



## Pannel on Information and Signal Processing

*Theme: Trends on Body Networks*

*Topic: Cognitive and Human-friendly Devices*



**Moderator : Pr. Wilfried Uhring – University of Strasbourg and CNRS, France**

**Pannel List :**

**Viktor Sydoruk, IBG-2: Plant Sciences, Forschungszentrum Jülich GmbH, Germany**

**Michal Placek, Wroclaw University of Science and Technology, Poland**

**Peter Edge, Ara Institute of Canterbury, New Zealand**

**Lial Khaluf, Heinz Nixdorf Institute, Germany**

**Lisa Ehrlinger, Johannes Kepler University Linz and Software Competence Center - Hagenberg, Austria**

**June 23 2019 – Athens, Greece**

# Introduction

- Topics:
  - software and hardware for wearable/implementable devices
  - cognitive components, such as bracelets,
  - special cameras, sensors, cognitive lenses/glaces and related issues
  - cognitive computing vs restricted storage and computing capabilities
  - cognitive interfaces
  - ... :) mind-driven future

Actually, panels are open bidirectional discussions, for mass-participation... a mix of commonsense and scientific details

# Introduction

*What is a Cognitive and Human-friendly  
Devices?*

# Introduction

## C3-PO

- Protocol droid



fluent in over six million forms of communication.

Including the binary language of moisture vaporators

# Introduction

## Autonomous car



# Introduction

## Human friendly robots: Baymax



# Introduction

- **Viktor Sydoruk**
  - "How non-invasive sensors can improve plant investigations"  
"Network of non-invasive sensors to monitor plant development"
- **Michal Placek**
  - "It is possible to pull out small changes from videos by special amplification algorithms. This approach can be used, e.g., to retrieve sound from vibrating objects or to measure human pulse"
- **Peter Edge**
  - "I would briefly present on the state/trend of on body IoT, communications (fitness, health monitoring). Standards in communications and security around the inclusion of personal health data made available on home networks and ultimately cloud (Public or Private?)."
- **Lial Khaluf**
  - "organic real-time operating systems: I will present an algorithm, which can provide real-time applications with self-adaptability behavior. The goal is to have highly dynamic real-time applications. Adaptation can take place online. System reactions must not be pre defined offline. It can be added online.
- **Lisa Ehrlinger**
  - "I would like to highlight the importance and potential of semantics and data quality for cognitive computing, especially with respect to the restricted storage and computing capabilities in wearable devices. "

*Panelist*

*Organic Programming of Dynamic Real-Time Applications*

*Lial Khaluf*

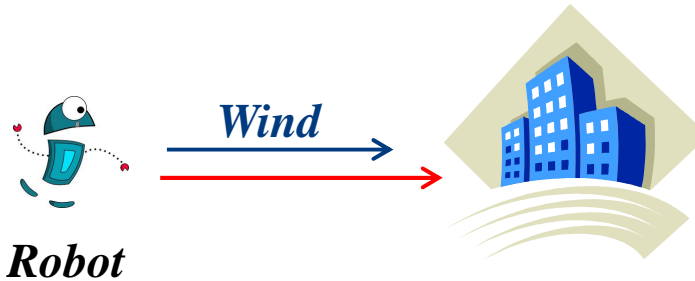
*Franz Rammig*



## *Motivation*



## *Objects in our Real World*



*Robot*

## *Robot in a Rescue System*

# *Motivation*

*Organic Behavior*



*Real-Time Systems*



*Dynamic Self-Adaptable Real-Time Systems*

# Scenario

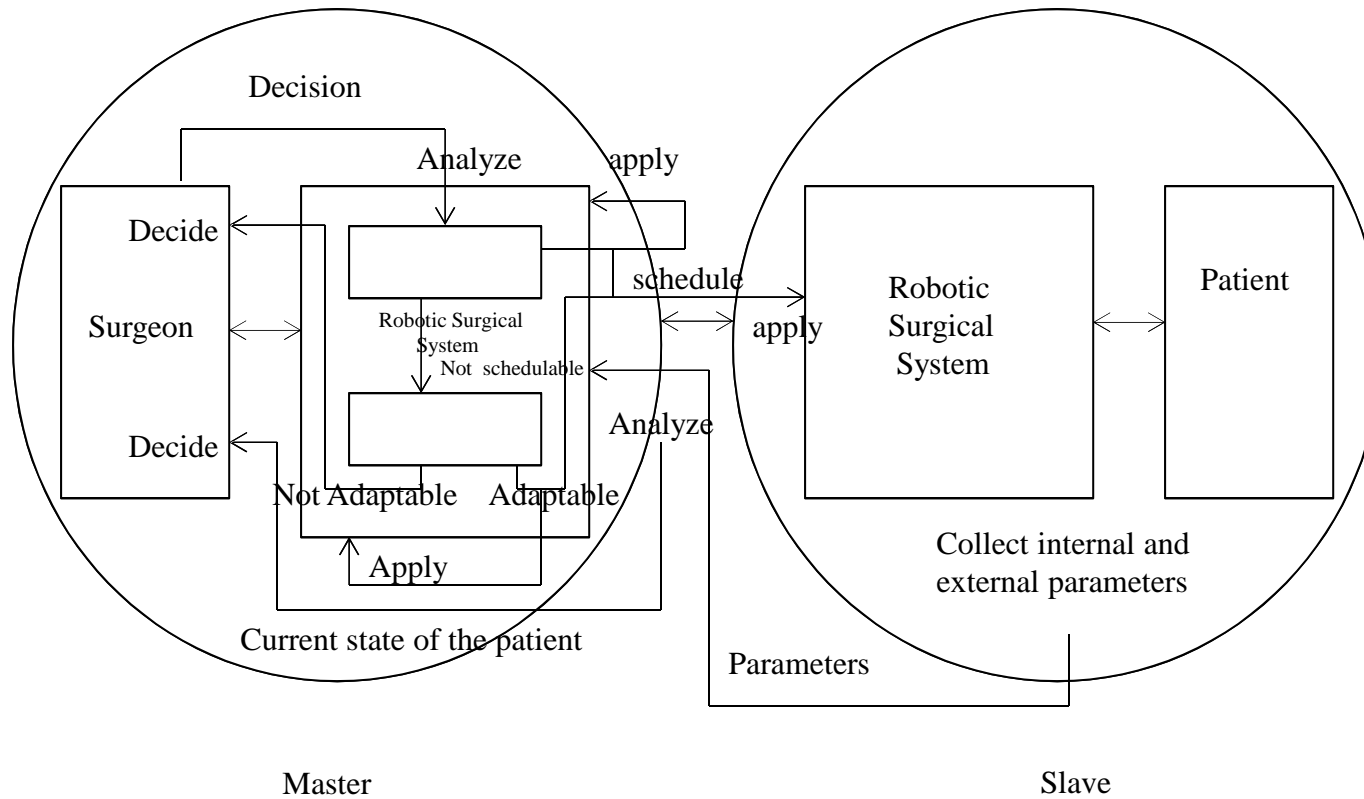
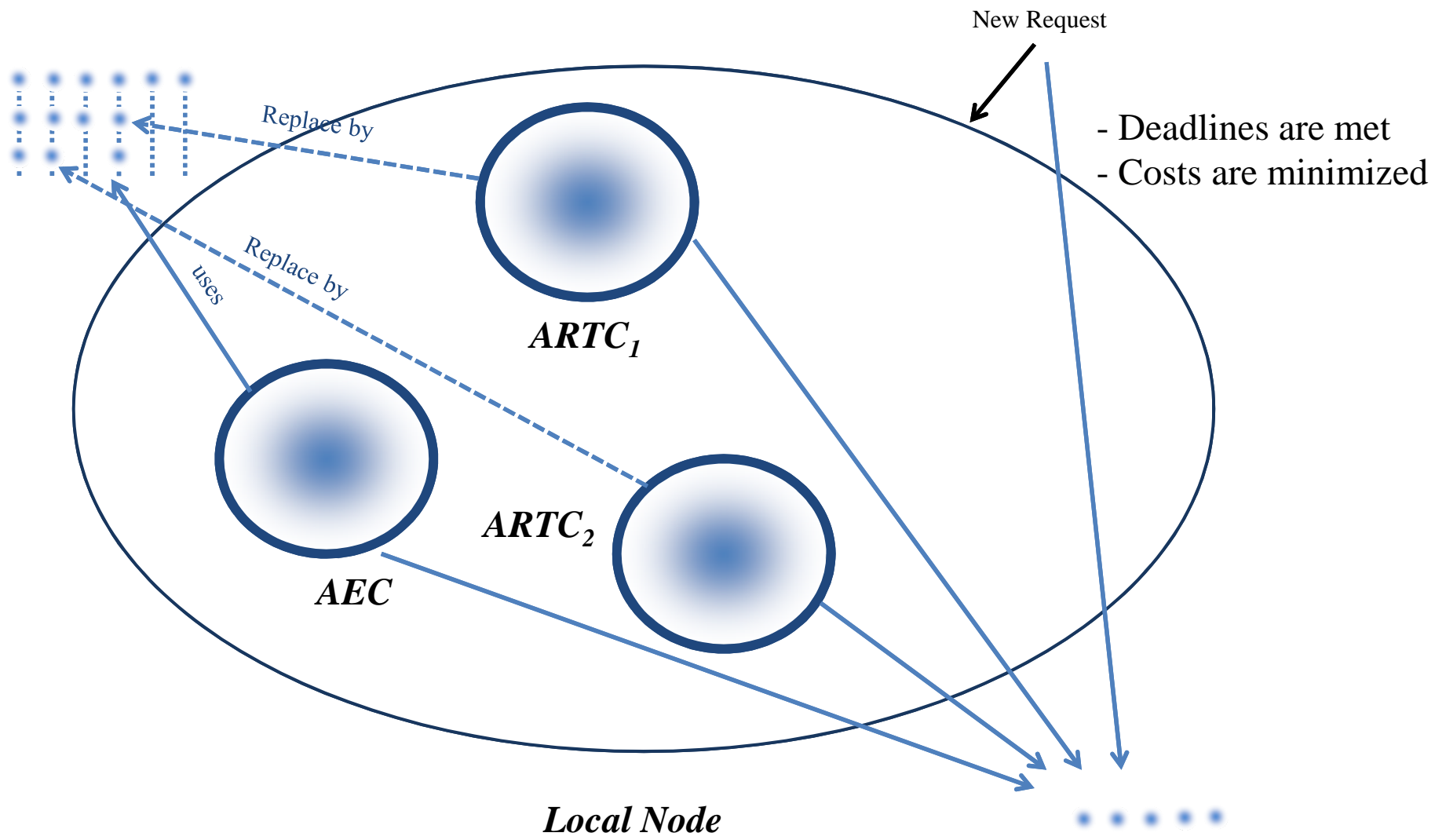


Figure 3: Self-Adaptable System of robotic surgery

# *Our Approach*



## *Future Trends*

- Distribute the central algorithm that is run by the Engine-cell on several nodes.
- In case of a distributed algorithm, how can we obtain fault tolerance?
- How to deal with the boundedness of the algorithm in case of a non- deterministic network.
- Having controlling cells other than the Engine-cell.
- Applying different genetic algorithms or solve the knapsack problem in a different way.
- Discuss task communication, or interrelated tasks.

# Improving Data Quality with **Knowledge Graphs** for Cognitive Computing

**Panel:** Cognitive and Human-friendly Body Network Devices

**Lisa Ehrlinger**

Johannes Kepler University Linz, Austria

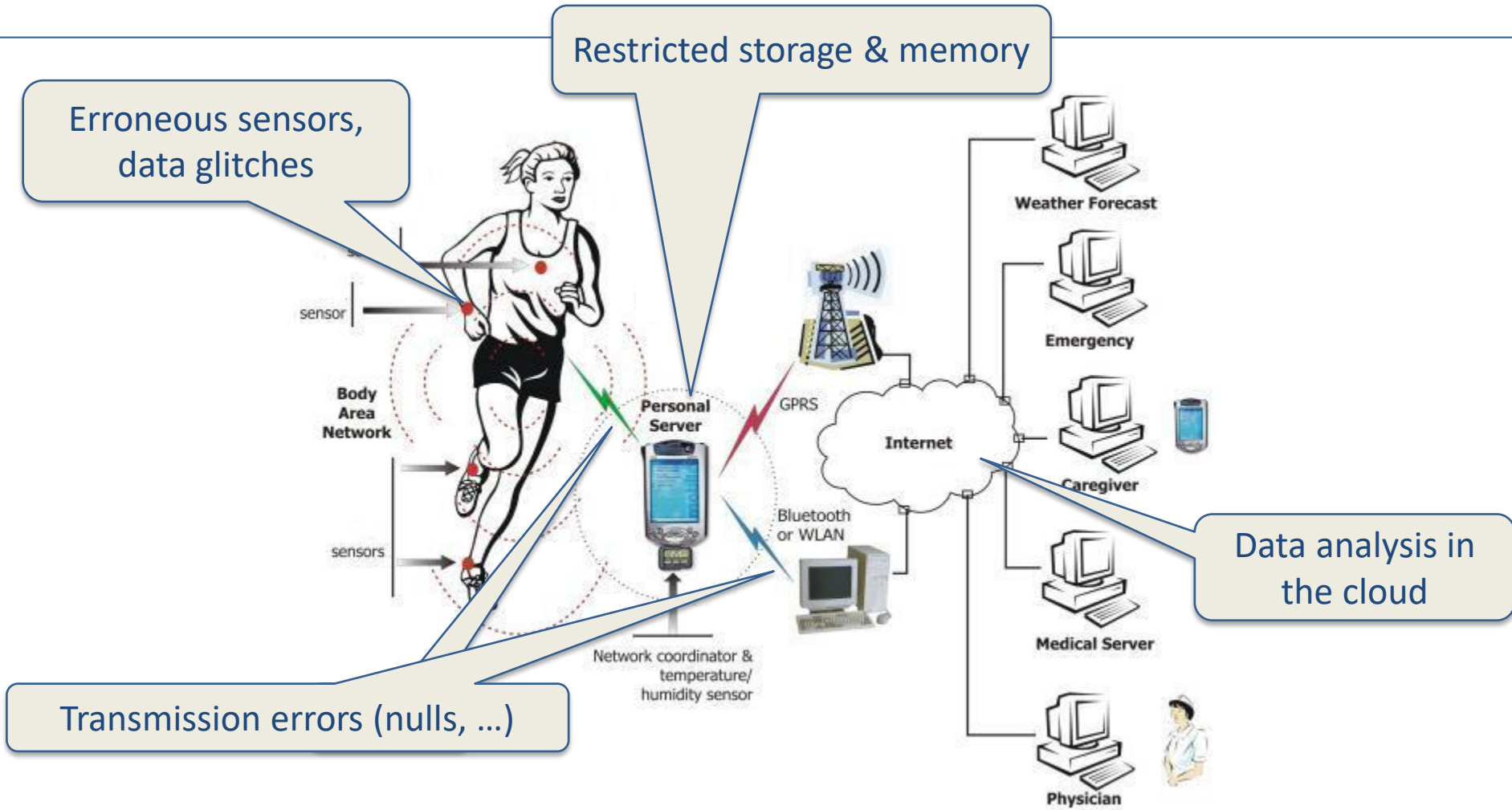
Software Competence Center Hagenberg, Austria

[lisa.ehrlinger@jku.at](mailto:lisa.ehrlinger@jku.at)

<http://faw.jku.at>

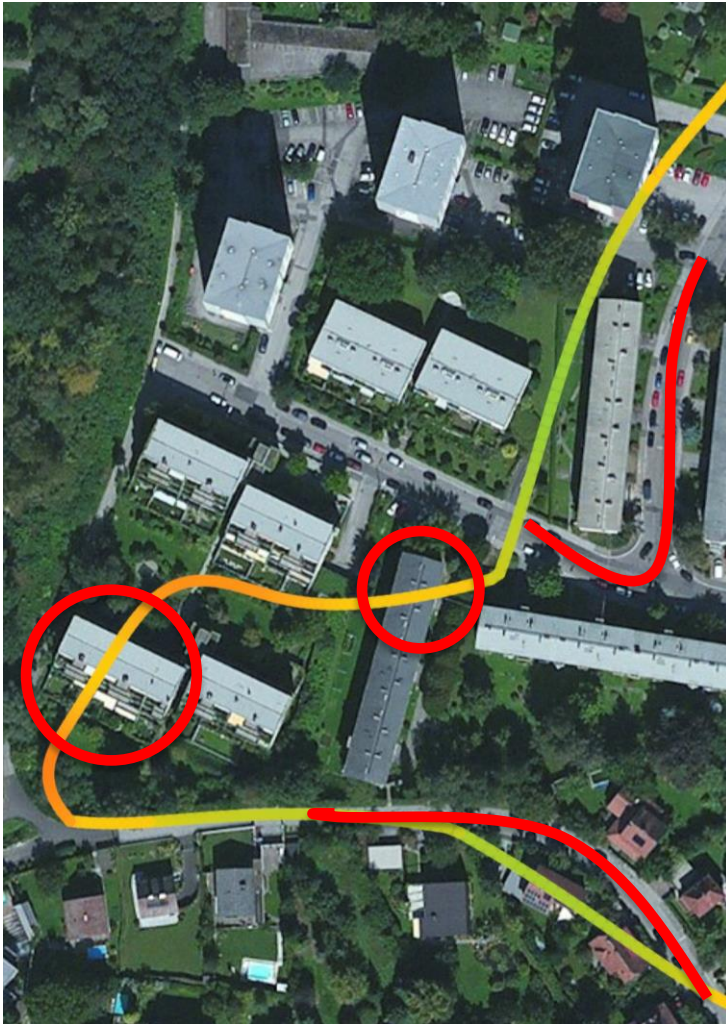


# Data Processing in Body Sensor Networks



Wikipedia contributors. (2019, February 20). Body area network. In Wikipedia, The Free Encyclopedia. Retrieved 08:31, May 29, 2019, from [https://de.wikipedia.org/w/index.php?title=Body\\_Area\\_Network&oldid=186859702](https://de.wikipedia.org/w/index.php?title=Body_Area_Network&oldid=186859702)

# DQ Issue 1: GPS Interpolation Error





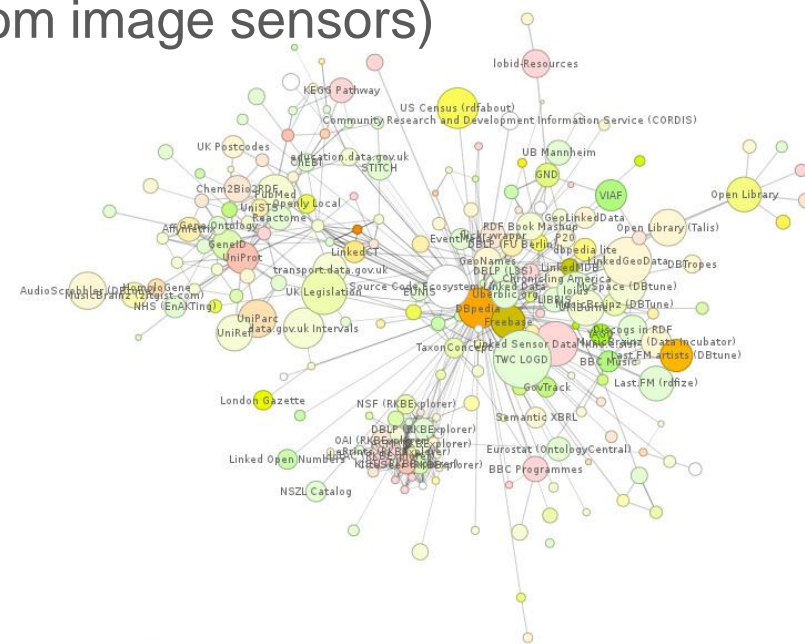
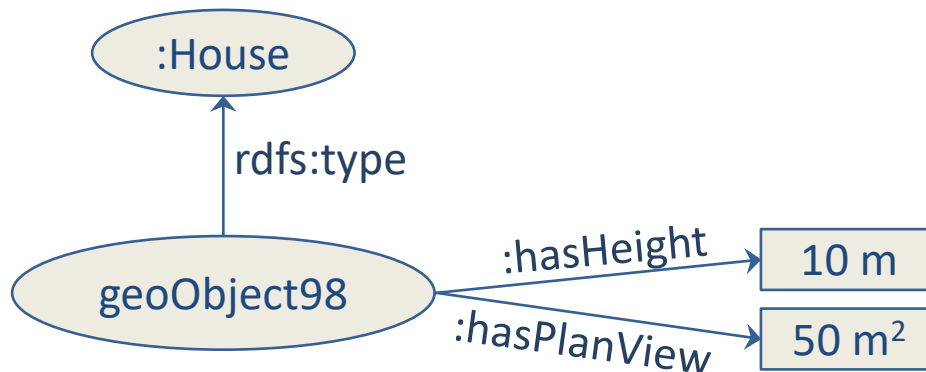
# DQ Issue 2: Electrocardiogram

- Detect atrial fibrillation (AFib)
- Ensure reliable data analytics through **continuous data quality measurement**



# The Power of Knowledge Graphs

- Enrich sensor data with machine-readable semantic information
  - to increase human-friendliness
  - to increase data quality
  - to reduce computing power (e.g., from image sensors)
  - to increase prediction accuracy



Panel on Information and Signal Processing

# Color and Motion Magnification

Presented by: Michał M. Placek



Wrocław University  
of Science and Technology

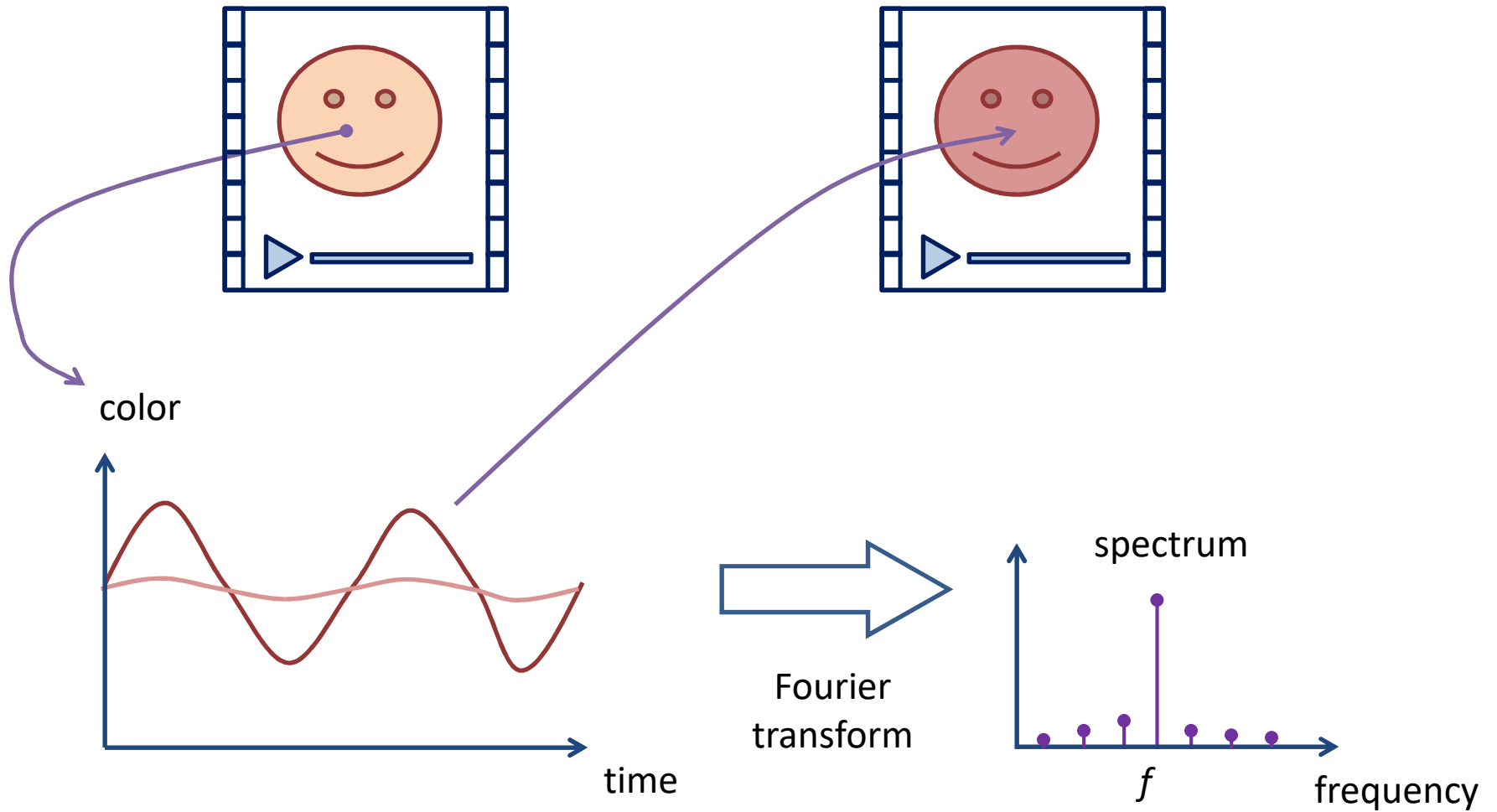


InfoSys 2019

June 2019, Athens, Greece



# Color Magnification



# Color Magnification



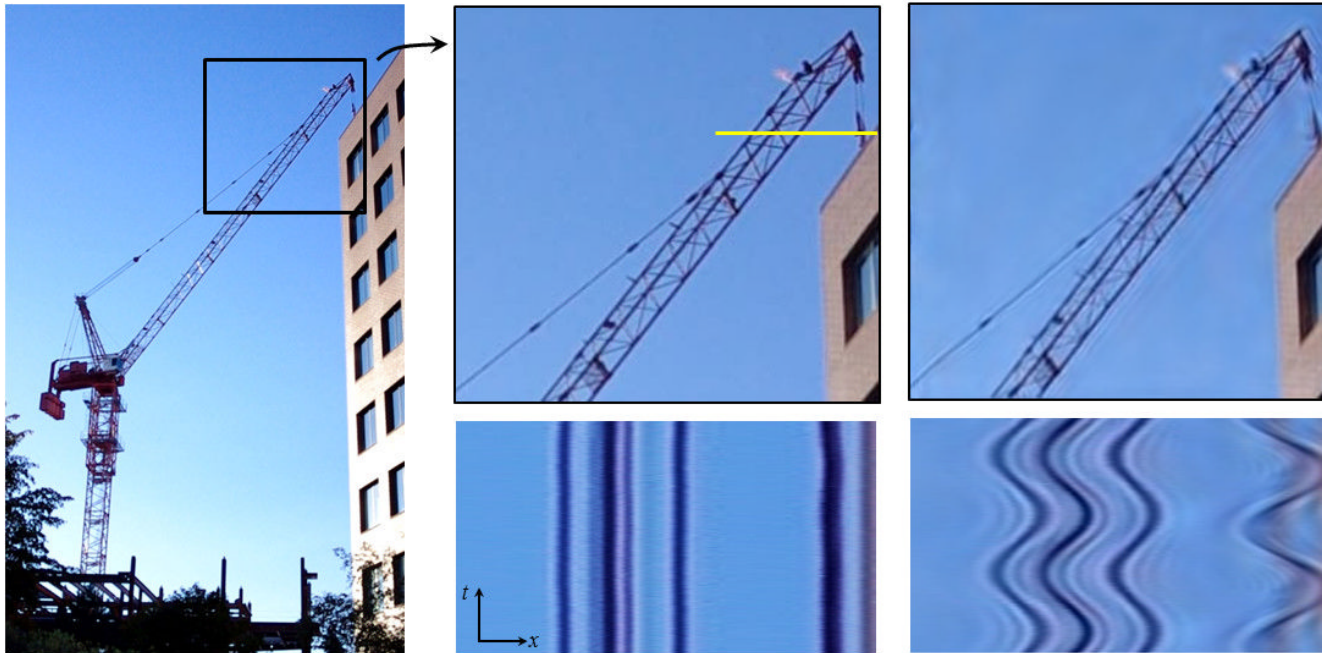
(a) Input



(b) Magnified

Source: <http://people.csail.mit.edu/mrub/vidmag/>

# Motion Magnification



Source: <http://people.csail.mit.edu/mrub/vidmag/>

# On Body IoT Communications (wearables)

Specification, Security and Privacy

# Specifications

Technology	Range	Frequency	Security
Bluetooth	1–100 metres	2.4 GHz	56-128 bit key
ANT	30 metres	2.4 GHz	AES-128 and 64-bit key
ANT +	Optimised for sports equipment	2.4 GHz	AES-128 and 64-bit key

Medical applications for wireless communication include:

- Surface to surface (Bluetooth)
- Surface to implant (RF)
- Implant to remote location (WiMax)



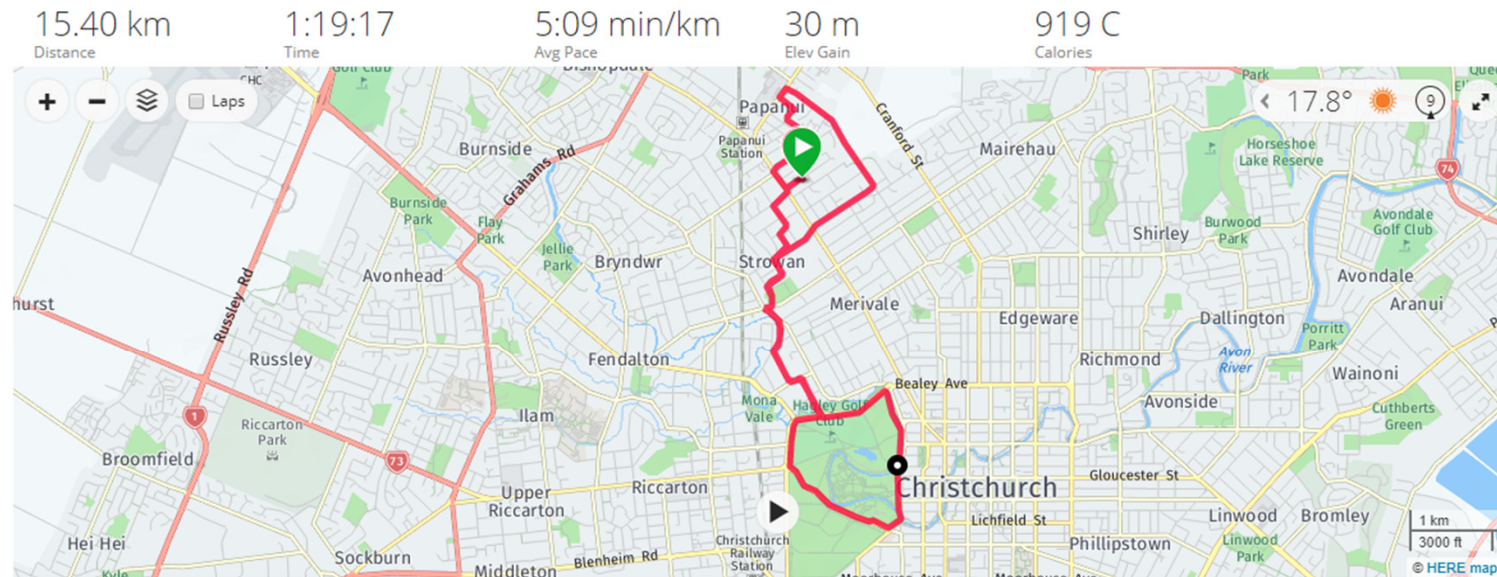
# Body Area Network (BAN) communications

Adaptable Network Topology (ANT) +

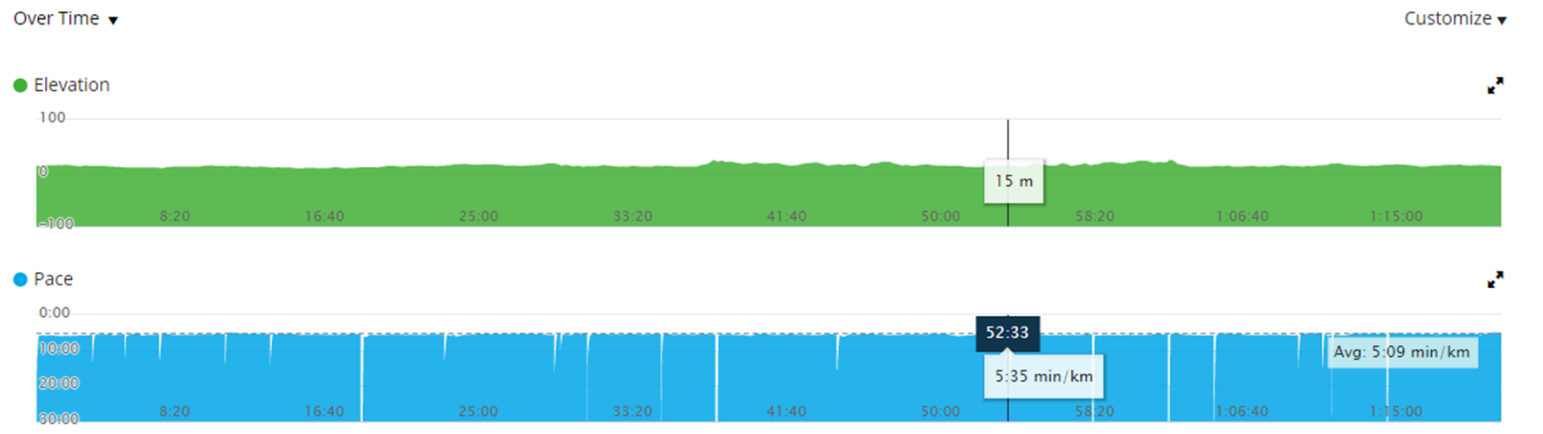
Bluetooth



# Garmin Data



[Garmin Activities](#)



# Strava Data

Data made available publicly create security issues for individuals

Start and end points are clearly visible to all that view the data

Routes are visible along with start and finish times

The screenshot shows a Strava activity page for a run titled "Afternoon Run". The activity was recorded on Friday, 17 May 2019 at 16:39. The statistics displayed are: Distance 8.12 km, Moving Time 45:17, Pace 5:34/km, Elevation 10m, Elapsed Time 45:27, and Calories 671. The user is wearing a Garmin Forerunner 235 and HOKA ONE ONE Clifton Black shoes. The "Give Kudos" button is circled in red, showing 4 kudos and 0 comments. A "View Flybys" link is also visible.

The screenshot shows a map view of the "Afternoon Run" activity. The route is highlighted in red on a map of the Westlake Park area in Auckland, New Zealand. The map includes street names such as Dunbars Rd, Checketts Ave, Halswell Rd, Sparks Rd, Sutherland Rd, Clashmore Rd, Trices Rd, Quaites Rd, Fountains Rd, Hoopers Rd, and Hodgsons Rd. The activity starts and ends at Sabys Rd. The map interface includes a zoom control (+/-), a GPX download button, and a Terrain Map toggle.

Splits			
KM	Pace	GAP	Elev
1	5:17 /km	5:18 /km	-1 m
2	5:31 /km	5:31 /km	-2 m
3	5:35 /km	5:36 /km	-2 m
4	5:40 /km	5:38 /km	3 m
5	5:38 /km	5:37 /km	2 m
6	5:45 /km	5:47 /km	-4 m
7	5:44 /km	5:43 /km	1 m
8	5:34 /km	5:32 /km	3 m
0.12	4:33 /km	4:32 /km	0 m

# Strava Data (contd)

This user has 1300 followers

This is also valued data for health and insurance companies

A high marketing value

Give Kudos **1374** 4

**Afternoon Run**  
13:20 on Friday, 31 May 2019

12.87 km 58:58 4:35/km 17  
Distance Moving Time Pace Relative Effort

Elevation 67m Calories 605  
Elapsed Time 59:44

Garmin Forerunner 935 Shoes: HOKA ONE ONE Tracer2 (3,881.8 km)

Splits			
KM	Pace	GAP	Elev
1	4:45 /km	4:34 /km	15 m
2	4:35 /km	4:28 /km	6 m
3	5:12 /km	5:16 /km	-8 m
4	4:27 /km	4:32 /km	-10 m
5	4:34 /km	4:38 /km	-7 m
6	4:33 /km	4:35 /km	-4 m
7	4:32 /km	4:30 /km	3 m
8	4:34 /km	4:30 /km	4 m
9	4:28 /km	4:21 /km	9 m
10	4:21 /km	4:15 /km	11 m
11	4:35 /km	4:29 /km	10 m
12	4:27 /km	4:31 /km	-11 m

Map view showing the run route in red on a map of Boulder, Colorado. Landmarks include Tantra Park, Harlow Platts Community Park, and the University of Colorado Boulder. The route starts near the intersection of 95 and 157, heading south and then east.

# Conclusion

- Many health and fitness applications available
- Data can be freely available and used by marketing
- Users often don't check to see whether data is being sent to the cloud
- Some data is protected, some is highly visible and others are held by the owner of the application. User denied access

# HOW NON-INVASIVE SENSORS CAN IMPROVE PLANT INVESTIGATIONS

## NETWORK OF NON-INVASIVE SENSORS TO MONITOR PLANT DEVELOPMENT

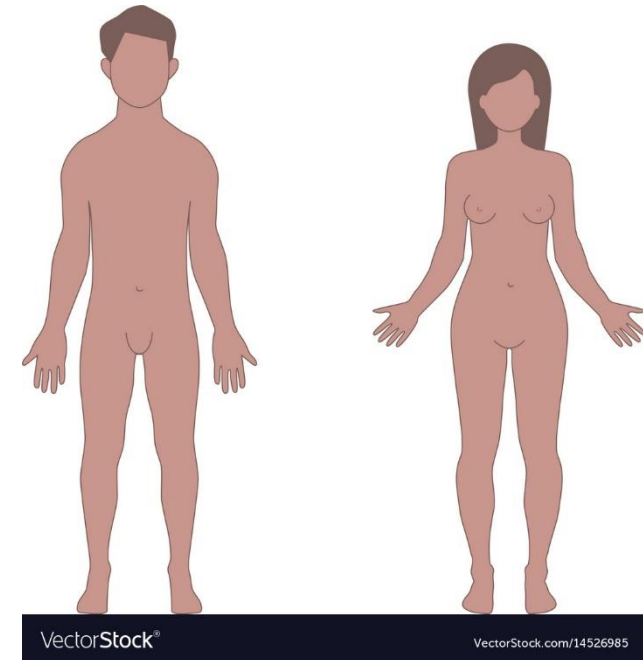
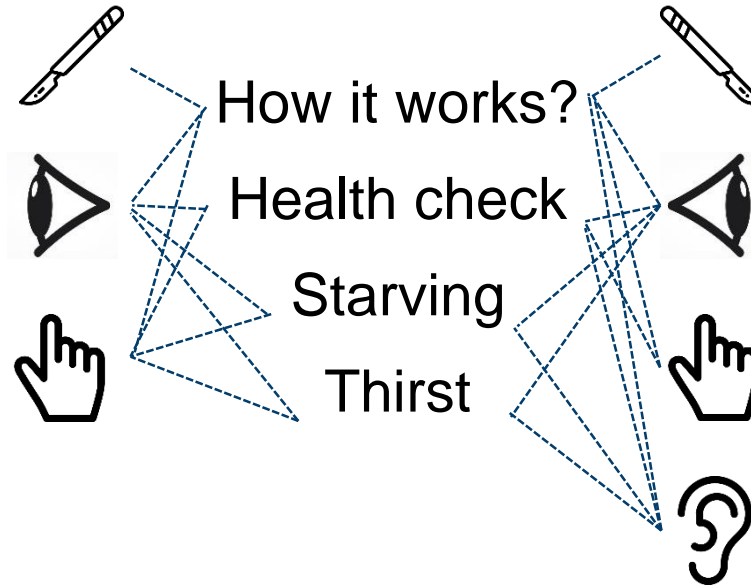
JUNE 4, 2019 | SYDORUK

# HOW NON-INVASIVE SENSORS CAN IMPROVE PLANT INVESTIGATIONS

## Research in the past



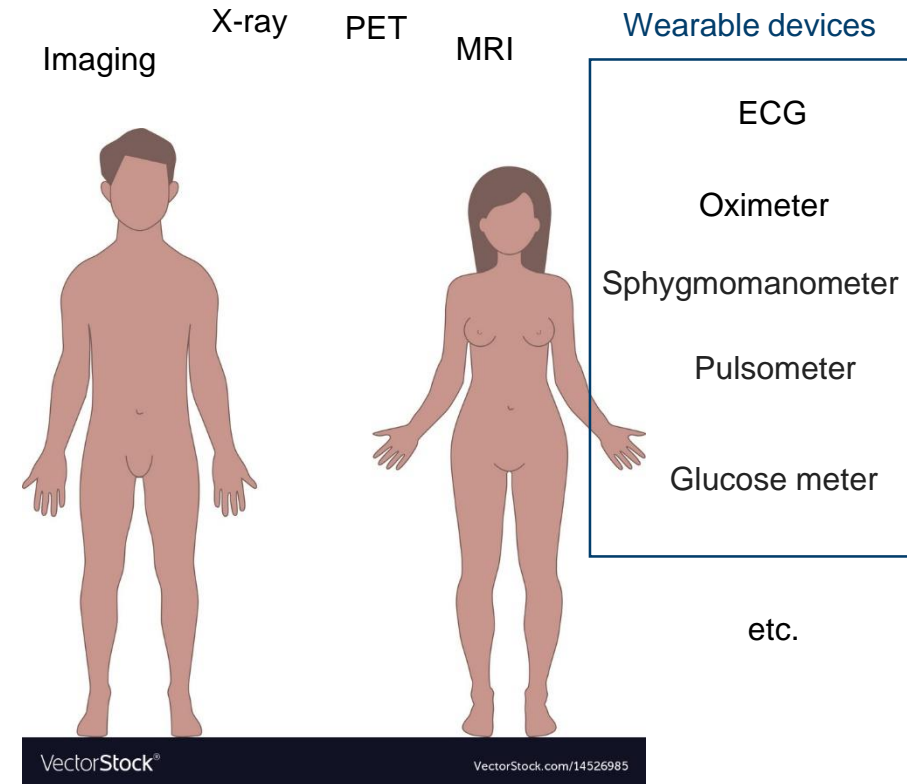
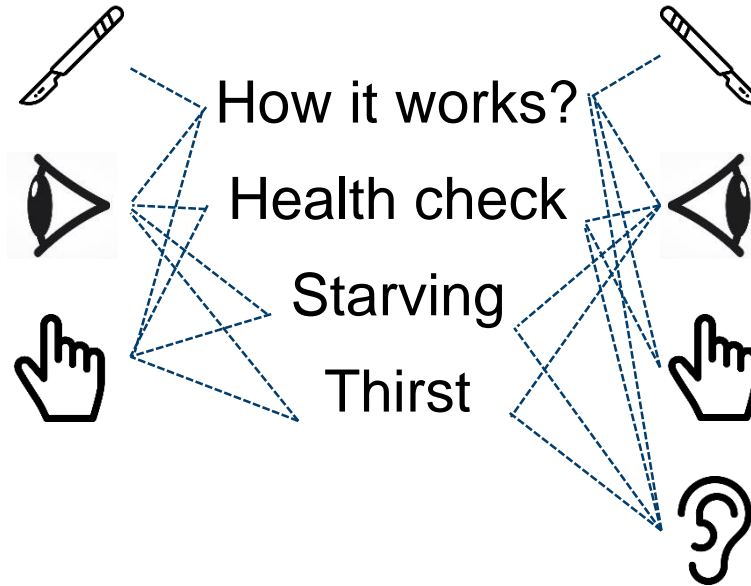
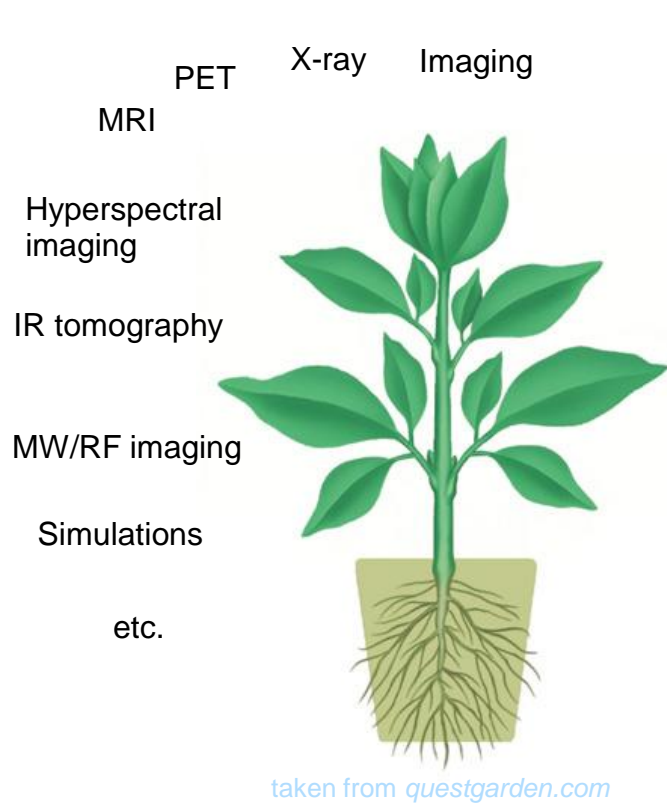
taken from [questgarden.com](http://questgarden.com)



Results: yes/no + impression about the level

# HOW NON-INVASIVE SENSORS CAN IMPROVE PLANT INVESTIGATIONS

## Research now



Results: yes/no + precise level (in many cases)



# NETWORK OF NON-INVASIVE SENSORS TO MONITOR PLANT DEVELOPMENT

Institute for Bio- and Geosciences, IBG-2: Plant Sciences, Forschungszentrum Jülich GmbH, Germany



Hyperspectral imaging



Portable MRI

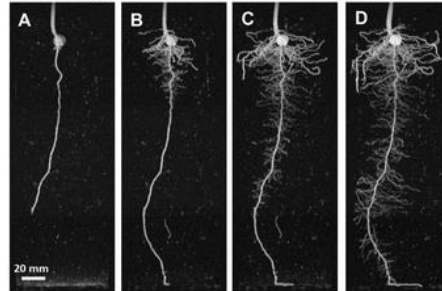


phenoSeeder



MRI

MRI root imaging



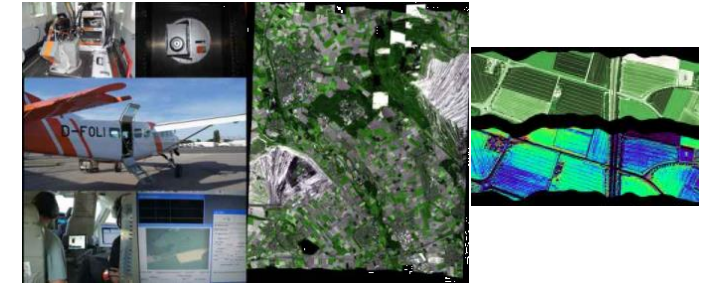
6, 9, 12 and 15 DAS

Van Dusschoten et al. 2016



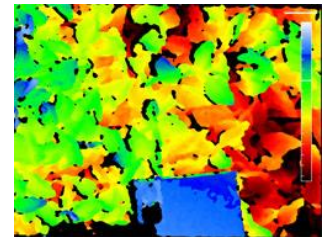
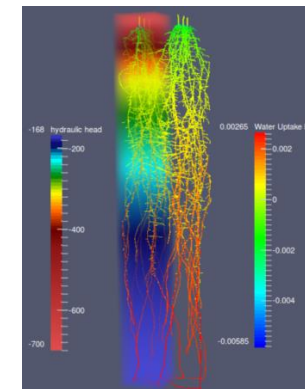
questgarden.com

Imaging



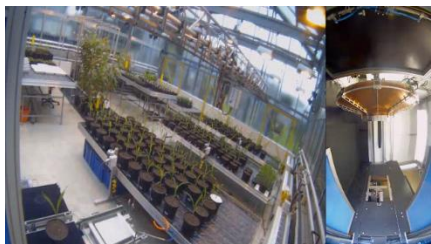
High-performance airborne imaging spectrometer

Simulations



Stereo cameras

MW/RF imaging



PET

