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

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• Introduction

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

• Conclusion
Deschambault Station

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

- Recording system
  - Created by the CDPQ in 2013
  - Measures water consumption per pig
  - Individual identification system
  - Installed in 28 pens
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.)
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.
• 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
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
Infrared thermography
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.)
Daily mean (24h rolling average) max $T^\circ$ for one replicate
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 thermography (project 2)

Infrared camera FLIR A325sc

Infrared camera FLIR AX8
Infrared thermography (project 2)

Infrared camera FLIR A325sc

Infrared camera FLIR AX8
Infrared thermography (project 2)

- $T^\circ$ 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

<table>
<thead>
<tr>
<th>Time</th>
<th>A325 Temperature ($^\circ$C)</th>
<th>AX8 Temperature ($^\circ$C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6h16</td>
<td>35.4</td>
<td>35.4</td>
</tr>
<tr>
<td>6h35</td>
<td>36.0</td>
<td>35.2</td>
</tr>
<tr>
<td>7h07</td>
<td>36.1</td>
<td>34.8</td>
</tr>
<tr>
<td>9h44</td>
<td>36.5</td>
<td>35.3</td>
</tr>
<tr>
<td>10h00</td>
<td>36.4</td>
<td>35.1</td>
</tr>
<tr>
<td>10h30</td>
<td>36.0</td>
<td>35.5</td>
</tr>
<tr>
<td>10h46</td>
<td>35.4</td>
<td>35.1</td>
</tr>
<tr>
<td>11h21</td>
<td>35.6</td>
<td>35.2</td>
</tr>
<tr>
<td>11h58</td>
<td>36.1</td>
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</tr>
<tr>
<td>13h39</td>
<td>36.4</td>
<td>35.7</td>
</tr>
<tr>
<td>14h07</td>
<td>35.7</td>
<td>34.9</td>
</tr>
</tbody>
</table>
Lessons learned from infrared thermography

- Many factors influence heat emission (activity, stress, ambient T°, ...)
- Adjustment needed for summer
- Rapid and non invasive method
- No animal handling
- Precise and can be affordable
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)
Vision system to evaluate weight and conformation
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)
• Kinect 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)
### Results from the CDPQ’s research

<table>
<thead>
<tr>
<th></th>
<th>Weighting scale</th>
<th>Optisort</th>
<th>Kinect system</th>
<th>PigWei</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of pigs</td>
<td>72</td>
<td>72</td>
<td>35</td>
<td>90</td>
</tr>
<tr>
<td>Average body weight</td>
<td>95.6 kg</td>
<td>95.6 kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average half carcass weight</td>
<td></td>
<td></td>
<td>52.6 kg</td>
<td></td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.63 kg</td>
<td>2.85 kg</td>
<td>1.9 kg</td>
<td></td>
</tr>
<tr>
<td>Coefficient of variation</td>
<td>0.659%</td>
<td>2.98 %</td>
<td>3.61 %</td>
<td></td>
</tr>
</tbody>
</table>
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
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 manufacturer 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
Tracking system to assess behaviour
Tracking system to assess behaviour

- Software «EthoVision XT Noldus Information Technology »
  - Nursery
  - Colour tape
- Quuppa system installed in October 2017

Tracking system to assess behaviour
Tracking system to assess behaviour

• TrendNet Cameras
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
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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