



ETRO VUB-DEPARTMENT  
OF ELECTRONICS  
AND INFORMATICS



VRIJE  
UNIVERSITEIT  
BRUSSEL

# Department of Electronics & Informatics (ETRO)

***Making sense of hyper-dimensional sensors and signals***

2018

# Department of Electronics & Informatics (ETRO)

Department  
Head



J. Stiens



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## IRIS (Multidimensional Signal Processing)

- Multi-dimensional signal representation, processing, transmission, visualization,
- Big data mining – deep learning
- 3D Video & graphics, Light Field Processing
- Holographic & Acoustic Imaging
- Medical Image analysis – assistive technologies
- Hyper spectral remote sensing
- Smart Nets
- Parallel & GPU computing
- Embedded systems

## LAMI (Micro- & Optoelectronics)

- Analog Circuit Design
- Opto-electronics
- MM&THz wave sensing & Imaging
- Biomedical Sensing

## AVSP (Audio-Visual Signal Processing)

- Speech processing & modification
- Speech synthesis: from text and audio-visual
- Affective Computing
- Machine Learning & Computer Vision
- Video (microscopy)



# Collaborations

## IMEC

- **Smart applications** B.U. (previously iMinds)  
Core Research Team Data Science strategic program
- Smart Systems B.U.
- BiSens associated laboratory** on  
mm & THz wave sensing & radar & communication  
Automotive & Driver Assistance

## JBDR - Joint laboratory on Big Data with Duke University (US), UCL (UK) and UGent

Advanced theory, algorithms and system design / smart cities / smart healthcare / art investigation / political/security risk monitoring

## AVSP - Joint laboratory on audio visual signal processing with School of Computer Science at NPU, Xi'an (China)

Virtual reality / Speech recognition and synthesis / Audiovisual scene analysis & emotion recognition

## NANO - Joint laboratory on nano-medicine and nano-biotechnology with EPFL, Lausanne (Switzerland)

Nano-technology, biotech, food

## JICT - Joint laboratory on E2E ICT Systems with University of Patras (Greece)

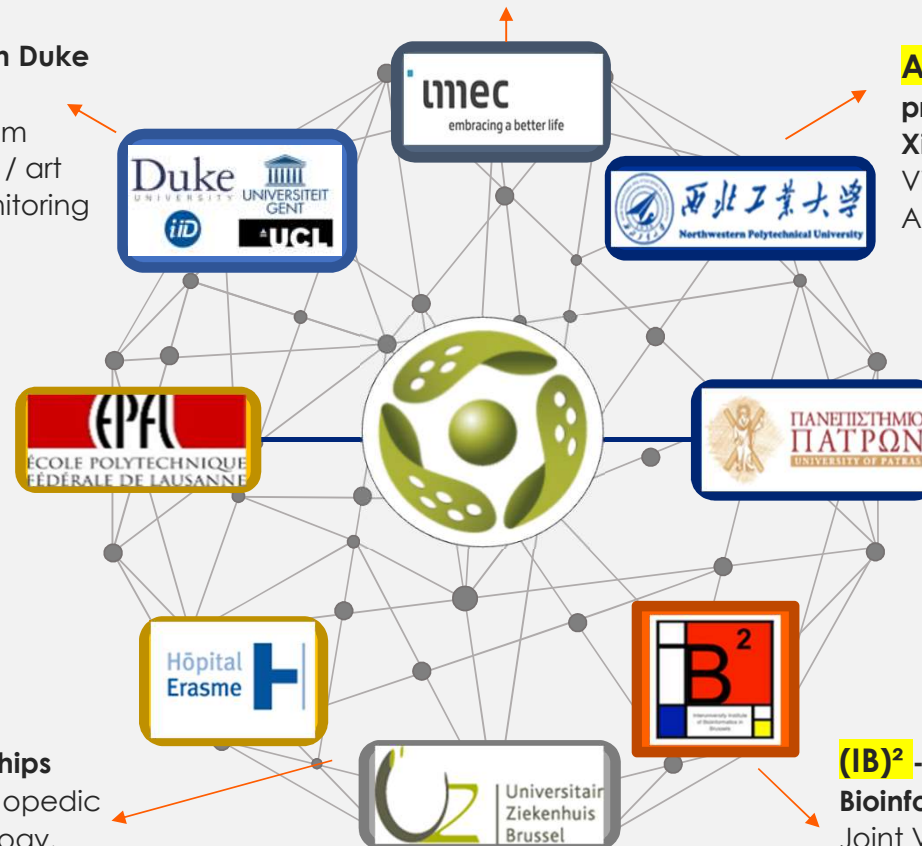
Conventional source compression / robust transmission / network / information theory / sensor networks / security and authentication / multimedia forensics and bioinformatics

## Hospitals - Strategic partnerships

Radiology, Radiotherapy, Orthopedic Surgery, Pulmonology, Cardiology, Anatomy, Geriatrics, C4N

## (IB)<sup>2</sup> - Interuniversity Institute of Bioinformatics in Brussels

Joint VUB-ULB institute specialized in bioinformatics analysis of large scale omics data



# ETRO's spin-off companies- realise +100 FTE jobs

## UNIVERSUM DIGITALIS (°2008)

develops solutions for the management of multimedia databases and provides generic data-exchange interfaces for distributing data to various client applications.

## EXIA (°2013)

is an R&D driven provider of blind spot sensors with the ambition to render road transport safer and less damage prone, by avoiding blind spot incidents upon the introduction of innovative sensor technology.

## EQCOLOGIC (°2005)

is a fab-less semiconductor company, specializing in high speed, low power analog and mixed-signal ICs for digital signal equalization. In November 2013, EqcoLogic has been sold to **Microchip Technology Inc.**

## OPTRIMA/SOFTKINETIC (°2009)

enables fully immersive, transparent and intuitive user experiences by providing 3D real-time hardware for interactive Digital Entertainment, Consumer Electronics, Fitness/Health equipment and Industrial manufacturers. In October 2015, Softkinetic has been sold to **SONY**

## M2WAVE/AQUANTIS (°2014)

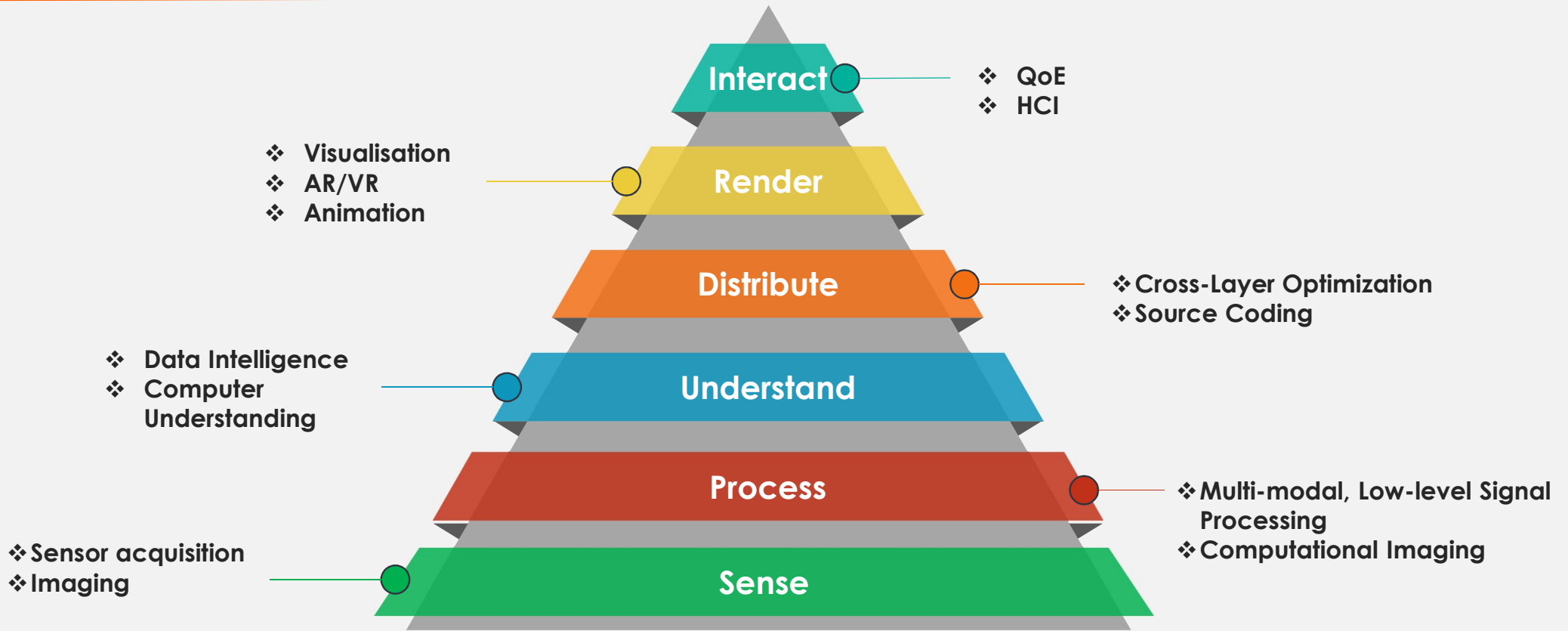
uses fundamentally new insights into dielectric sensing at millimeter wave frequencies to offer novel cutting-edge sensor modalities for monitoring industrial processes and to bring novel analytical instruments for the life science industry.



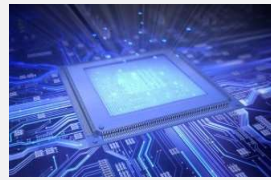
# ETRO technology space

Software

Hardware



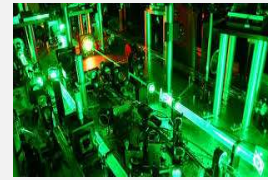
Sense



Semiconductor



HPC



Photonics



Electromechanics



Display

# Our Expertise

Interaction physics, including multi-physics  
(thermal, dielectric modelling, food,..)

Sensor assemblies/systems



Integrated multi-modal systems

Imaging systems, including body  
scanners

Advanced signal processing, including  
compressive sensing

Sensor Front-ends

Electromagnetic simulations, including  
numerical techniques

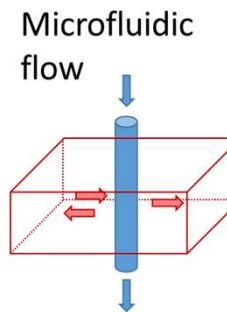
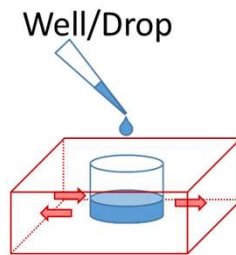
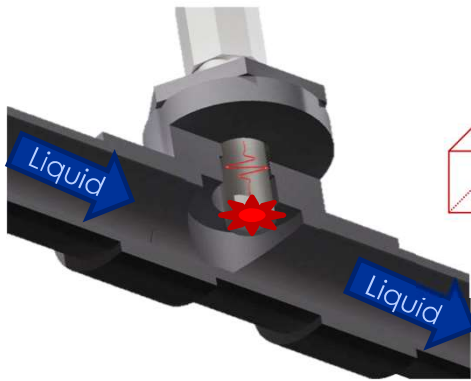
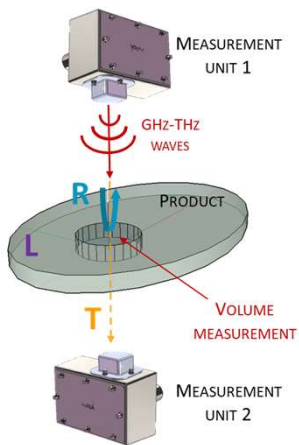
Device Physics (graphene based devices)





# Mm-wave sensor research

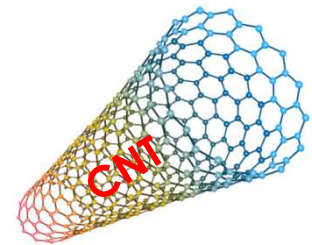
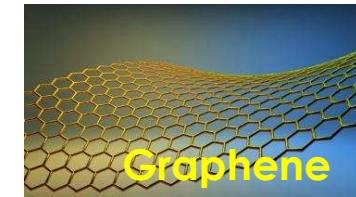
- EM Modelling of Sensor front end → world record designs
  - Frequency domain: extreme resonance sensitivity
  - Time domain: sub-ps fully blind transient radar
- Forward-Inverse Problems Solving
- Multi-physics problems: heat – mass – Phase transitions



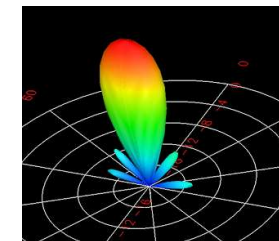
## Application domains



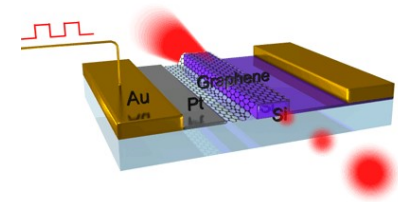
# Graphene & CNT



## Design of graphene based devices



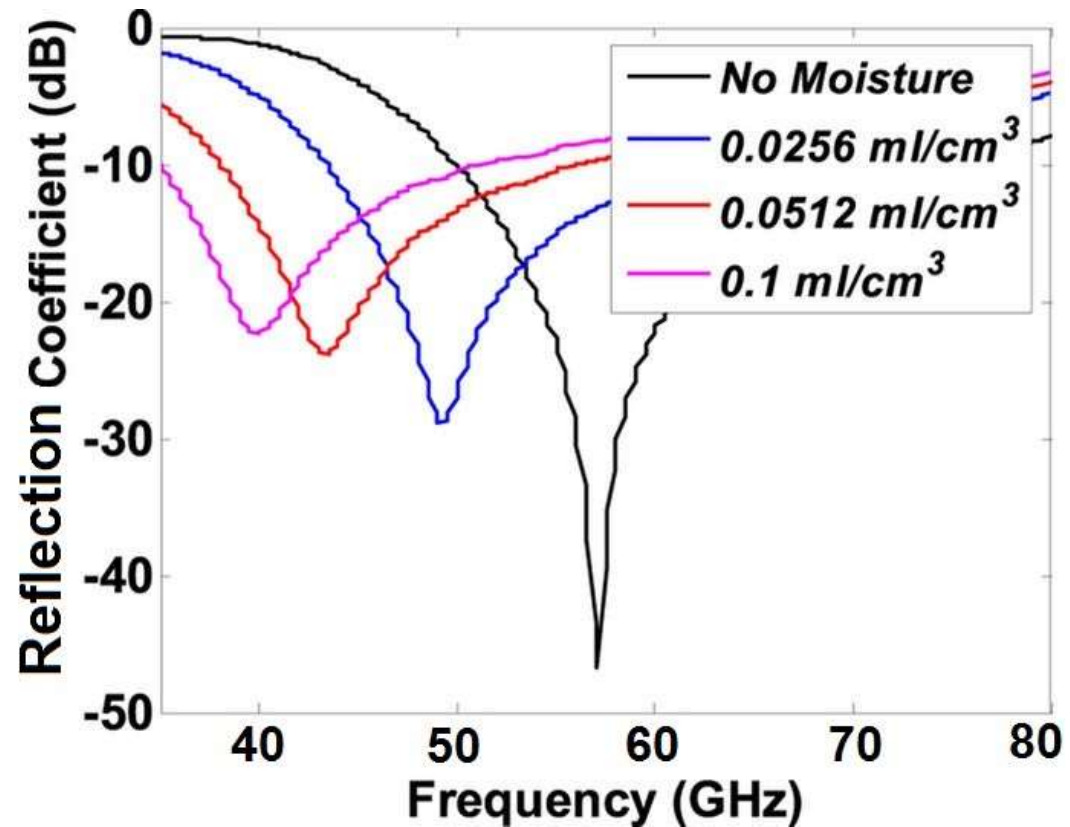
Antenna Radiation  
Pattern Modulation



Waveguide  
Amp – Phase  
Modulation

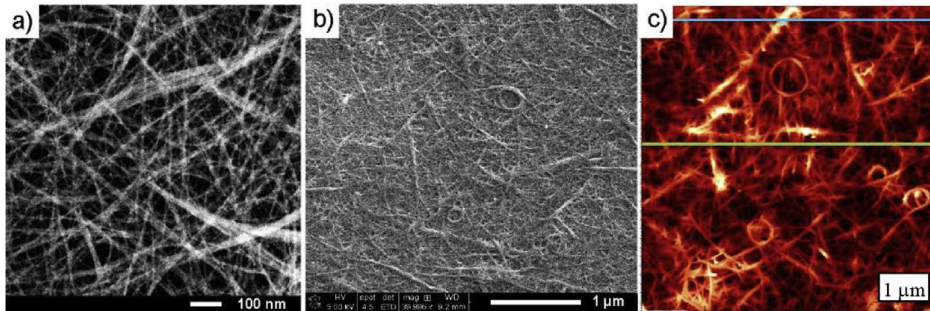
# Humidity sensors

We are able to sense  
**0.00045%** moisture  
content change

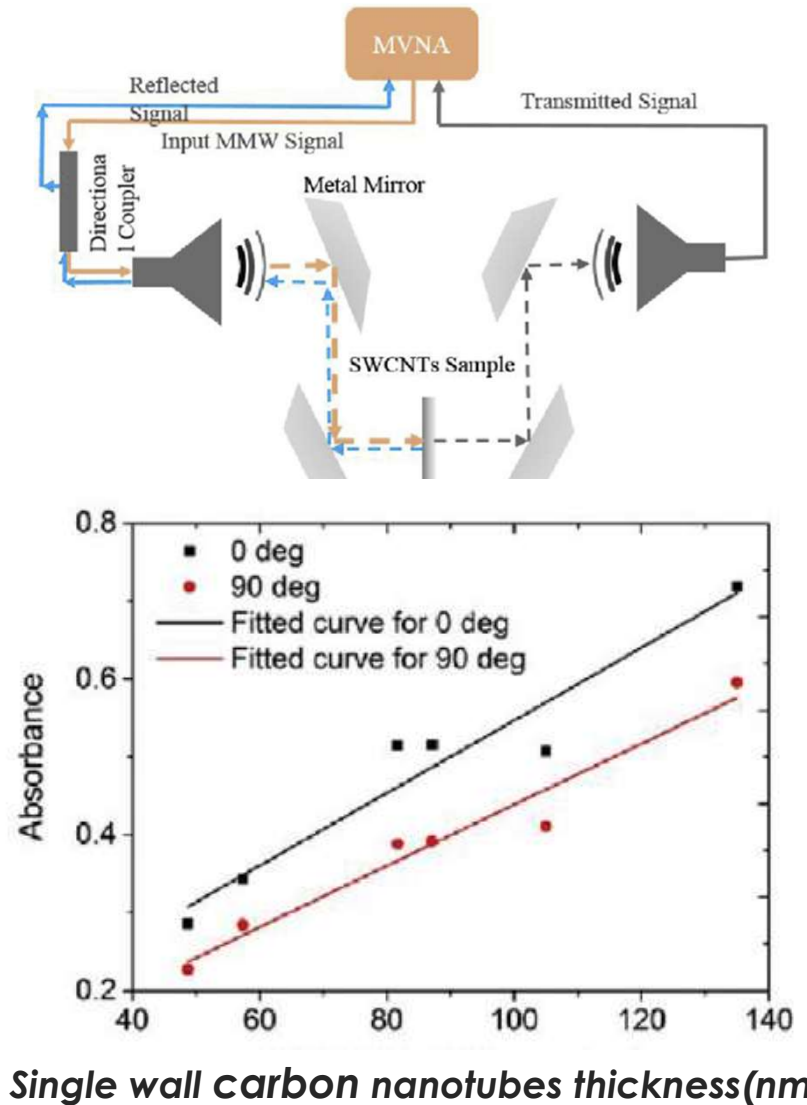




## Absorbance at 0 and 90 direction versus Carbon Nano Tubes thickness at 55 GHz



DOI: <https://doi.org/10.1016/j.compscitech.2017.08.004>



# Concept of Transient Radar Method (TRM)

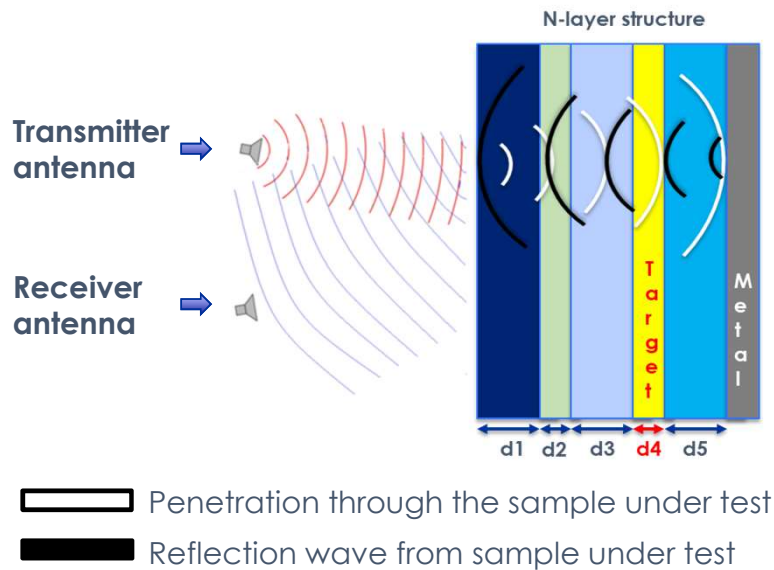
## Our target

Real-time contactless **blind** Nondestructive testing (NDT)/characterization of single or multilayer structures for **nonmetallic materials**

## Our method

Multilayer structure as a sample under test

- Contactless measurement



## What can we do?

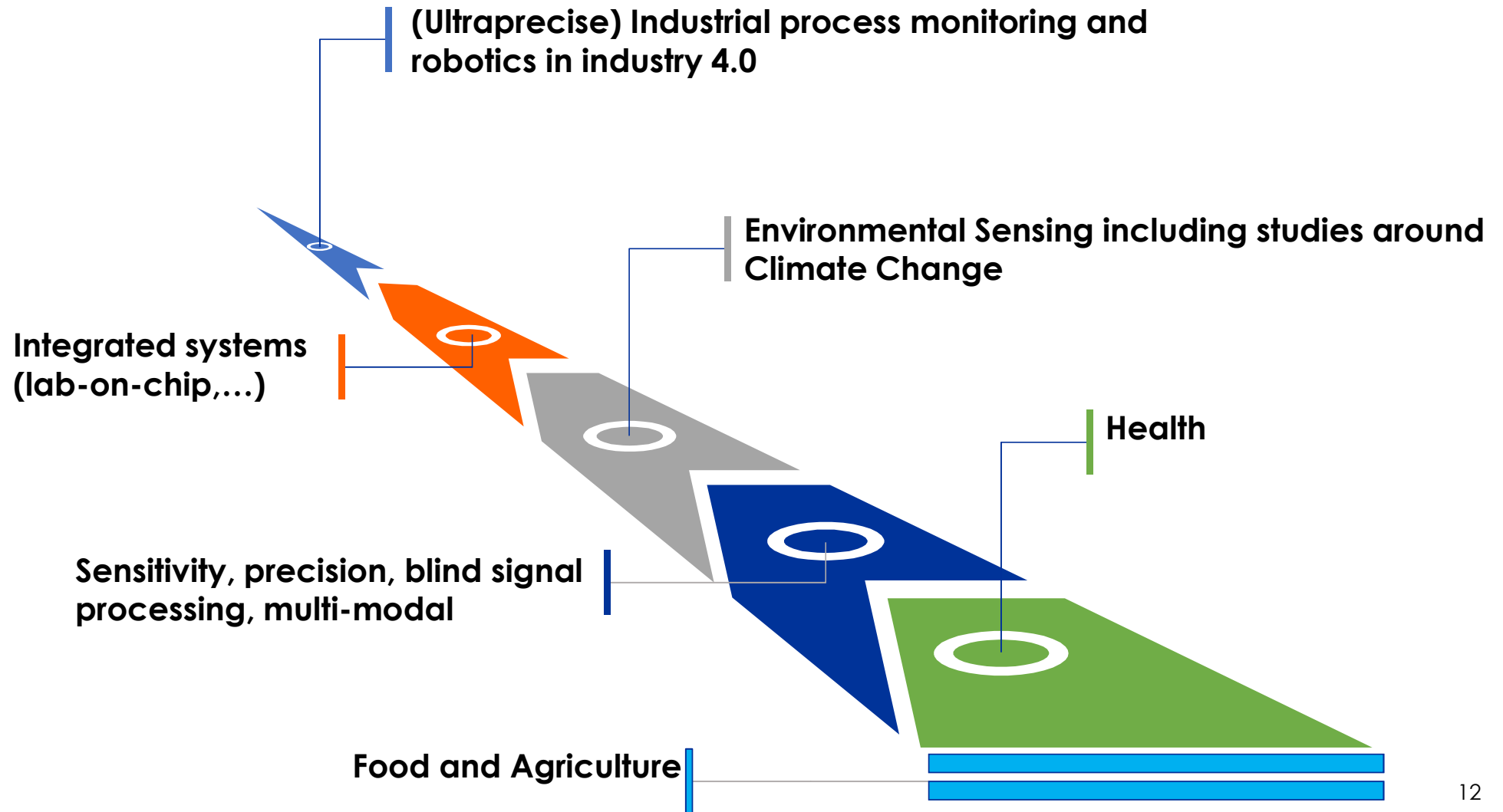
- **Thickness** measurement
- **Defective region** determination
- **Vibration** measurement (Remote distance measurement)
- **Humidity** measurement
- **Temperature** measurement
- **Density** measurement
- **Permittivity** measurement
- **Permeability** measurement

# Transient radar method in the future

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- Fully automated analysis of sandwich consist of several layers. Order of magnitude of layer thickness can be from few tens of micrometer up to several tens of centimeters
- Depth resolution beyond  $\frac{\lambda}{300}$
- Lateral resolution beyond  $\frac{\lambda}{30}$

# Our Vision




# THANK YOU

## Business contact

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