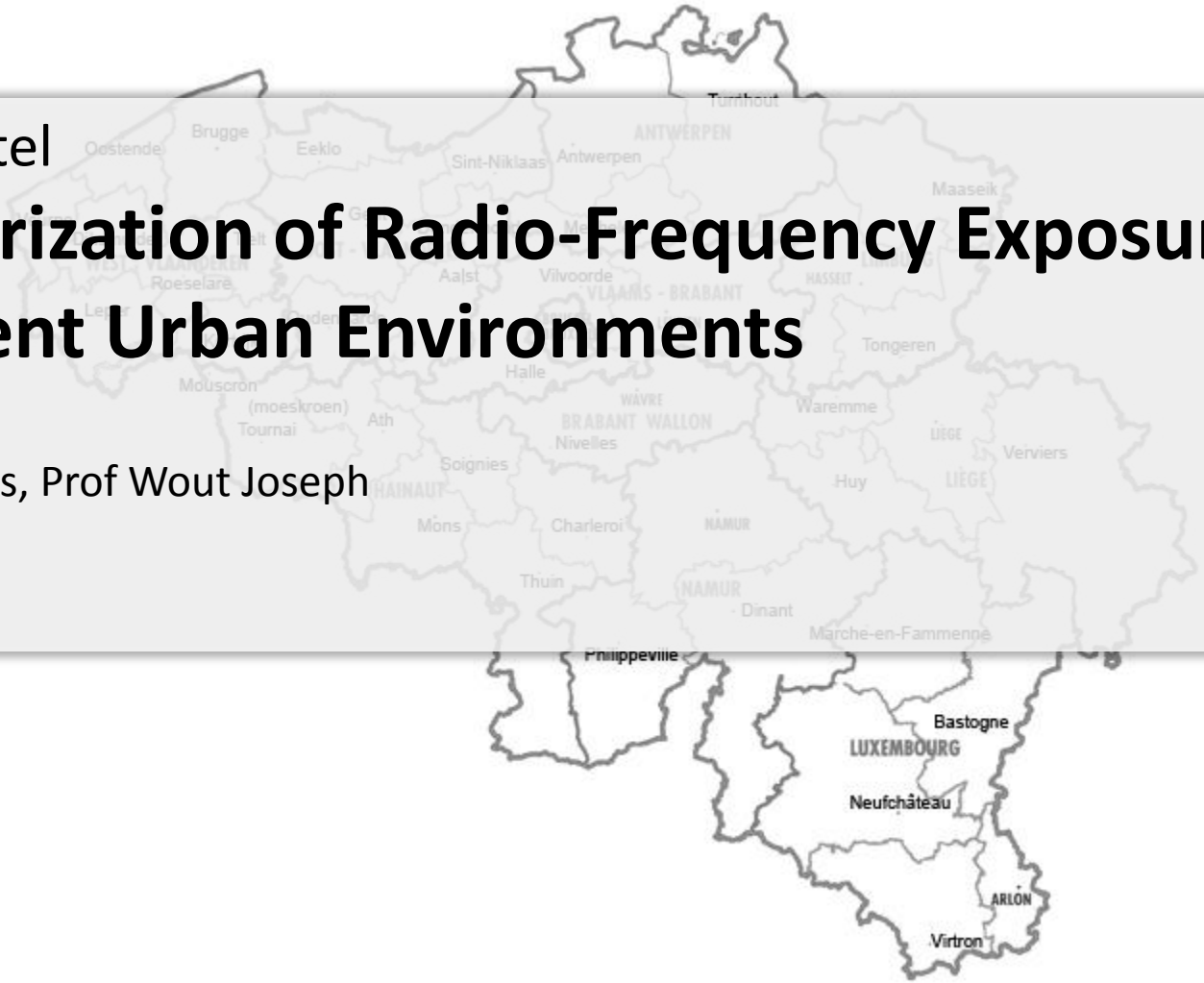
Characterization of Radio-Frequency Exposure Levels in Different Urban Environments

Promotoren

Prof Luc Martens, Prof Wout Joseph

Begeleider

Arno Thielens



Problem

Flanders

f (MHz)	Cumulative Norm (W/m^2)	Residential[1] (W/m^2)
10-400	0.50	0.011
400-2 x 10^3	0.0012 x f	2.7 x 10^{-5} x f
2 x 10^3-10 x 10^3	2.5	0.053

[1]Residential, maximum per antenna

Different Regulations

Does this lead to differences in exposure?

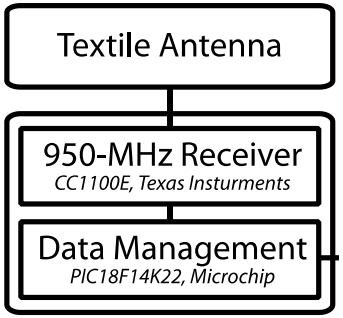
Brussels

f (MHz)	Norm (W/m^2)
10-400	0.043
400-2 x 10^3	1.1 x 10^{-4} x f
2 x 10^3-10 x 10^3	0.22

Method

Measurements of **personal exposure** using a **new measurement device**

4 x



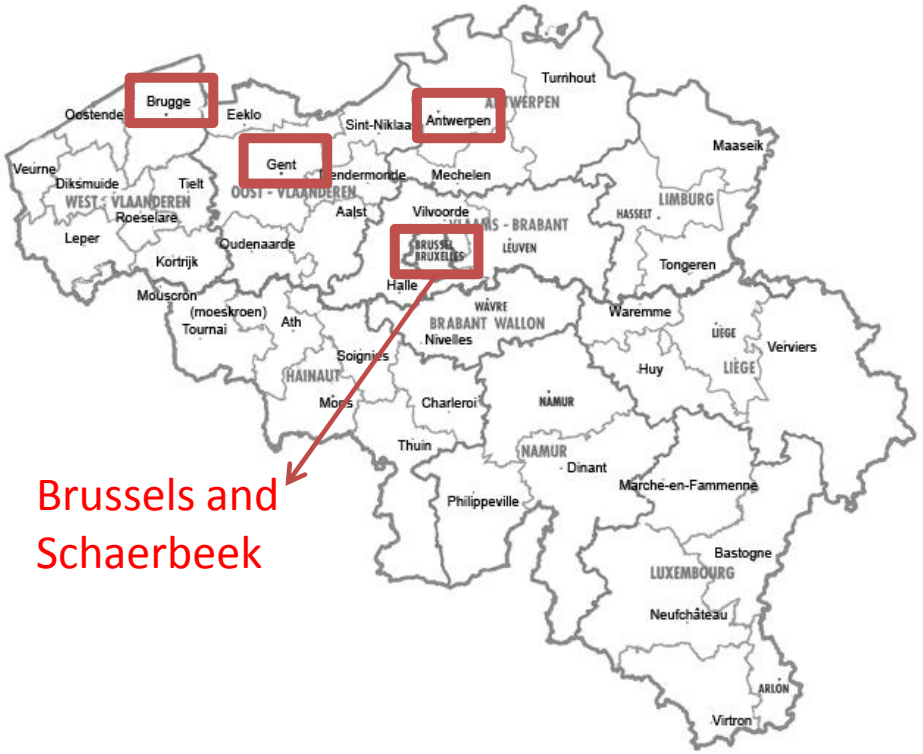
© Ralph Lauren

Method

Measurements in **different micro-environments**

Type of micro-environment	urban*
outdoor areas	
downtown area	2
business area	2
shopping area	2
residential area	2
public places	
railway station	2
bus station	2
university	2
transportation mode	
train	2
bus	2
metro/tram	2
car	2
Total N	**22**

* Antwerp, Ghent, Bruges, Brussels, and Schaerbeek



Comparison of five cities in Flanders and Brussels

Thesisvoorstel

Simultaneous Characterization of Exposure to Sound and Electromagnetic Low Frequency near Power Transformers

Promotoren

Prof Dick Botteldoorn, Prof Wout Joseph

Begeleider

Arno Thielens

Problem

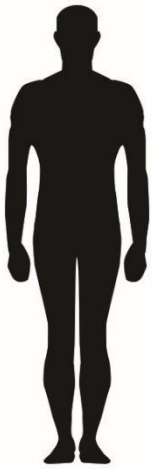
Transformer

Subject

Sound →

Low Frequency EMFs →

Exposure



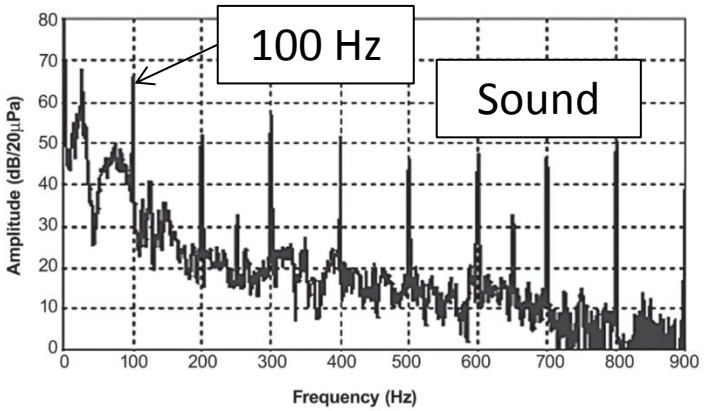
Same physical mechanism!

Exposure to both sound and LF EMFS ⟶ Two measurements are necessary

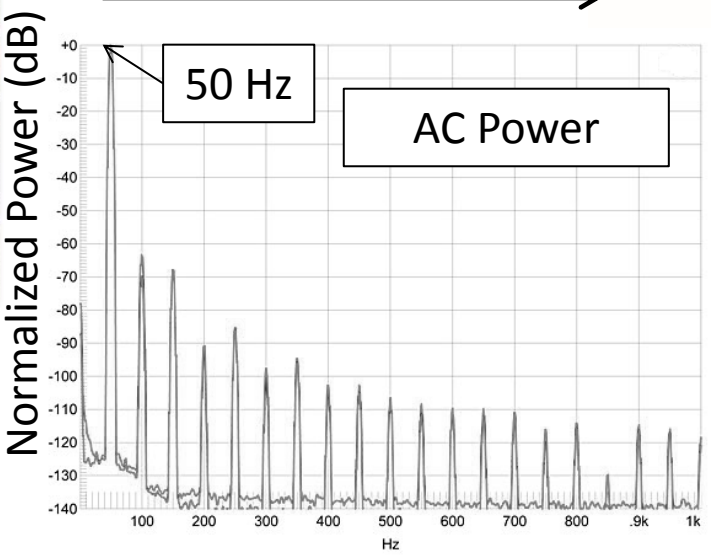
Can both be obtained from one measurement?

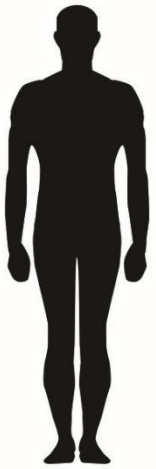
Methodology

Transformer



Exposure





UNIVERSITEIT GENT

FACULTEIT INGENIEURSWETENSCHAPPEN EN ARCHITECTUUR

Comparison of interpolation techniques in the assessment of radiofrequency electromagnetic fields in an urban environment

Promotoren: prof. Luc Martens, prof. Wout Joseph
Begeleider: Sam Aerts (*sam.aerts@intec.ugent.be*)

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Probleemstelling

Continue blootstelling aan radiofrequente (RF) elektro-magnetische straling (GSM, UMTS, LTE, Wi-Fi, FM, ...)

? Waar hoeveel ?

Nood aan informatie

In kaart brengen van elektromagnetische straling

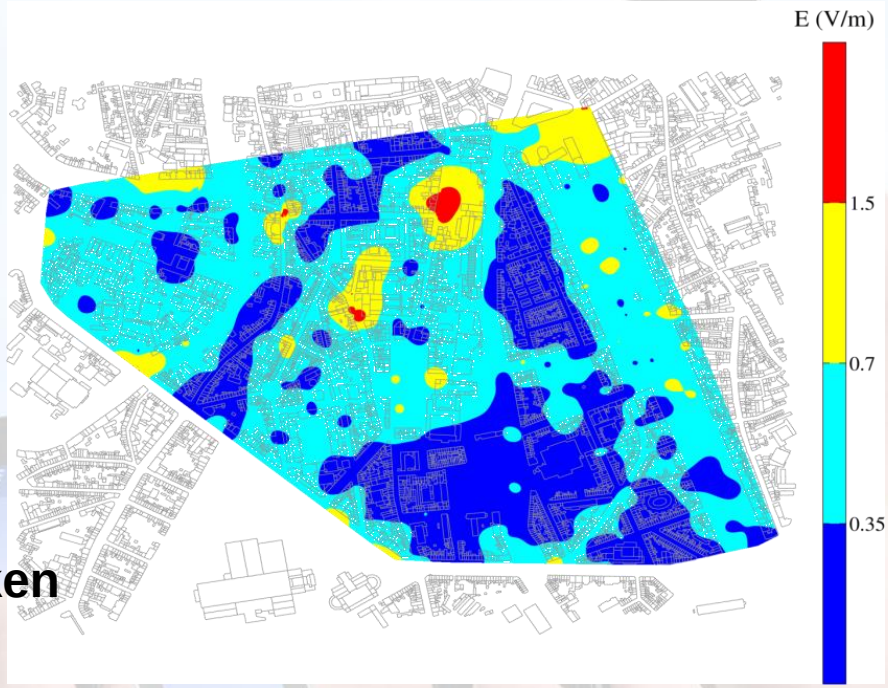
→ *Moeilijk in real-life*: (bewegende) obstakels, interferentie, …

- Simulaties, maar veel nauwkeurige info nodig
- Interpolatie, maar veel tijdrovende metingen nodig

Comparison of interpolation techniques in the assessment of radiofrequency electromagnetic fields in an urban environment

Doel thesis

DOEL = nauwkeurige blootstellingskaart voor een echte omgeving (Gent) adhv metingen



Onderzoek

- **Literatuurstudie**
  - Meetapparatuur
  - Efficiënte locatie metingen
  - Interpolatietechnieken
- **Metingen**
- **Verschillende interpolatietechnieken toepassen**

Comparison of interpolation techniques in the assessment of radiofrequency electromagnetic fields in an urban environment

Medische toepassingen

UNIVERSITEIT GENT

FACULTY OF **ENGINEERING**

Master Thesis 2015 - 2016

Design and optimization of RF coil for a minimal interference between PET and MRI subsystems

Supervisors

Prof. Wout Joseph, Prof. Roel Van Holen

Mentors

Amine Samoudi, Günter Vermeeren

Contact

amine.samoudi@intec.ugent.be

WICA

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Magnetic Resonance Imaging (MRI)

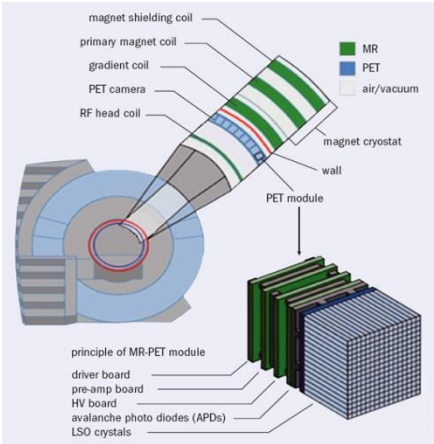
Positron Emission Tomography (PET)

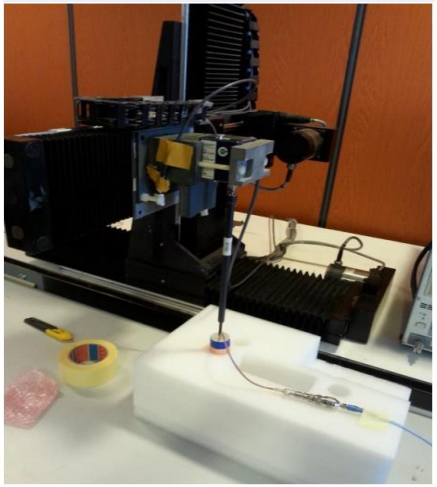
- Interferences between the components, mainly for the Radio Frequency (RF) system of the MRI

- Increased noise level for the RF system
- Image deterioration for the combined system
- Generation of eddy currents in PET conductive components …

Purpose

1. Design and optimize the RF coil to mitigate the effects of interferences due to insertion for PET/MRI system.
2. Design an optimized shielding mechanism for the RF subsystem while keeping eddy currents minimal





Method

3D Electromagnetic solvers

FEKO
Comprehensive Electromagnetic Solutions

FDTD tool

Hybrid MoM/ FEM tool

WiCa

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UNIVERSITEIT GENT

FACULTY OF **ENGINEERING**

Master Thesis 2015 - 2016

Investigation of head and local RF absorption in human head model within MRI/SPECT system

Supervisors

Prof. Wout Joseph, Prof. Roel Van Holen

Mentors

Amine Samoudi, Günter Vermeeren

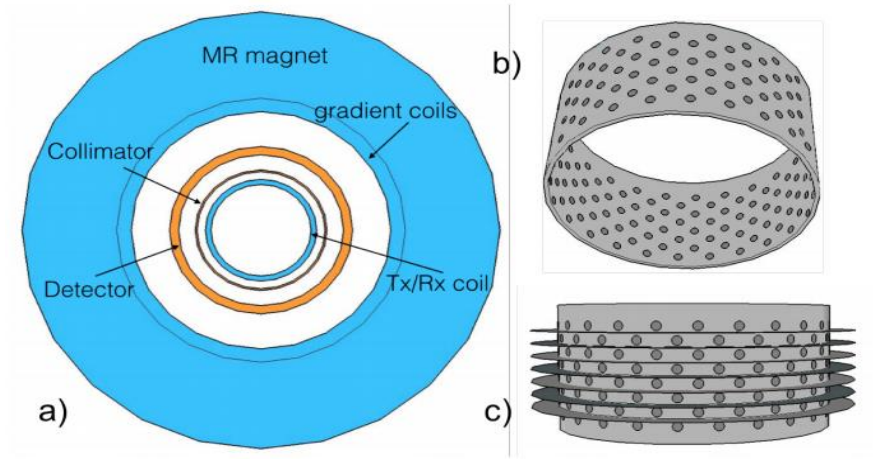
Contact

amine.samoudi@intec.ugent.be

WICA

iMinds CONNECT.INNOVATE.CREATE

- New combined SPECT/MRI systems require compliance with the ICNIRP (independent researchers group)
- Energy absorption should be limited by controlling the Specific Absorption Rate (SAR)



Purpose

1. Simulate the induced SAR in different 3D realistic human head models inside the SPECT/MRI system
2. Compare the head SAR and the local SAR with the basic restrictions levels for exposure at reference levels.

Method

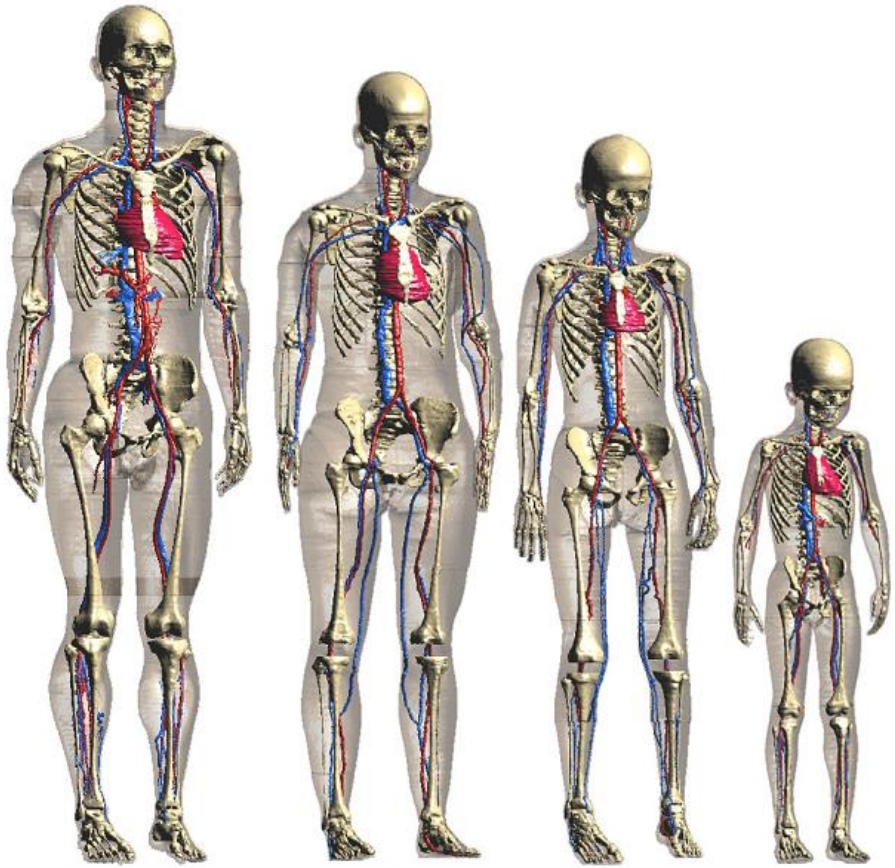
3D Electromagnetic solvers

FEKO
Comprehensive Electromagnetic Solutions

FDTD tool

Hybrid MoM/ FEM tool

Method



Virtual Family models

WiCa

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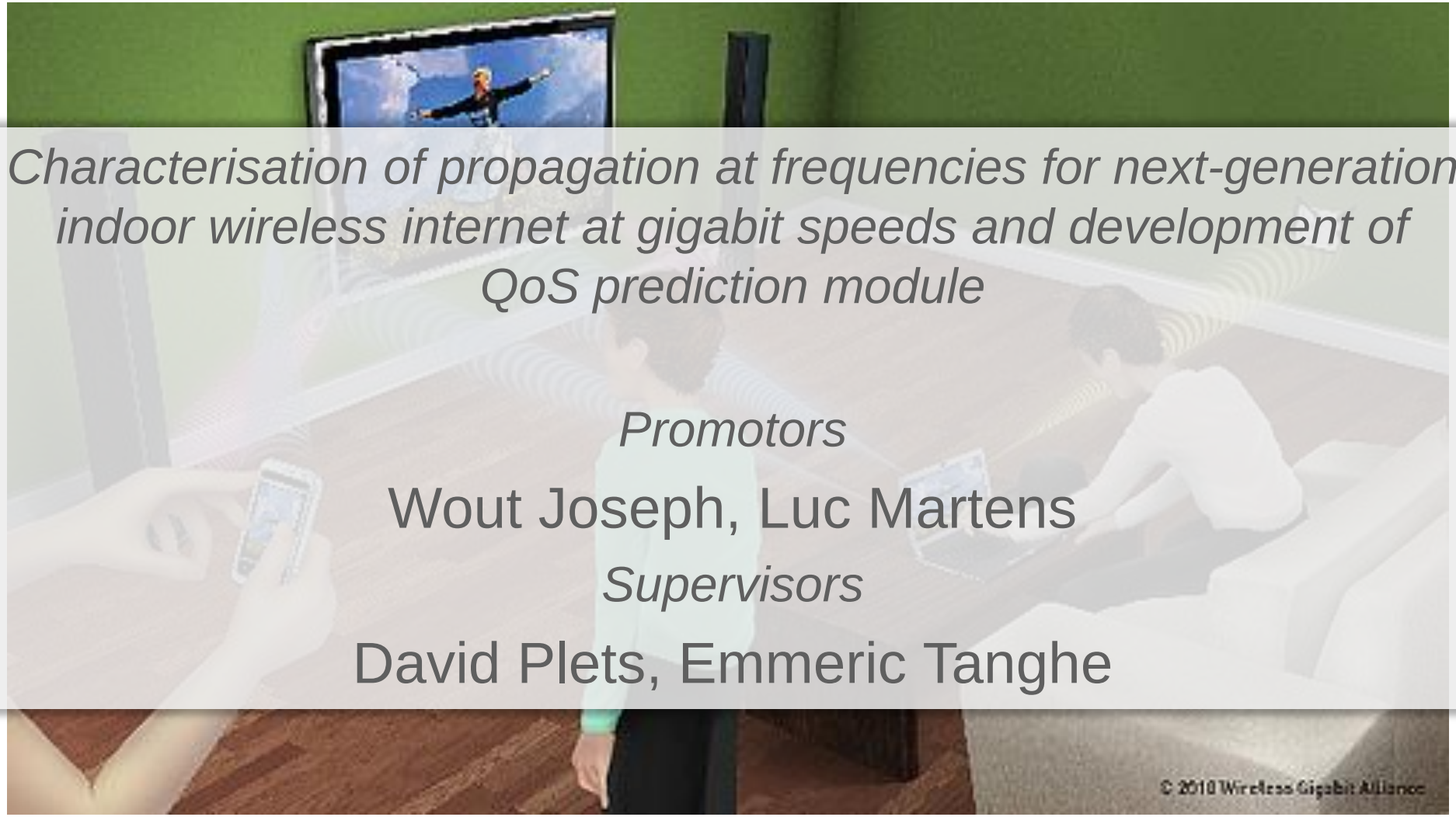
Communicatie en propagatie voor draadloze netwerken



Characterisation of propagation at frequencies for next-generation indoor wireless internet at gigabit speeds and development of QoS prediction module

Promotors

Wout Joseph, Luc Martens

Supervisors

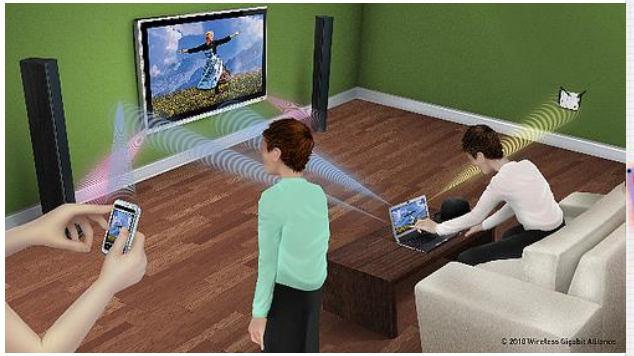
David Plets, Emmeric Tanghe

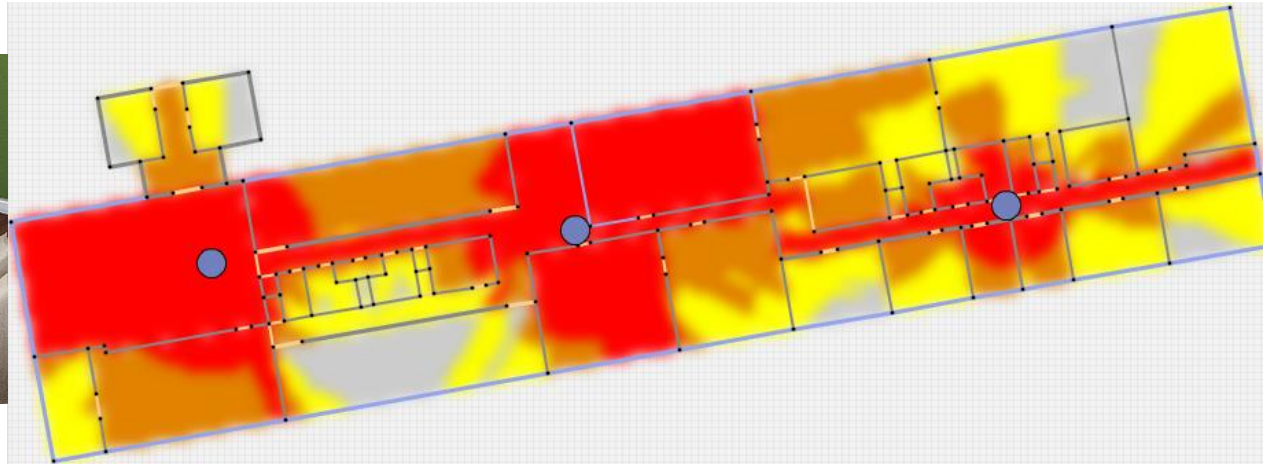
Context

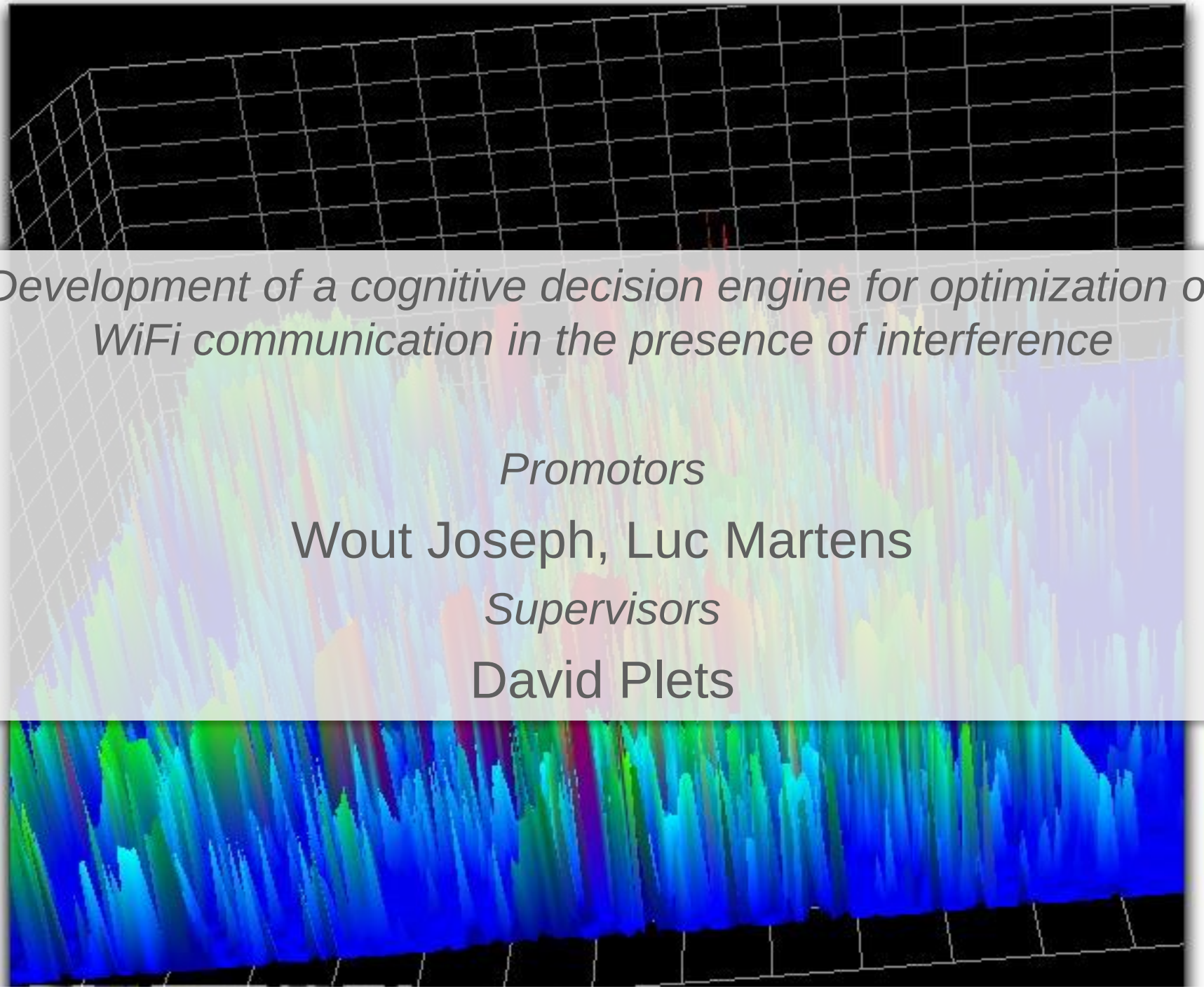
- WLAN 2.4/ 5 GHz not sufficient for next-generation conference systems
  - 16 simultaneous HD uplink and downlink channels
- A wide spectrum available at 60 GHz
  - + No interference from current WLAN networks
  - + Signal spatially confined to room itself
  - - Signal path very sensitive to obstructions
- Tool required to predict signal behavior

Goal

- Design of a 3D- network planning tool for QoS predictions at 60 GHz
  - Characterisation and modelling of propagation characteristics
    - Influence humans, objects on signal strength
    - Influence reflections on walls
- Implementation of models in existing tool







Development of a cognitive decision engine for optimization of WiFi communication in the presence of interference

Promotors

Wout Joseph, Luc Martens

Supervisors

David Plets

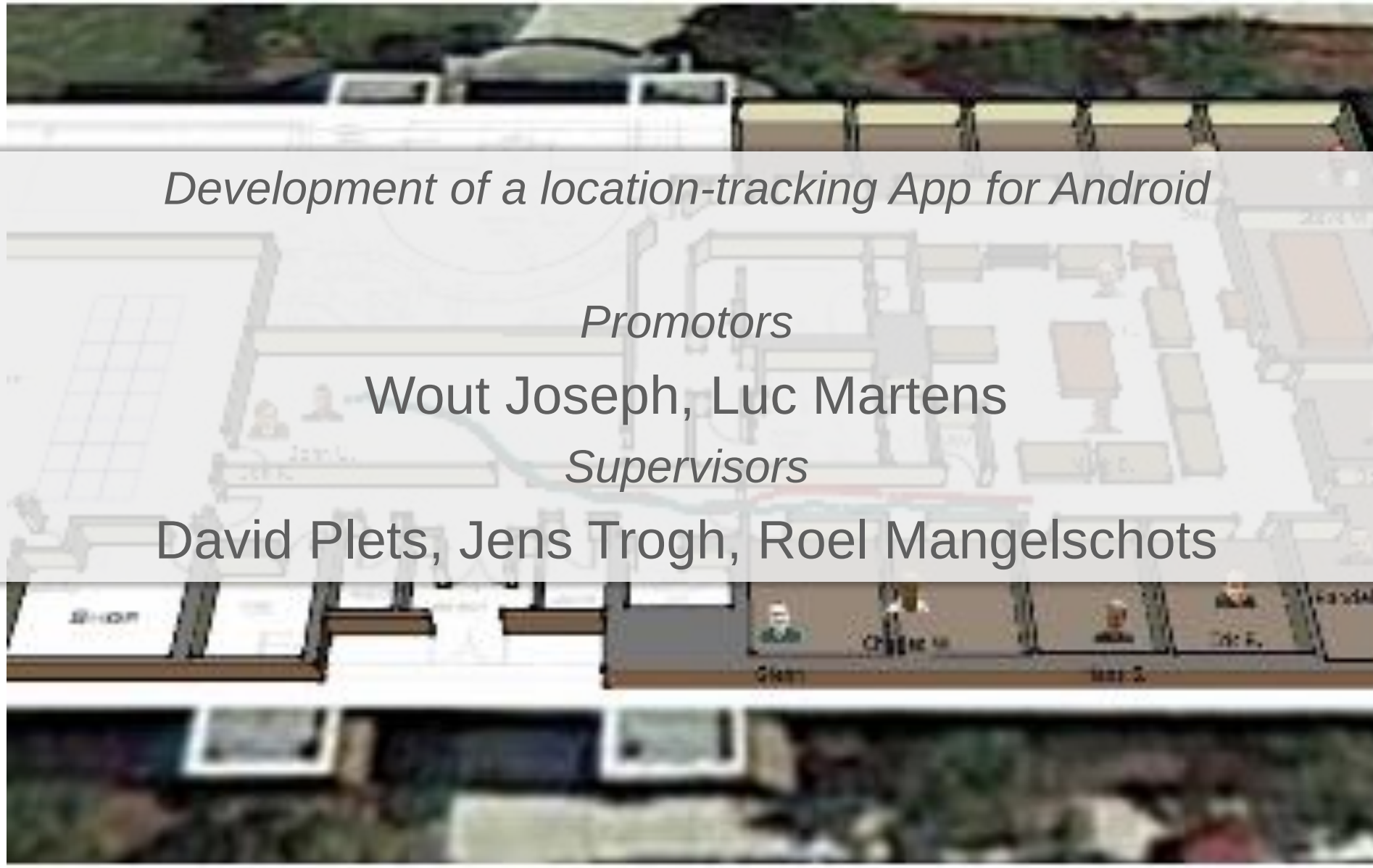
Context

- Increase of WiFi interference due to rapid growth of the use of wireless networks
- Cognitive solutions required to automatically optimize the AP settings
  - Transmit power
  - Channel
  - ...

  based on observations in the network
  - Observed power on different channels
  - Channel occupation degree
  - ...

Goal

- Development of cognitive decision engine (CDE)
  - Study on WiFi principe, become familiar with w-iLab-t testbed
  - Perform set of experiments to simulate real-life environments
  - Analyse and model the dependencies
  - Propose CDE based on experiment results and models
  - Test, validate, and refine CDE



Development of a location-tracking App for Android

Promotors

Wout Joseph, Luc Martens

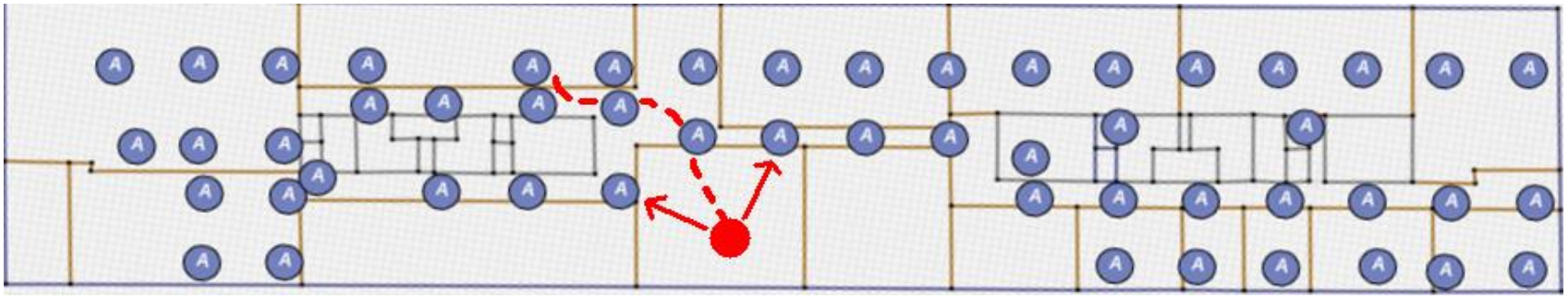
Supervisors

David Plets, Jens Trogh, Roel Mangelschots

Context

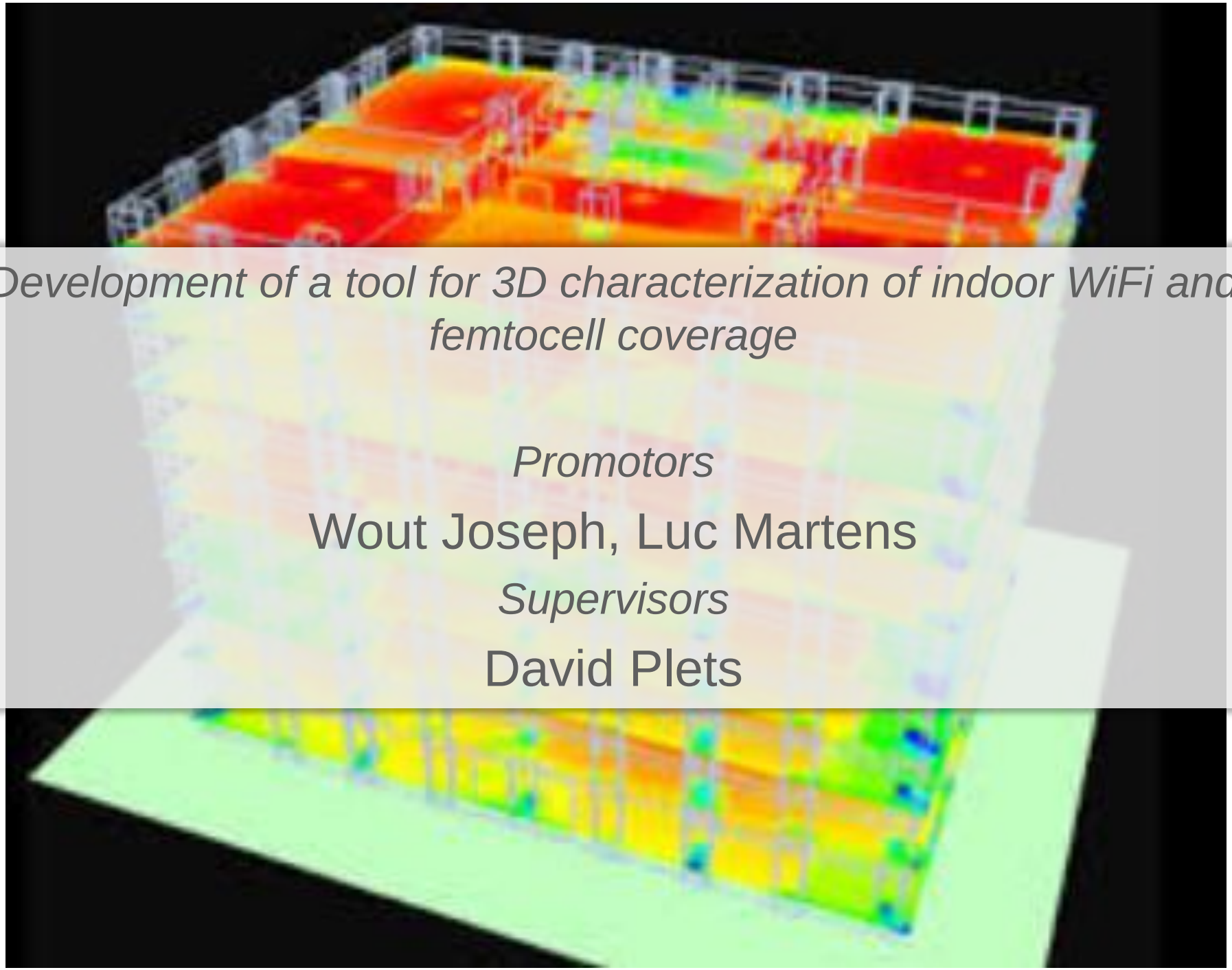
- Localisation useful in
  - Health sector (tracking elderly persons)
  - Industrial sector (tracking equipment)
  - Agricultural sector (finding animal)

- Based on transmitting device
- Measuring received signal strength at fixed beacon nodes allows localisation



Goal

- Develop location-tracking App
  - Incorporate existing building visualiser and existing localisation algorithm to visualize location on tablet in real time
  - Create user-friendly fingerprinting solution
    - Compare accuracy and human effort with that of existing algorithm
  - Create navigation feature, usable for different floors
  - Investigate Bluetooth Low Energy (BLE) proximity sensing to locate a person (with tag) on a building floor
  - Validate, test, finetune the mobile application



Development of a tool for 3D characterization of indoor WiFi and femtocell coverage

Promotors

Wout Joseph, Luc Martens

Supervisors

David Plets

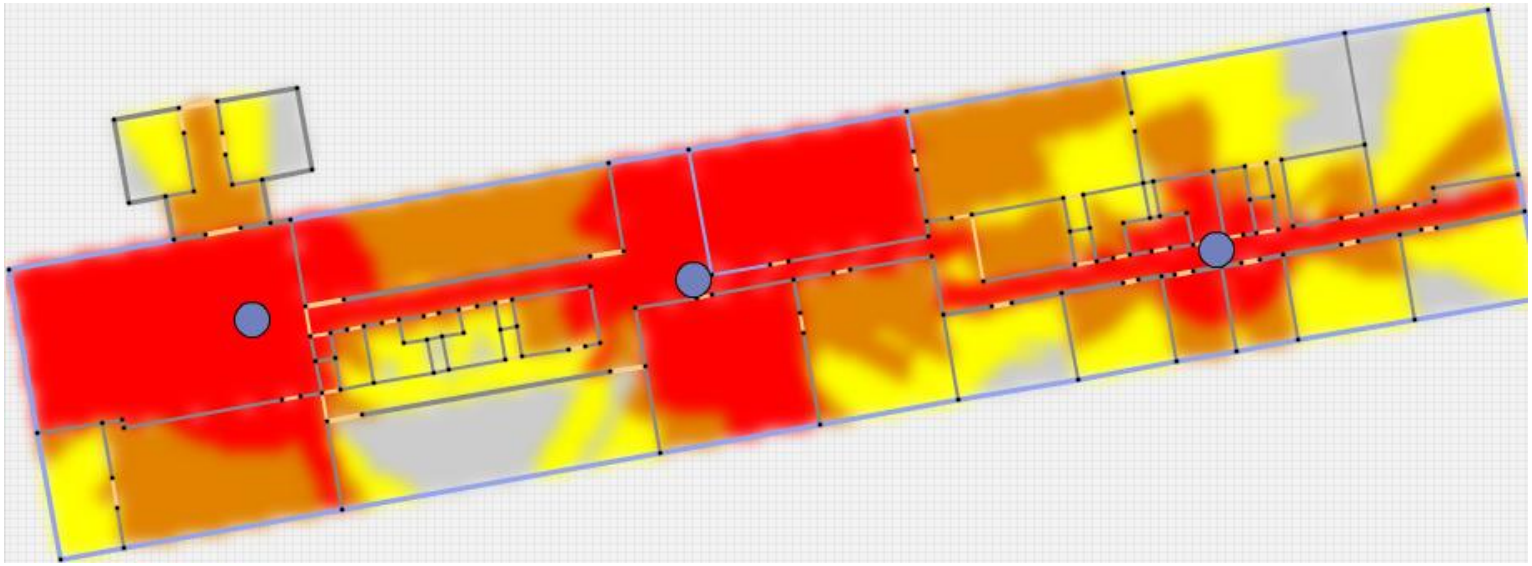
Context

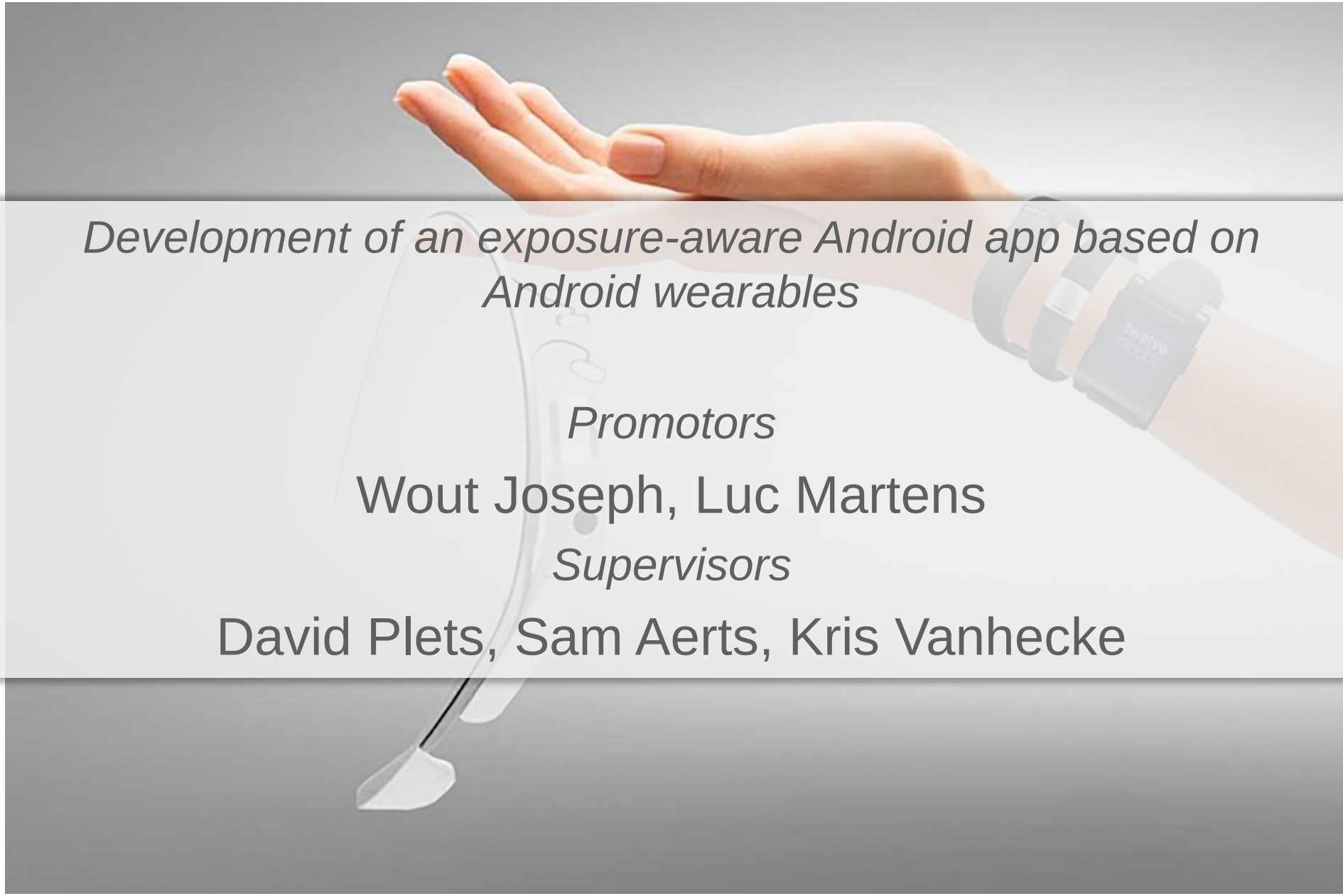
- Expansion of wireless networks, also indoor
  - Very complex environment
- Prediction tools require accurate path loss models
  - Environment (office vs. industrial)
  - 3D influences
    - Height transmitter (access point) and receiver (laptop)
    - Floor of transmitter and receiver
  - Transmission frequency (2.4 – 5 GHz)
  - Technology (WiFi vs. 4G femtocells)

- Accurate determination of influences is necessary

Goal

- Design of indoor 3D network planning tool by accurately characterising influencing factors on path loss
  - Execute path loss measurements to assess influence of height, frequency, environment,...
  - Analyse date and construct models
  - Incorporate models in existing tool





Development of an exposure-aware Android app based on Android wearables

Promotors

Wout Joseph, Luc Martens

Supervisors

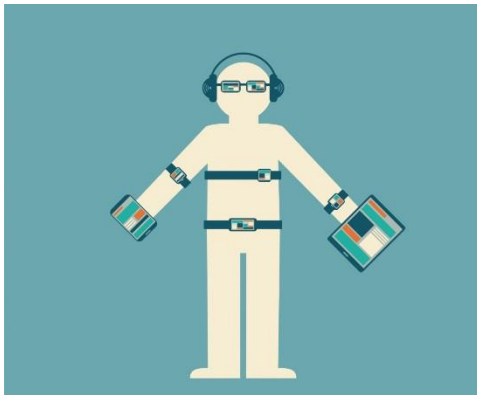
David Plets, Sam Aerts, Kris Vanhecke

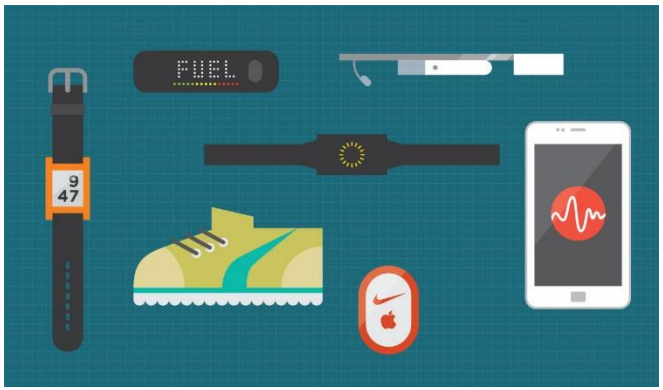
Context

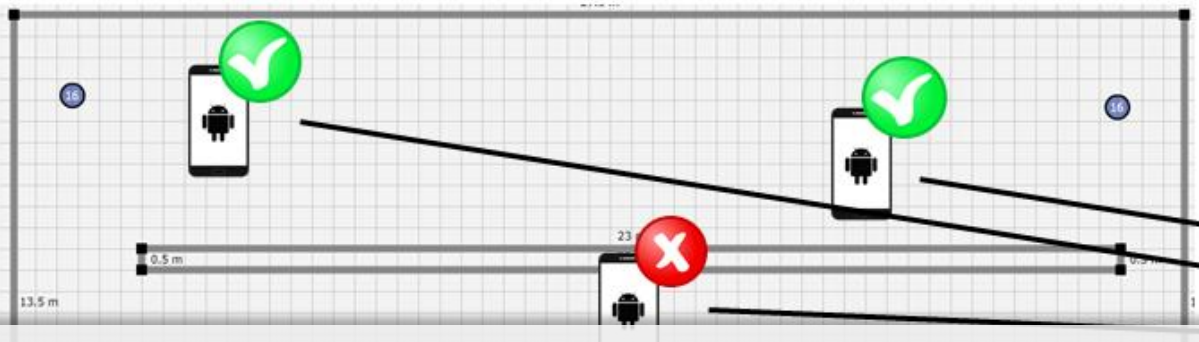
- Expansion of wireless communication
- Concerns on health effects of electromagnetic radiation
- Exposure depends on
  - Location
  - Application
  - Technology
  - Usage time
- Common man could use an application that shows his daily exposure to electromagnetic radiation

Goal

- Develop exposure-aware Android app
  - Study on absorption, field strength, wireless technologies, Android...
  - Develop modules for collection of exposure-related data
    - Smart glasses, smart watches, wristbands, smartphones,...
  - Collect data and translate to exposure value
  - Develop user-friendly app
    - Consultation of exposure value
    - Comparison with others
    - Give advise on user-specific measures for a lower exposure







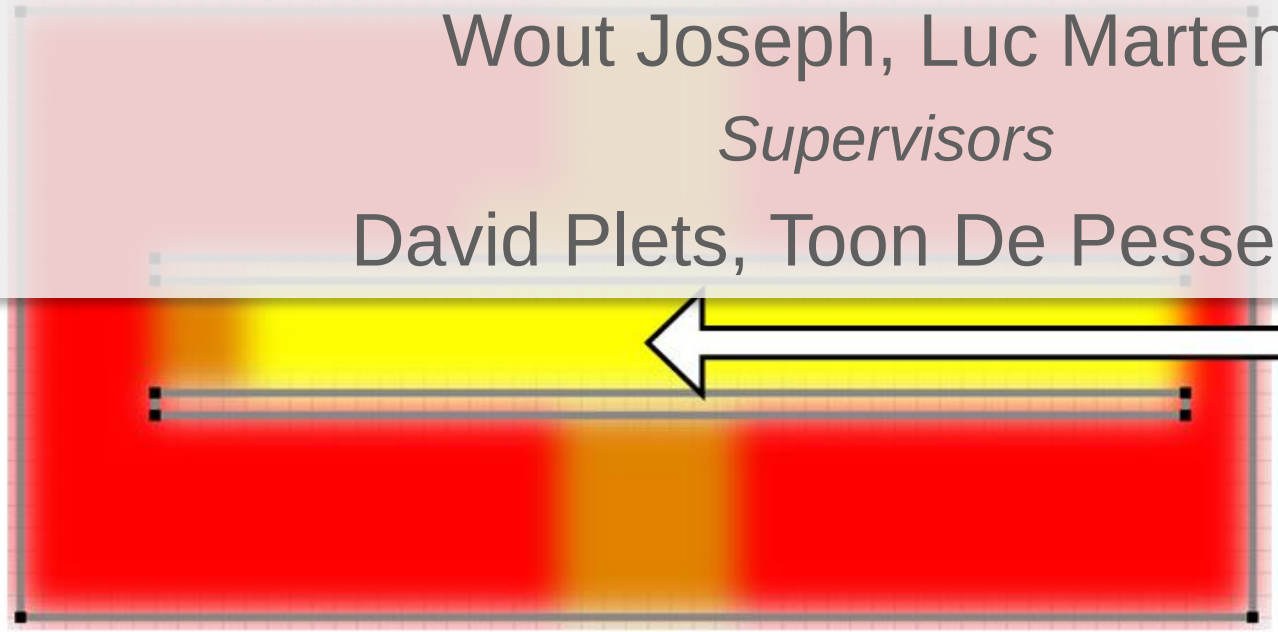
Development of an advanced Android monitoring system for WiFi networks

Promotors

Wout Joseph, Luc Martens

Supervisors

David Plets, Toon De Pessemier



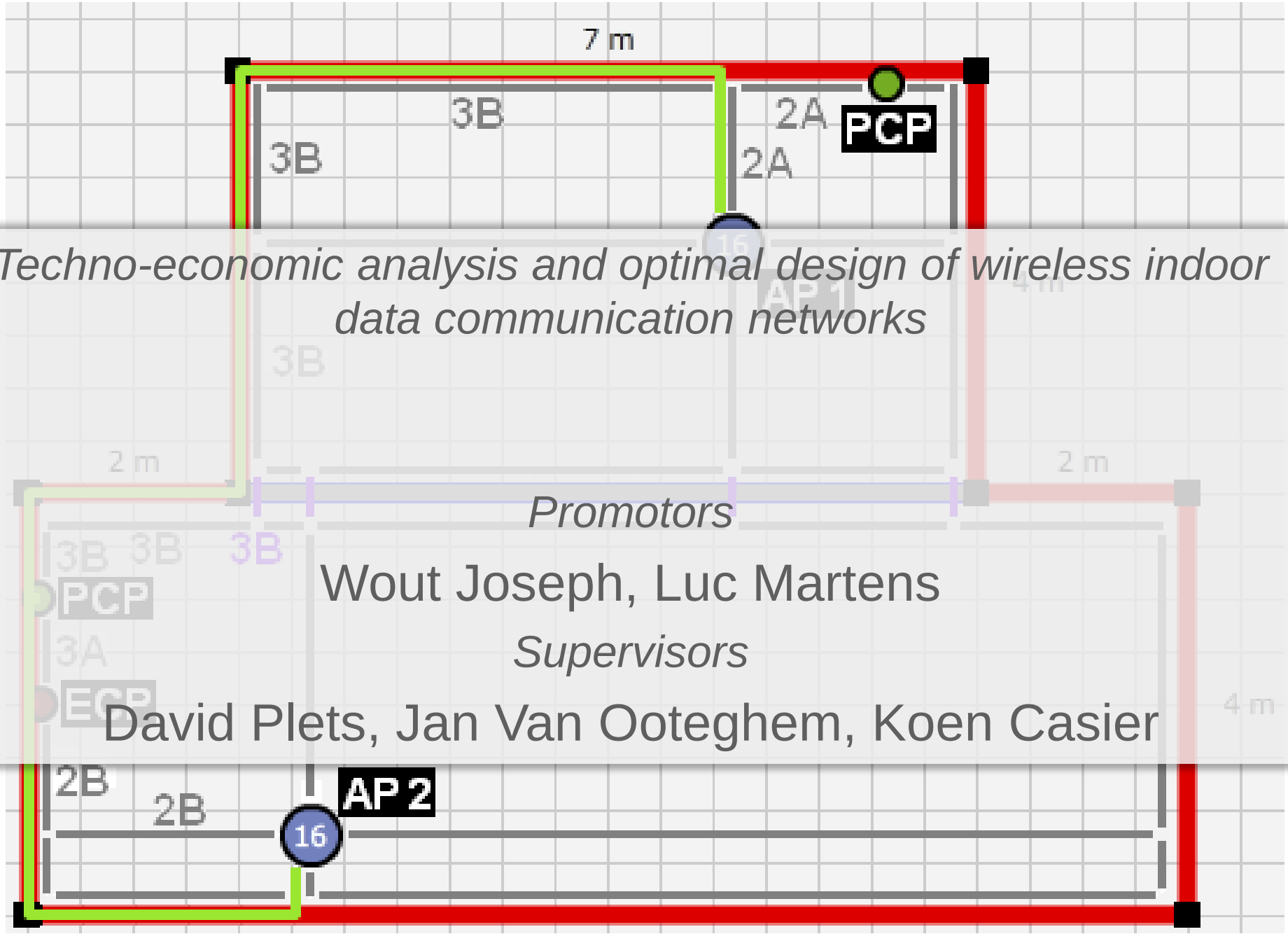
Context

- Usage of WiFi in industrial environments
  - Harsh and changing environments
- Need for real-time monitoring and management of the wireless network
  - Use of measurement nodes
- Problems
  - These nodes are often not on the location of the user
  - A large number of nodes is required

➔Perform monitoring *on the user device* to obtain a broad, accurate, and real-time view of the network

Goal

- Develop real-time Android monitoring system
- Off-the-shelf Android devices (smartphones, tablets)
  - Localisation
  - What can be measured?
- Implementation
  - Transfer all measured information to network planner
- Indicate problem areas on environment map
  - Send robot to problem area to perform more accurate measurements
  - Adapt network settings (access point on/off state, transmit power)



Techno-economic analysis and optimal design of wireless indoor data communication networks

Promotors

Wout Joseph, Luc Martens

Supervisors

David Plets, Jan Van Ooteghem, Koen Casier

Context

- Installation of wireless data communication networks not always straightforward
  - Coverage requirement
  - Capacity requirement
  - Interference with other systems
  - Possible antenna locations
  - Building materials and structure
  - Installation and maintenance cost
- Cost of installation often >> access point cost
- Development of algorithm for automatic calculation of installation cost and optimal cabling
- Techno-economic analysis

Goal

- Gain insight in deployment process of wireless communication network
- Calculate cabling for given set of access points
  - Graph model of building (with edges and nodes) already available
- Calculate optimal location of access points, based on building and connection characteristics
- Construct scenarios
  - Networks, architecture, bandwidth, users,...
- Techno-economic analysis
  - Upfront cost (antennas, equipment, cabling, installation,...)
  - Operational cost (electricity, maintenance,...)

Interferentie door onvoldoende cyclic prefix voor realistische 60 GHz kanalen

- **Performantie degradatie van OFDM systemen door propagatie delay spread: onvoldoende cyclic prefix geeft:**
  - Intersymbol interferentie
  - Intercarrier interferentie
- **Recent ontwikkeld: meetmethode voor deze interferentie**

- door *narrowband channel sounding*
- toegepast op IEEE 802.11 OFDM

- **Thesis: uitbreiding naar 60 GHz OFDM**
  - voor IEEE 802.11ad (WLAN) en IEEE 802.15.3c (WPAN)
  - 60 GHz vector netwerk analyzer beschikbaar
  - Uitbreiding redelijk straightforward
  - Doelstellingen:
    - Aanpassing experimentele setup
    - Uitbreiding van data processing code + convergentie analyse
    - Toepassing van meetmethode op realistische kanalen (vnl. WPAN):
      - karakterisering interferentie
      - invloed van antenne polarizatie op interferentie

Adaptieve locatiebepaling in een MIMO-UWB draadloos netwerk

- Ontwerpen van een algoritme die aan de hand van elektromagnetische propagatiepaden de ongekende positie schat van een mobiele gebruiker

Literatuurstudie

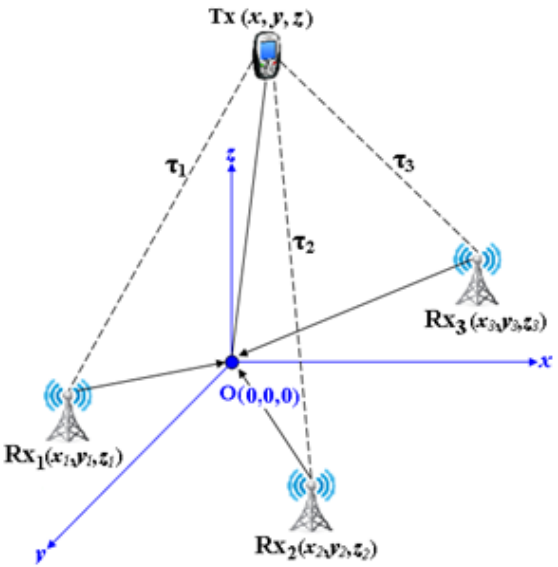
- Schatten propagatiepaden
- Ultra-Wideband technologie
- Algoritmen voor locatiebepaling

Adaptieve locatiebepaling

- Obstructie van directe pad tussen Tx en Rx
- Afwegen verschillende benaderingen (bv. RSSI)
- Ontwerp hybride-strategie die algoritmen combineert

Analyse

- Uitvoeren testmetingen en bepaling evaluatie-metriek
- Parameter sensitiviteits-analyse (AoA, delay, vermogen)
- Betrouwbaarheid locatiebepaling en/of frequentie-gedrag



Clustering van Ultra-Wideband multipad-propagatie

- Ontwerpen van een algoritme die propagatiepaden groepeert op basis van gelijkaardige parameters zoals vermogen en aankomsthoek i.f.v. frequentie

Literatuurstudie

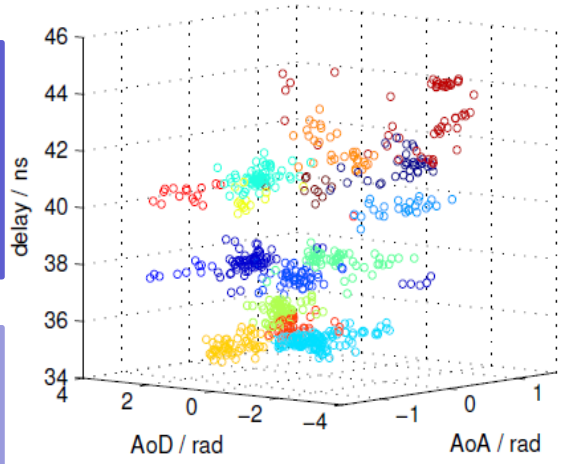
- Schatten propagatiepaden
- Ultra-Wideband en frequentie-afhankelijkheid
- Algoritmen voor clustering van propagatiepaden

Ontwikkeling clusteringsalgoritme

- Clustering-metriek (AoA, AoD, delay, vermogen)
- Clustering-strategie (apart, gezamenlijk, hybride)
- Combinatie met frequentie-afhankelijkheid van UWB

Analyse

- Uitvoeren testmetingen en bepaling evaluatie-metriek
- Feedback naar algoritme en/of validering met ray-tracing
- Analyse i.f.v. verschillende domeinen (ruimtelijk, frequentie)



Green ICT

Thesisvoorstel

Expanding the capacity of a wireless access network by introducing new base station types

Promotoren

Prof Luc Martens, Prof Wout Joseph

Begeleiders

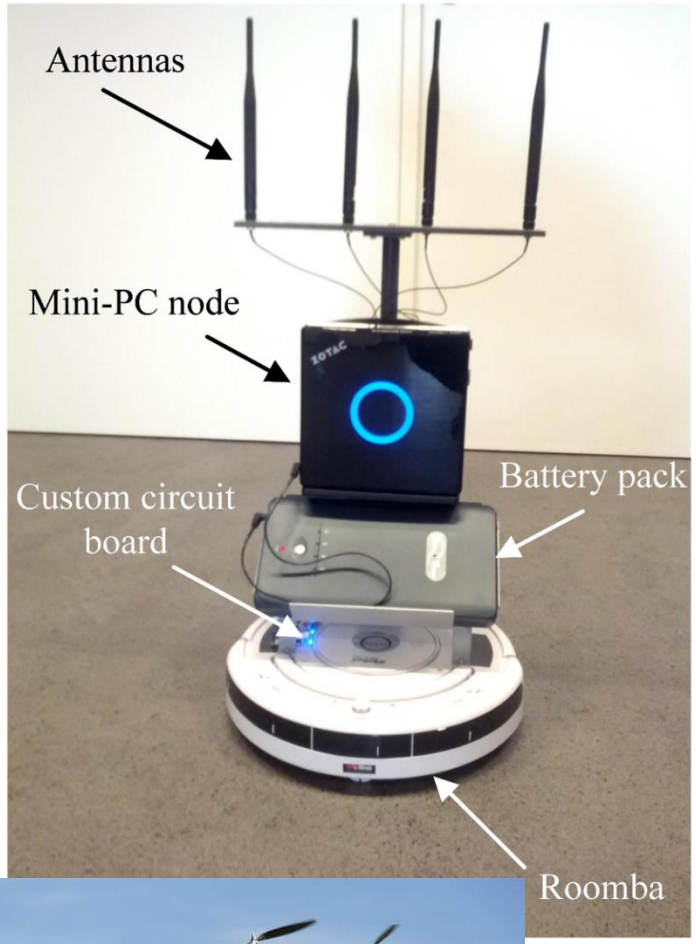
Margot Deruyck

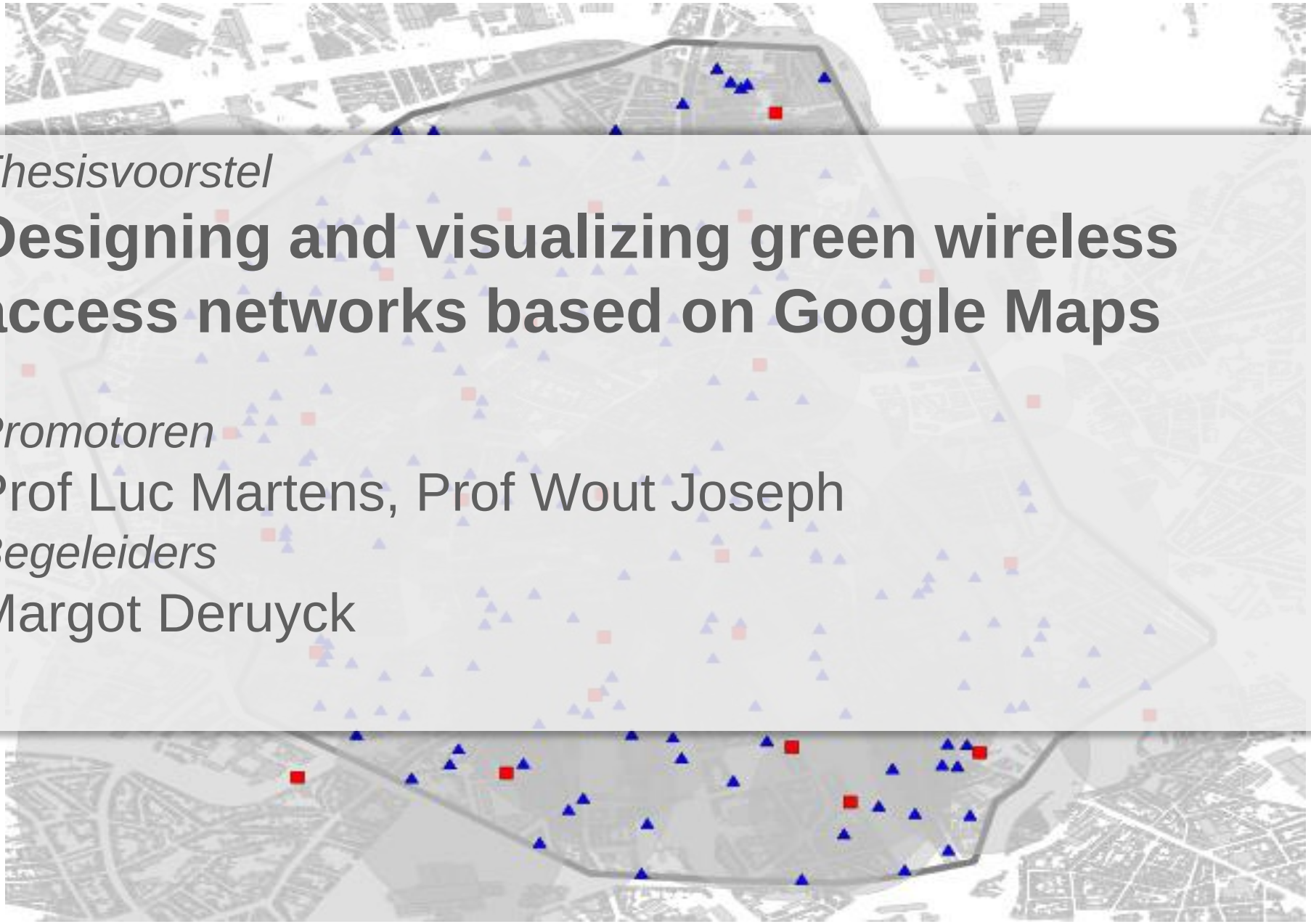
Uitbreiden capaciteit netwerken

- **Context**
  - Huidige draadloze netwerken vrij betrouwbaar
  - Maar soms ontoereikend in noodgevallen
    - Bv. Monsterfile op de autostrade, storm op festivalterrein, etc.
  - Hoe extra capaciteit aanbieden in dergelijke gevallen?

Uitbreiden capaciteit netwerken

- **Doel**
  - Onderzoeken of extra capaciteit kan aangeboden worden door gebruik te maken van nieuwe types basisstations
    - Bv. Communicatiesystemen v wagens, basisstations op robots of drones, etc.
- **Methode**
  - Eerste stap: WiFi access point op een Roomba iRobot
    - Backhaul connectie?
    - Metingen: dekking, capaciteit, blootstelling voor de mens
  - Tweede stap: WiFi access point op een drone
    - Backhaul connectie?
    - Metingen: dekking, capaciteit, blootstelling voor de mens





Thesisvoorstel

Designing and visualizing green wireless access networks based on Google Maps

Promotoren

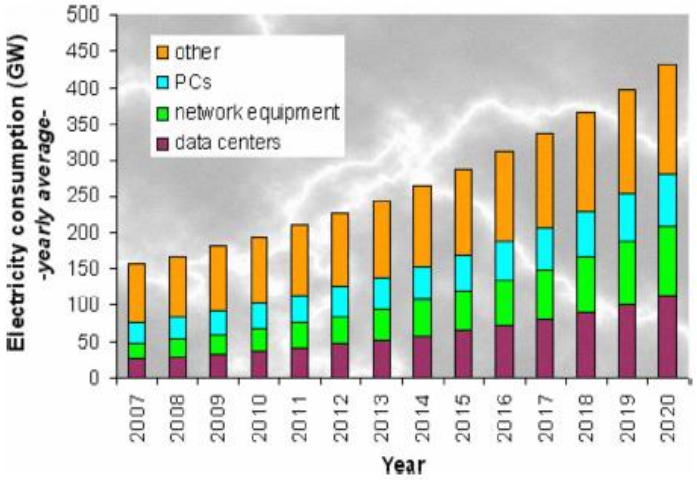
Prof Luc Martens, Prof Wout Joseph

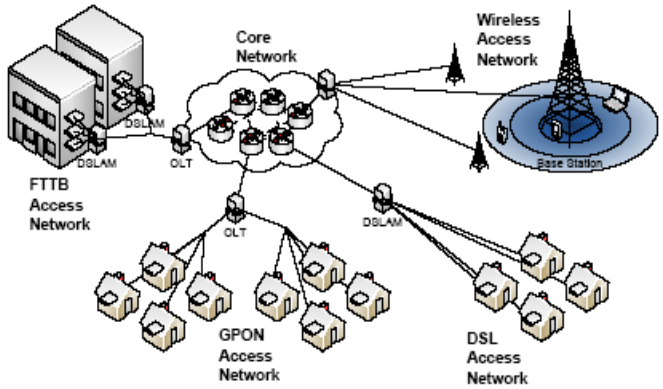
Begeleiders

Margot Deruyck

Groene IT

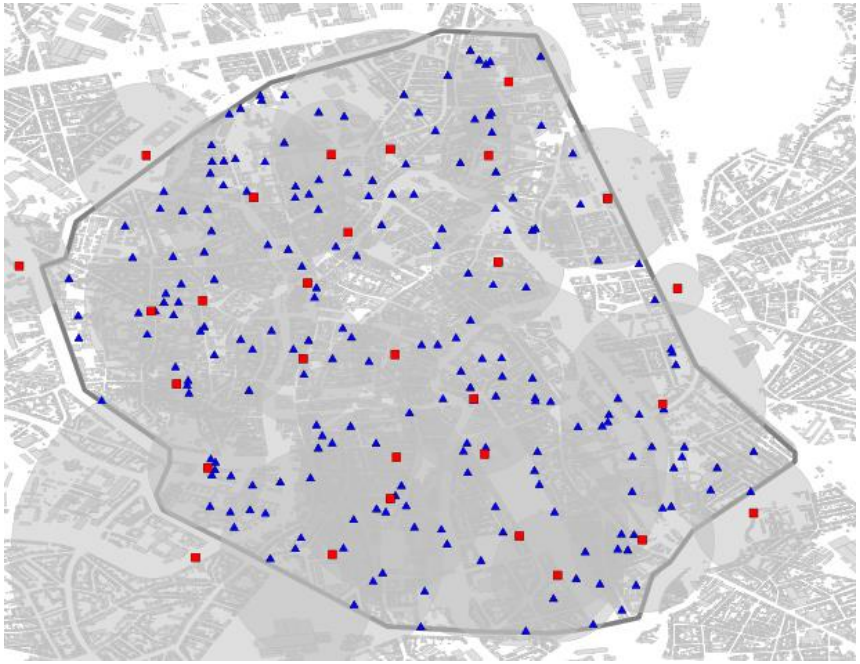
- **Context**
  - ICT: 4% van het wereldwijde energieverbruik
    - Verdubbeling in komende 10-15 jaar
    - Groot verbruik in draadloze toegangsnetwerken
  - Draadloze toegangsnetwerken: grootste verbruik binnen telecommunicatienetwerken
  - Belangrijk om het energieverbruik in de verschillende delen van het netwerk in kaart te brengen
  - Ook blootstelling belangrijk in toekomst
  - WiCa ontwierp een deployment tool voor toekomstige groene draadloze toegangsnetwerken
    - Nadeel: maakt enkel gebruik van shapefiles





Groene IT

- **Doel**
  - Ondersteuning aanbieden voor Google Maps
  - Visualiseren van de performantie van het netwerk
- **Methode**
  - Op basis van de simulatietool (in java) ontwikkeld binnen WiCa
  - Input op basis van Google Maps
    - Afbakenen gebied
    - Informatie gebied extraheren
    - Tool compatibel maken met deze info
    - Ontwerpen van een gepaste GUI
  - Output: netwerk visualiseren met google maps
    - Performantie visualiseren
      - Bit rate, coverage, signaalkwaliteit, heath map voor blootstelling, etc.



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UNIVERSITEIT GENT

FACULTY OF **ENGINEERING**

Master Thesis 2015 - 2016

Green Factory: Minimization of Industrial Energy Consumption by Production Scheduling

Supervisors

Prof. Wout Joseph, Prof. Luc Martens

Mentors

Xu Gong, Toon De Pessemier

Contact

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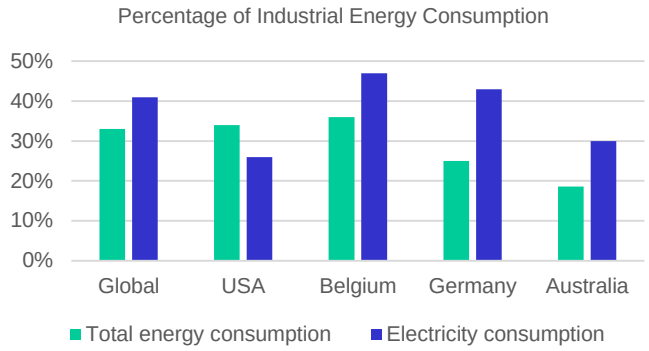
WICA

iMinds
CONNECT.INNOVATE.CREATE

Background



- The global industry leads to very high energy consumption
- Expenditure on energy consumption is becoming no longer negligible for industrial enterprises
- The electricity price has been tending to be volatile over time, making the industrial expenditure on electricity consumption even more uncontrolable
- The production activities on industrial machines/lines are usually scheduled in advance either manually or automatically, which provides high potential to control and minimize the industrial energy consumption by using computer-based intelligence

Purpose

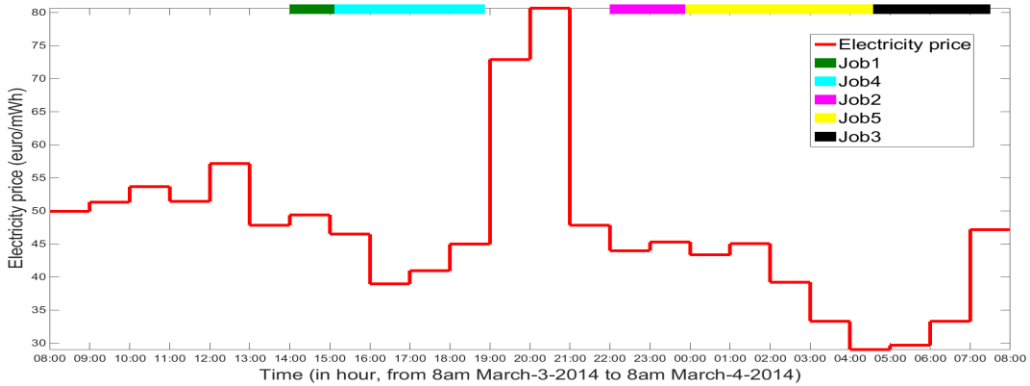
- To create advanced algorithms for automatically scheduling production activities, which take the volatile electricity price into consideration
- These algorithms are loadable into an internal memory of one or several digital computers, and executable for intelligently recommending an optimal production schedule
- Multiple optimization objectives: energy cost minimization, productivity maximization, etc.

Methods

- State-of-the-art research of energy-price-aware production scheduling: papers, patents, and commercial off-the-shelf (COTS) software. This covers interdisciplinary research domains: industrial energy consumption, Smart Grid based electricity pricing mechanism, and production scheduling.
- Design and development of energy-price-aware production scheduling algorithms in Java

  a) building production scheduling models considering the energy consumption and energy price, and at different levels in the factory hierarchy. The scheduling models may additionally include machine resource, customer order, energy consumption data (provided by WiCa), etc.

  b) implementation of at least two different algorithms of multi-objective optimization, e.g., ant colony optimization (ACO), particle swarm optimization (PSO), artificial neural network (ANN), fuzzy logic, etc.
- Creation of different scenarios, performing of production scheduling, and visualisation of the production scheduing results
- Benchmarking the new production scheduling algorithms and the ones at WiCa
- Possibility to publish journal/conference papers based on the actual progress



WiCa

http://www.wica.intec.ugent.be