Results & Perspectives about Automated Water Intake Recording, Infrared Thermography and Visual systems

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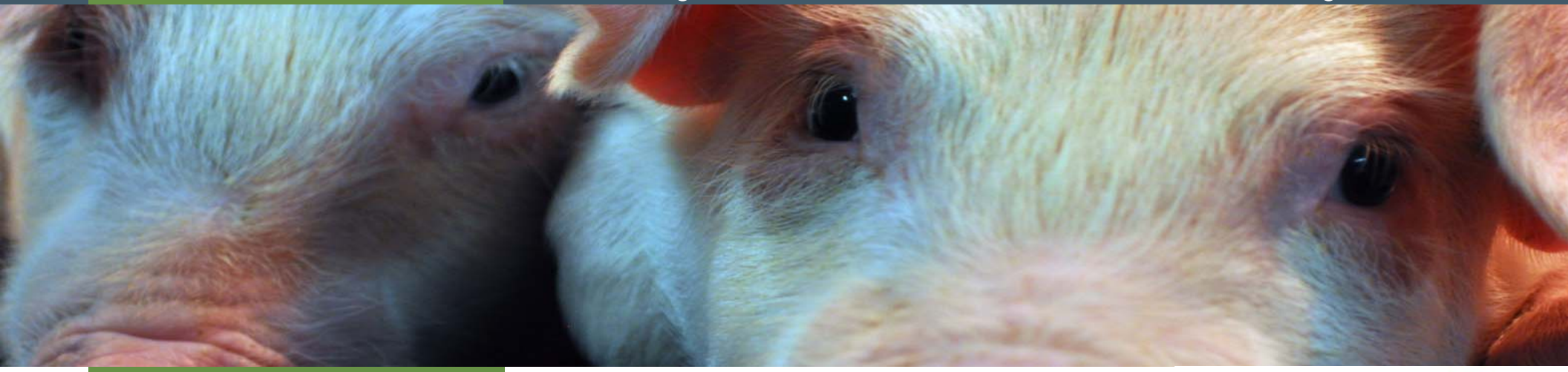

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Outline

- Introduction
- Technologies & Systems
  - Individual Water Consumption System
  - Infrared thermography
  - Vision system to evaluate weight and conformation
  - Tracking system to assess behaviour
- Conclusion

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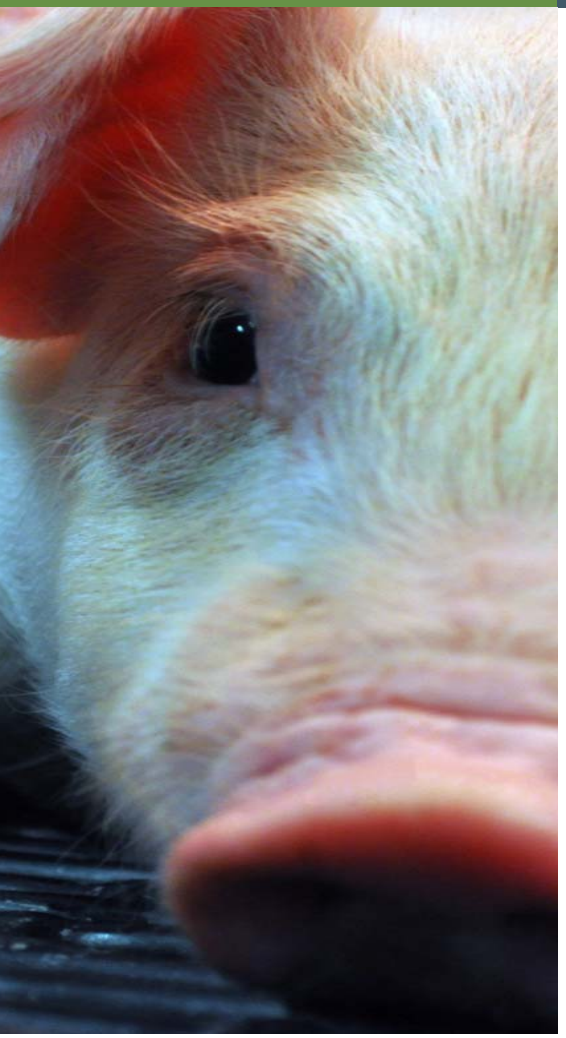
Deschambault Station

- Built in 1994 in Deschambault, Quebec
- Wean to finish operation of 360 pigs
- All-in-all-out swine production (until 2015)

The Station: a Phenomics Center

- "You can’t improve what you can’t measure"
- Difficult or expensive to measure traits
- Measurements:
  - Precise, goal-oriented, repeatable, automated, rapid, affordable, applicable, relevant



Individual water consumption system

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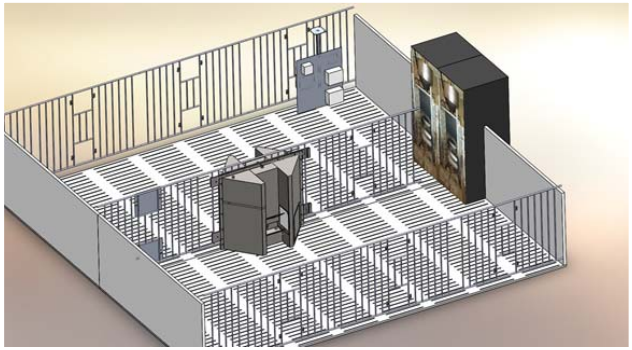
Individual Water Consumption System

- Recording system
  - Created by the CDPQ in 2013
  - Measures water consumption per pig
  - Individual identification system
  - Installed in 28 pens



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Individual Water Consumption System

- Results from data recorded during:
  - Trial 36: 361 pigs (Jan-Mar 2015)
  - Trials 37: 295 pigs (Jul-Oct 2015)
  - Females, castrates, Improvest® males, intact males
  - Other performance measurements recorded (feed intake, growth, carcass, etc.)

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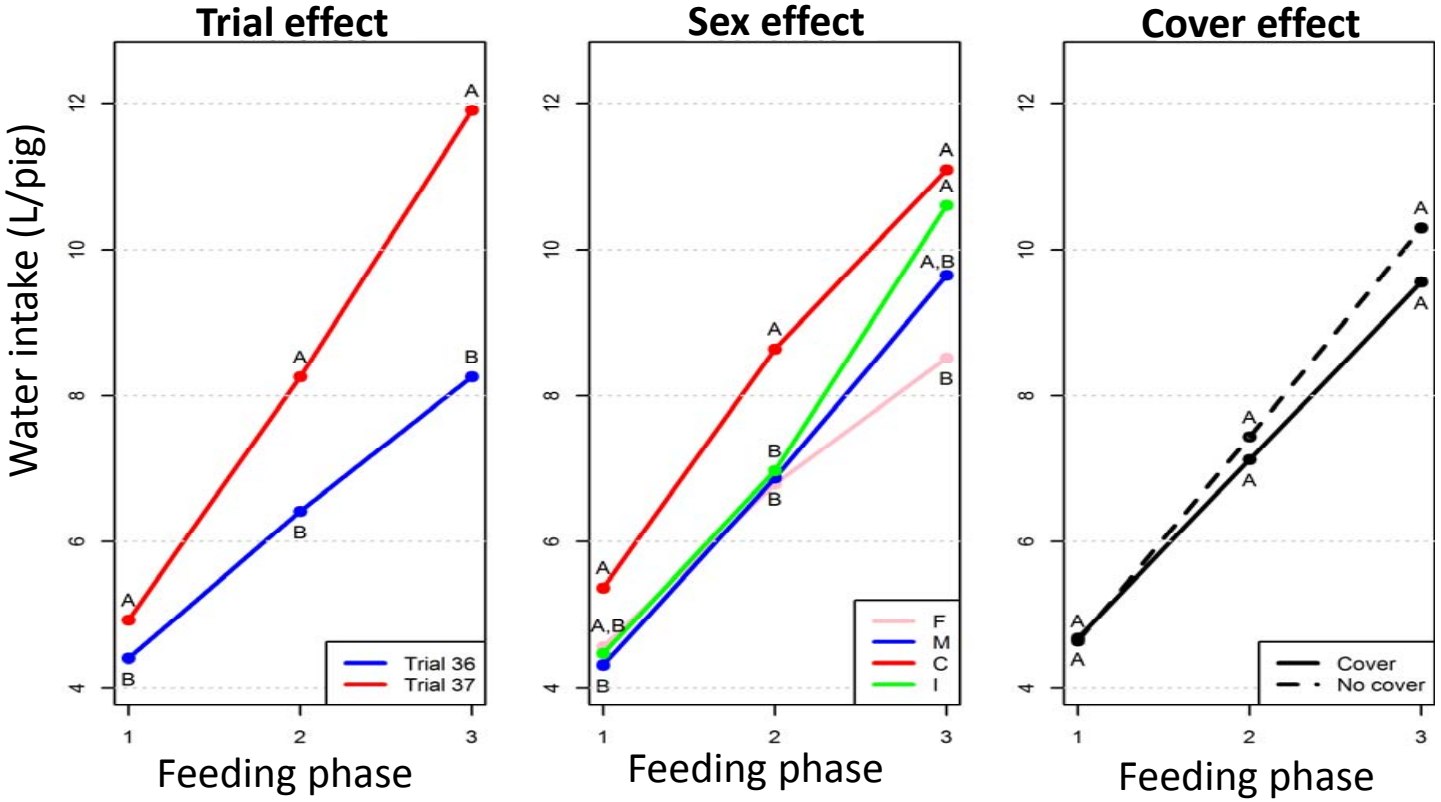
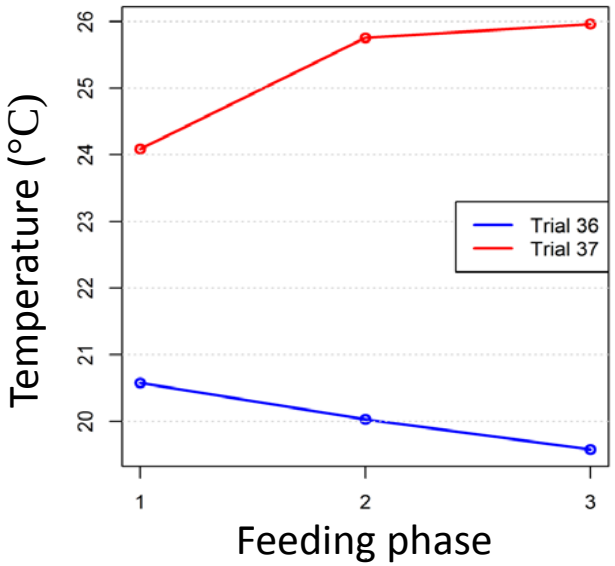
Effect of some parameters on water intake



Least-squares means per food phase for each factor. Modalities with different letters indicate a statistically significant difference (95% level). For sex, the Sidak adjustment was applied to account for multiple comparisons.



Mean temperature in the barn for each feeding phase for the two trials.

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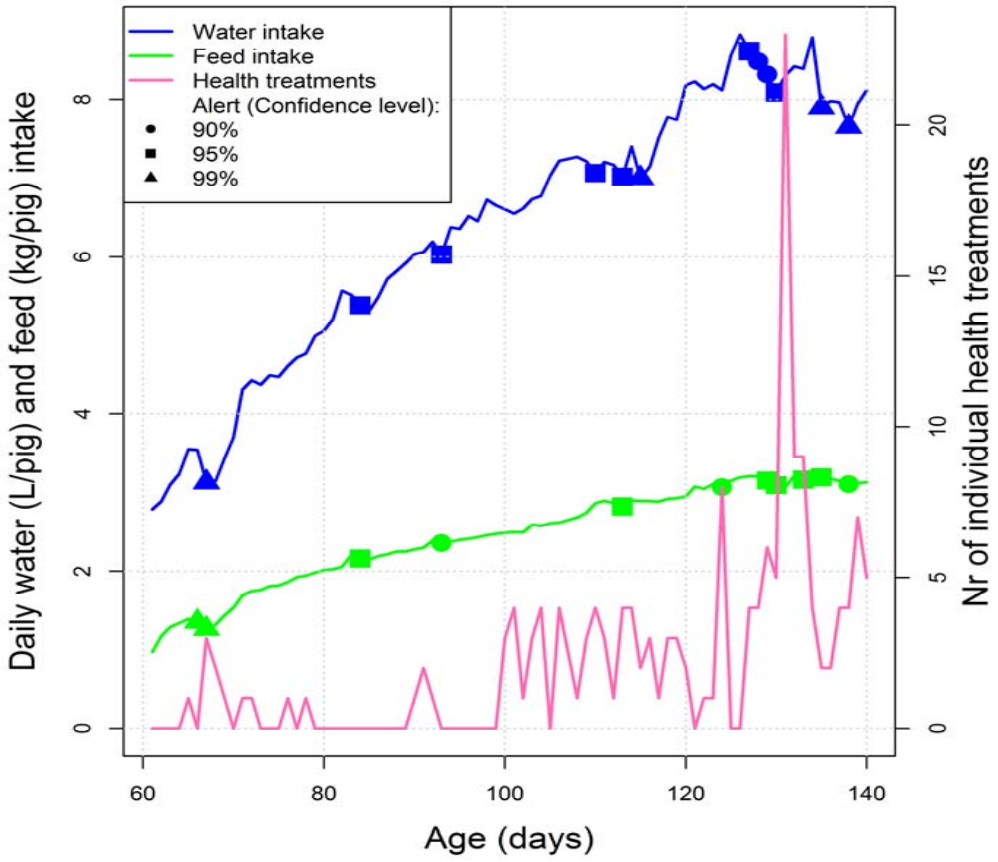
Water intake, feed intake and number of health treatments during the grow-finish phase

- Water and feed are reliable early indicators of health problems
- Several decreases in water consumption prior to treatments
- Water can detect health problems 3 days prior to the treatment



Lessons learned from water recording

- Seasonal effect
  - Adjustment of T° data needed during summer
  - Some wasting behaviors (specific pigs during summer)
  - Good water pressure needed during summer
- New systems should record only from the nipple (water meter)
- Precise and affordable measurement

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Potential applications in pig production

- Water intake recording in the pen (no RFID system)
  - Leads to a lower cost for the producer
  - Identification of health problems (at herd level)
  - Highly correlated to feed intake
- Individual water intake recording (RFID system)
  - Adjustment for T° needed for summer
  - Identification of sick animals (at individual level)
  - Assessment of behaviour, activity level, stress, etc.
  - Specification of drug concentrations in water

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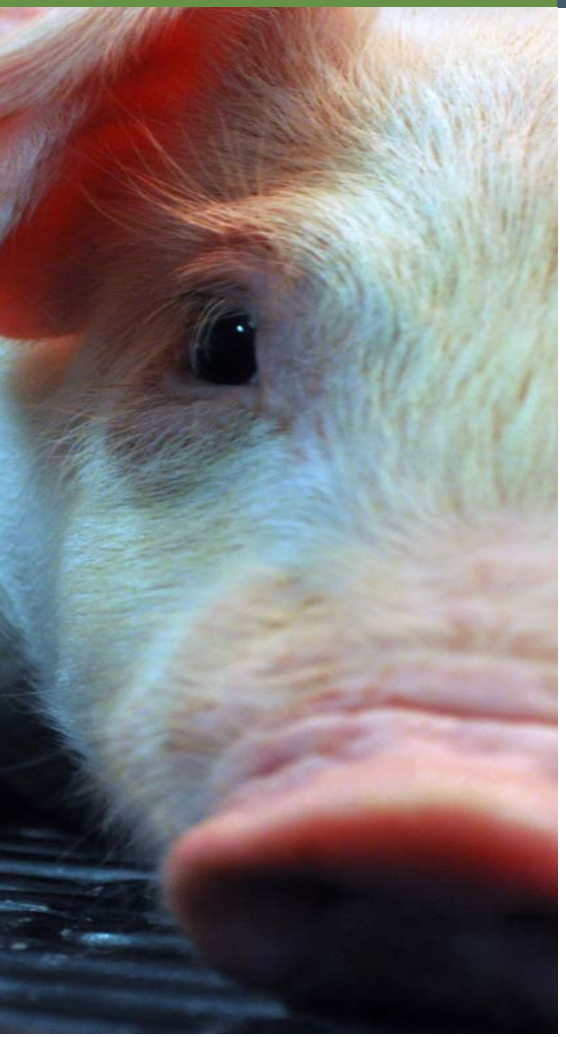

Infrared thermography

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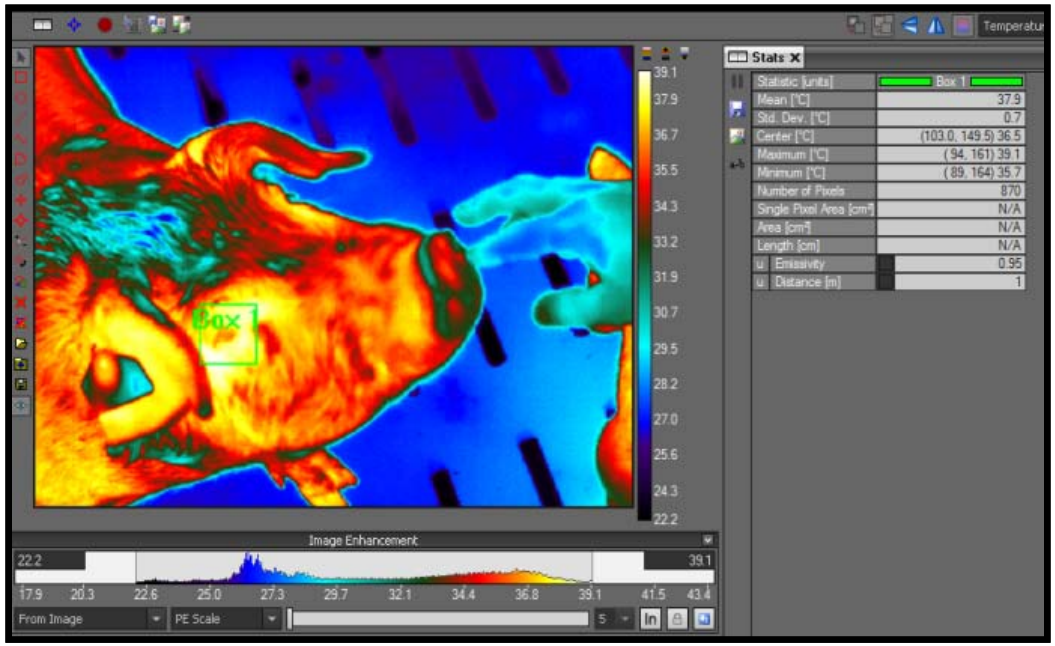
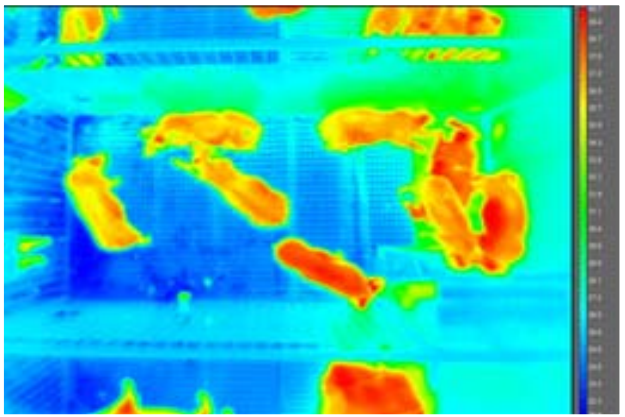
Infrared thermography

- Measurement of emitted heat (C°)
- Rapid method
- Non invasive
- No animal handling



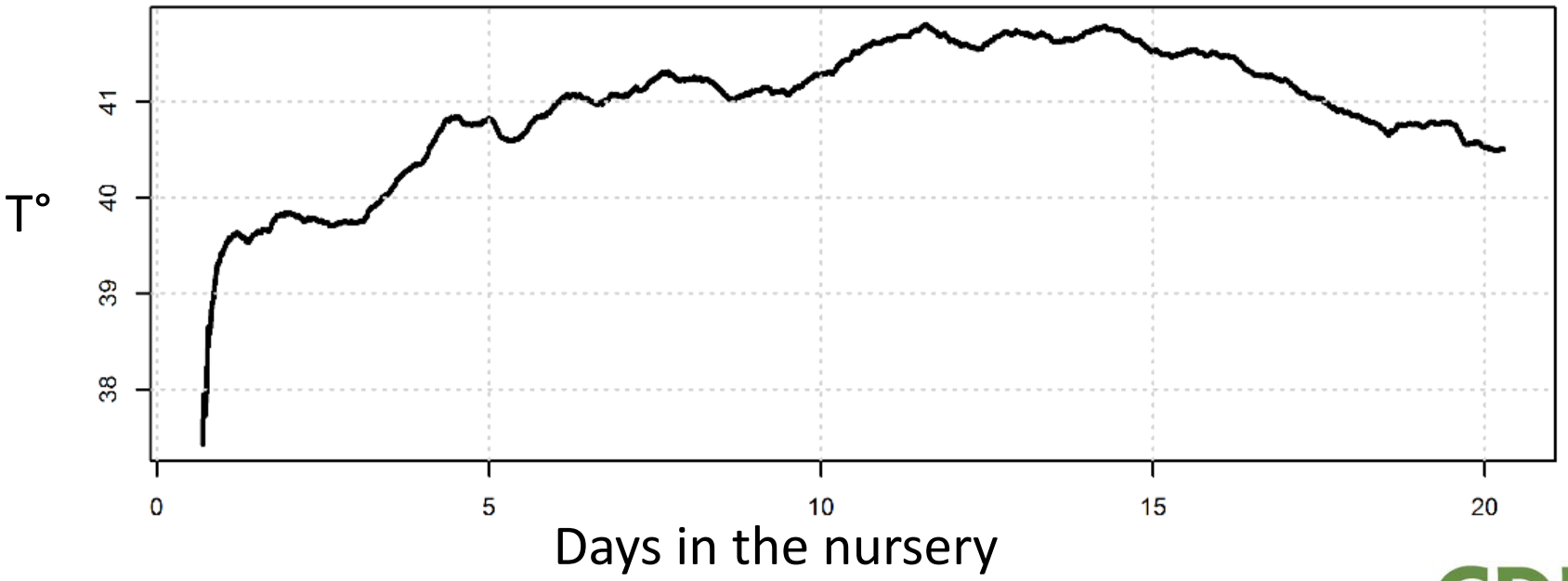
Infrared thermography (project 1 - nursery)



- Piglets from a natural disease challenge model
- Camera installed above 3 pens in the nursery
  - Picture taken every 5 minutes
- Group image analysis
  - T° data (max, mean, sub-group, etc.)

Infrared thermography (project 1 - nursery)

Daily mean (24h rolling average) max T° for one replicate



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Infrared thermography (project 2 – growing phase)

- Development of a custom bowl
- 2 cameras installed
  - A325 sc ($10k)
  - AX8 ($1k)
- T° measured from individual pig
- Comparison between 2 different cameras
  - Quality (correlation)
  - Automation
  - Reliability
  - Durability

Infrared camera FLIR A325sc

Infrared camera FLIR AX8

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Infrared thermography (project 2)

Infrared camera FLIR A325sc

Infrared camera FLIR AX8

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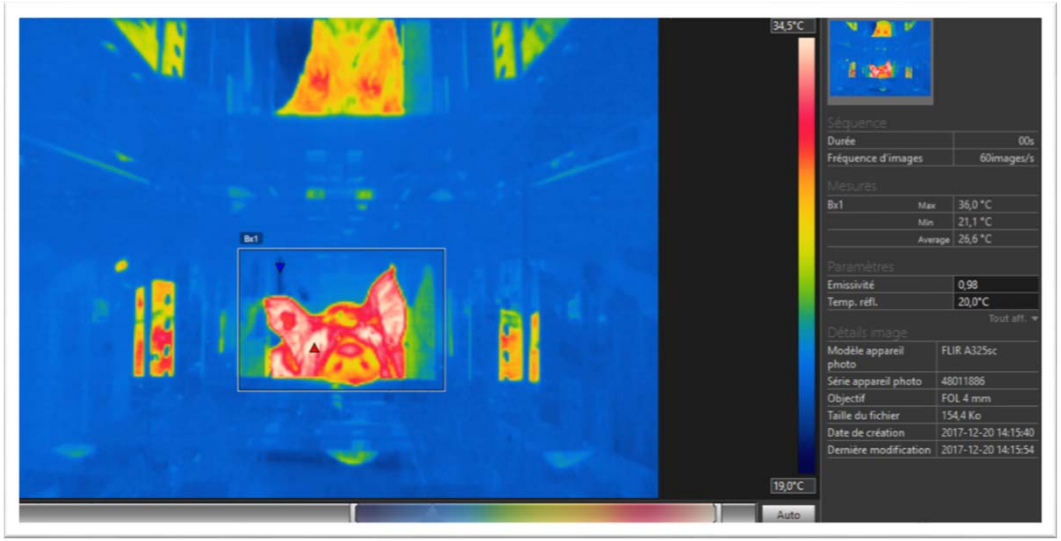
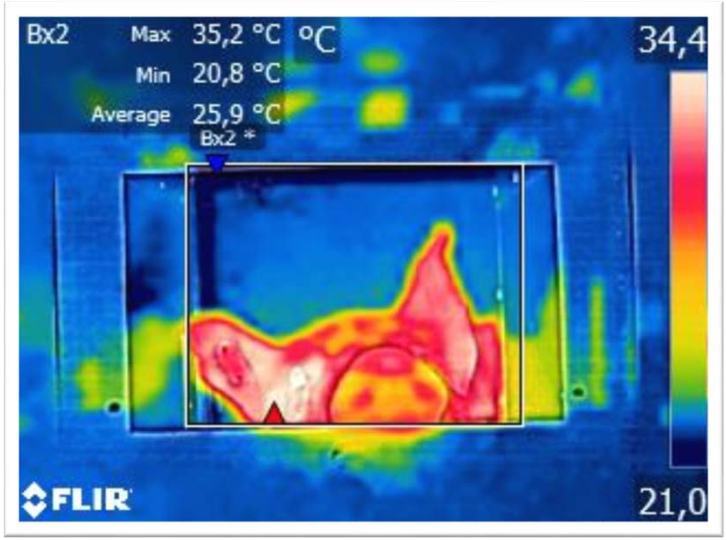
Infrared thermography (project 2)

Infrared camera FLIR A325sc



Infrared camera FLIR AX8



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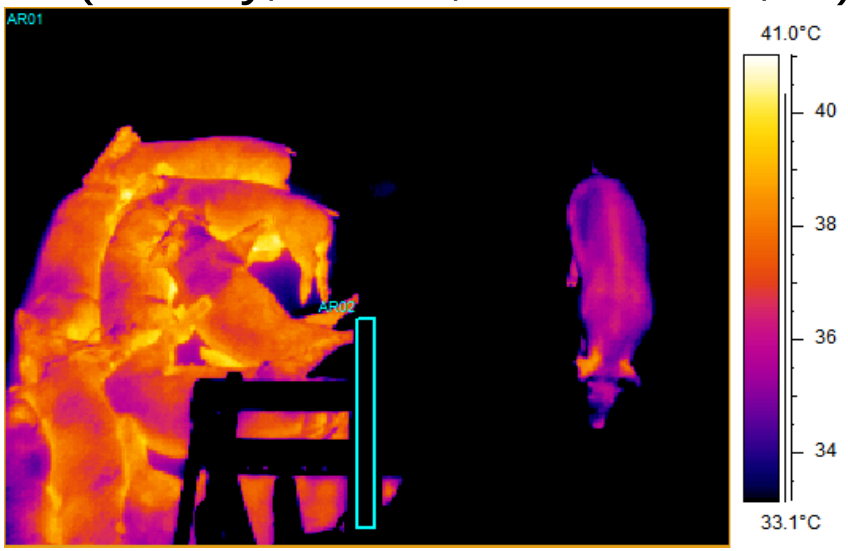
Infrared thermography (project 2)

- T° for A325 is higher, but it is a higher quality camera (more expensive)
- Same pigs used for each period of time
- Eye is always visible when using the new bowl

Time	A325 Temperature (°C)	AX8 Temperature (°C)
6h16		35.4
6h35	36.0	35.2
7h07	36.1	34.8
9h44	36.5	35.3
10h00	36.4	35.1
10h30	36.0	35.5
10h46	35.4	35.1
11h21	35.6	35.2
11h58	36.1	34.6
13h39	36.4	35.7
14h07	35.7	34.9

Lessons learned from infrared thermography

- Many factors influence heat emission (activity, stress, ambiant T°, ...)
- Adjustment needed for summer
- Rapid and non invasive method
- No animal handling
- Precise and can be affordable



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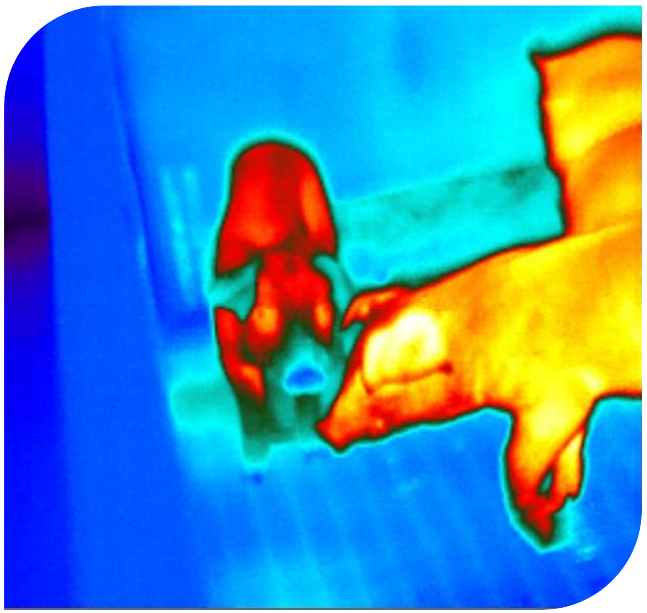
Potential applications in pig production

- Identification of sick animals
- Assessment of the level of activity or stress
- Indicator of feed efficiency
- Relationship with the quality of the meat (pre-slaughtering stress)



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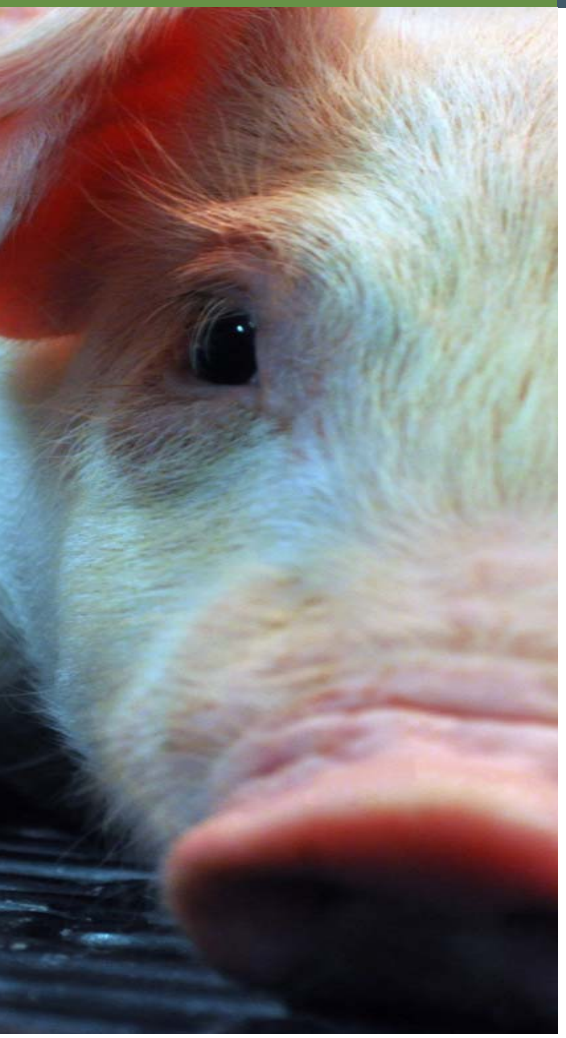

Vision system to evaluate weight and conformation

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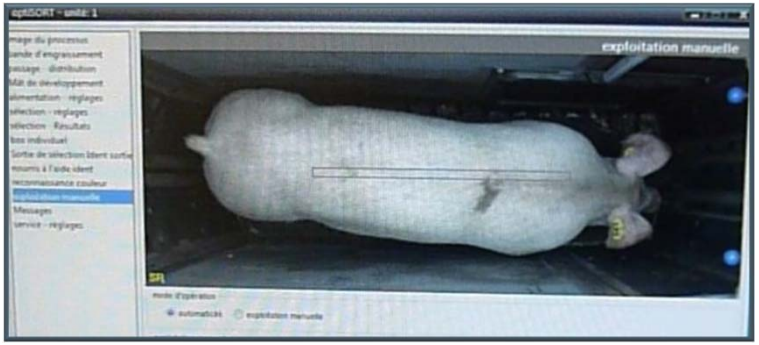
Vision system to evaluate weight and conformation

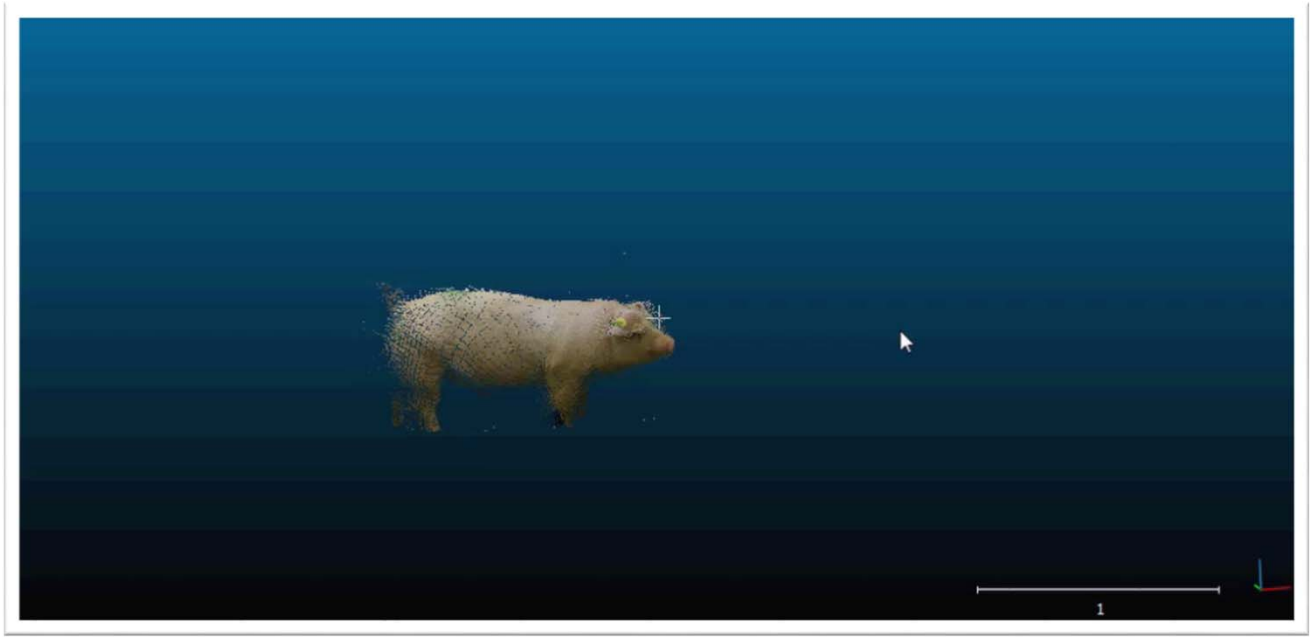
- 3 systems tested
  (1- OptiSORT (Hölscher+Leuschner))
  - 2D version in 2014
  - Hog sorting system
  - Weight + primal cuts



Source: http://www.hl-agrar.de/files/19H+L_optiSORT.pdf

Vision system to evaluate weight and conformation

- 3 systems tested (Kinect cameras)



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Vision system to evaluate weight and conformation

- 3 systems tested (PigWei)
  - From Ymaging (Spain)
  - Real time data analysis
  - Version 1 tested (videos)
  - Version 2 under development (images)

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Results from the CDPQ's research

	Weighting scale	Optisort	Kinect system	PigWei
Trial	Sept 2014	Sept 2014	Sept 2015	2017
Number of pigs	72	72	35	90
Average body weight	95.6 kg	95.6 kg		…
Average half carcass weight			52.6 kg	…
Standard deviation	0.63 kg	2.85 kg	1.9 kg	…
Coefficient of variation	0.659%	2.98 %	3.61 %	…

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Lessons learned from vision system

- Benefits for weighing:
  - No animal handling
  - Less stress and injuries (welfare)
  - Rapid and flexible measurements
- Other benefits:
  - Prediction of primal cuts yield
  - Relationship with other traits
    - Carcass quality
    - Lean yield
    - Feed efficiency
- Some imprecision of weight prediction from volume

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Potential applications in pig production

- Kinect cameras:
  - Not very user friendly in commercial farms
  - Development needed from image capture to image analysis
- OptiSORT
  - Hog sorter (following manifacturer specifications)
  - New version (3D, lean meat, carcass quality)
- PigWei
  - Technology may be able to replace human eye
  - Algorithm already functional in Spain
  - Development needed for Canadian breeds

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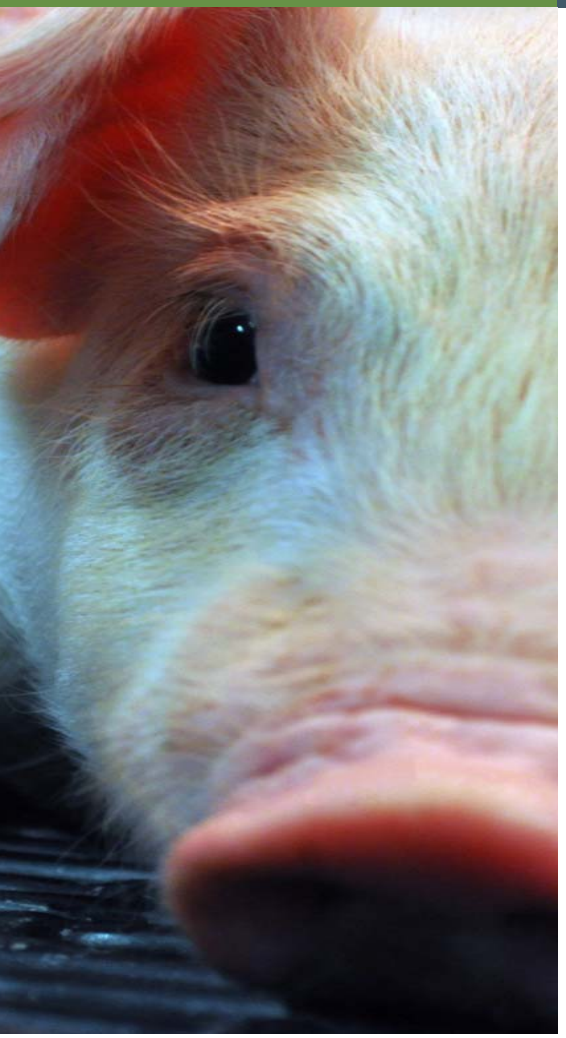

Tracking system to assess behaviour

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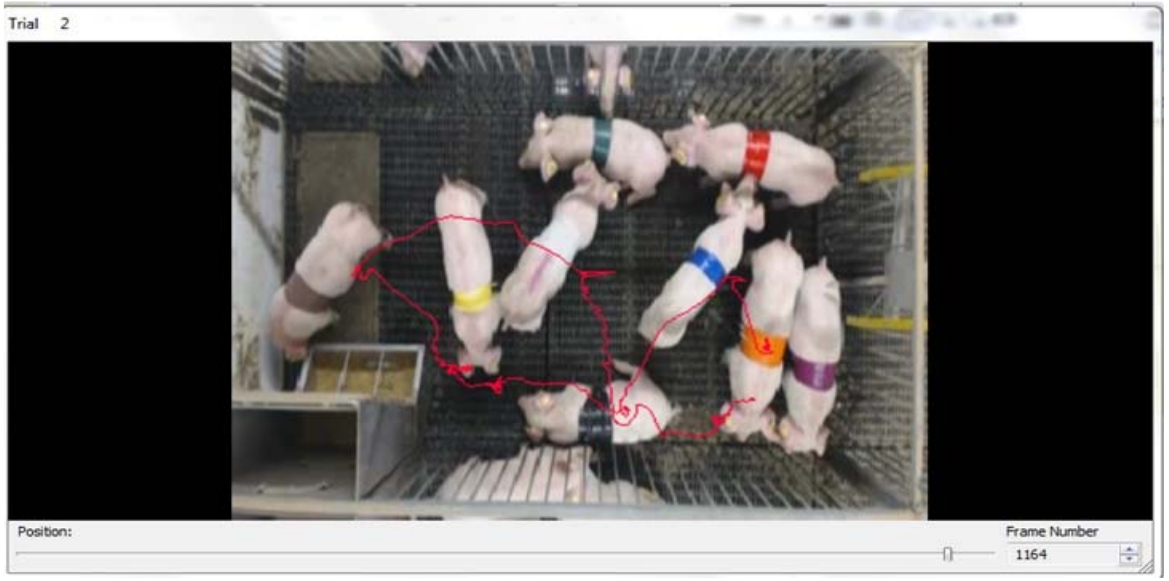
Tracking system to assess behaviour

- Software «EthoVision XT Noldus Information Technology »
  - Nursery
  - Colour tape



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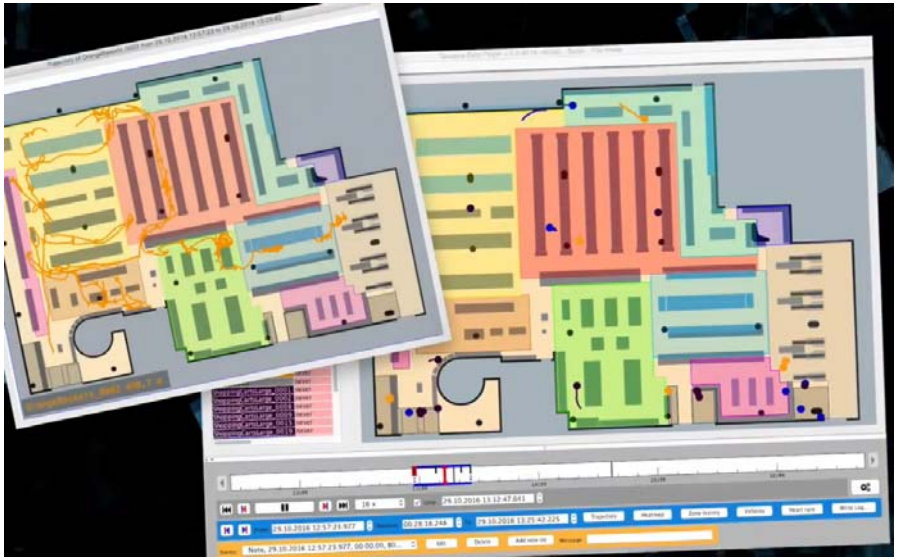
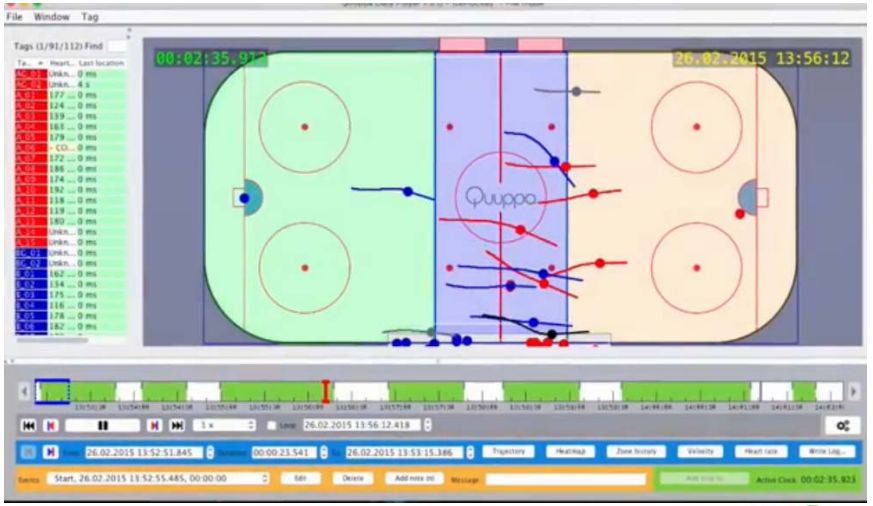
Tracking system to assess behaviour

- Quuppa system installed in October 2017





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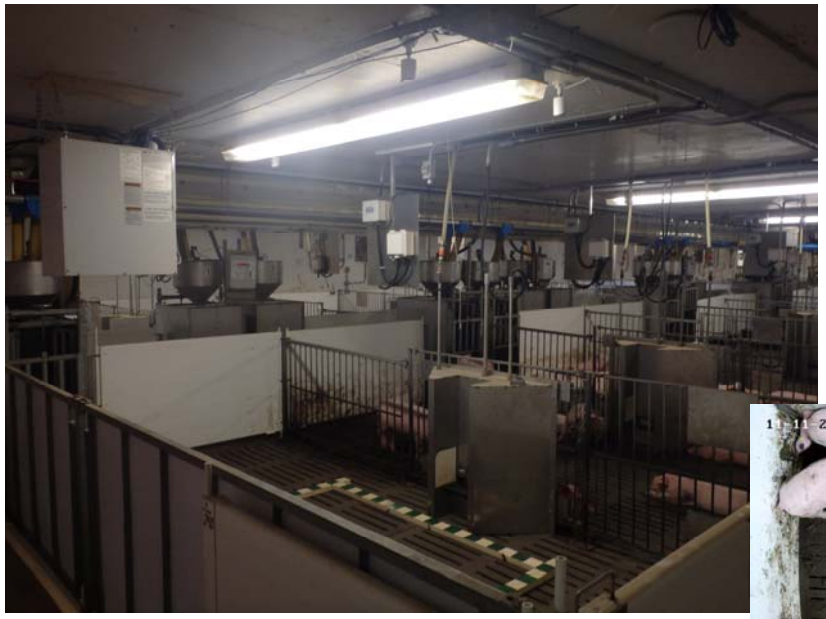
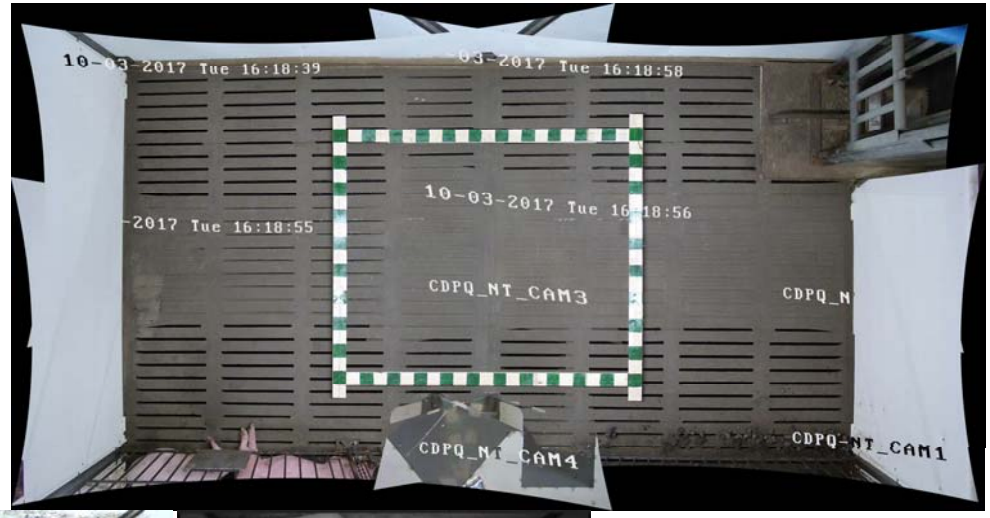
Tracking system to assess behaviour

- TrendNet Cameras





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Potential applications in pig production

- New phenotypes:
  - Active and inactive time
  - Velocity and acceleration
  - Time spent in a zone and number of visits
  - Number of contacts with an object or other pigs
- Assessment of behaviour, activity level, stress, etc.
- Identification of sick animals

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Conclusion

- The challenges from technologies
  1. Long time horizon for technology development & innovation
  2. Data analysis and interpretation of the results
  3. The technology not an end in itself
  4. Many technologies under development
     - Ex: More than 10 technologies for body fat measurement

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Thank you!

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