How Artificial Intelligence can help developing multi-function sensors for livestock monitoring

Digital farming

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Vision

Connect farmers
Improve their productions
Respect the environment
Skills

- Process based crop modeling
- Modeling animal behaviour
- Artificial Intelligence

Software conception / Platform

- UI/UX

IoT - Data

- Data analytics
- Machine Learning

Coaching / Training / Platform support

Integration

IT - Design

In brief

- 15 years of experience
- + 100 employees
- 10M€ turnover
- 2 patents
- 10 exclusive crop models
- 4 proprietary solutions

Main customers & partners

General presentation 2019
**Main Field**

- **Annual crops**
  - Wheat
  - Soybean
  - Cotton
  - Corn
  - Rice

- **High value crops**
  - Almonds
  - Grapevine
  - Cacao

- **Animal farming**
  - Dairy cows

*General presentation 2019*
CHALLENGE
Wearable Sensors for livestock monitoring: When cows turn to Christmas trees...

Location of engineered devices for in situ data collection in a cow: (1) ear tag, (2) halter, (3) neck collar with counterweight, (4) reticulorumen bolus (in reticulum), (5) rear leg pedometer, (6) upper tail ring, (7) tail head inject, and (8) vaginal bolus. (Caja et al, 2016)
• Many potentially interesting information for performance monitoring (feeding & reproductive)
• But economical nonsense with mono-function sensors:
  o Current cost : +- 50-100€/sensor : acceptable only for dairy cows
  o Prices may be significantly reduced only with larger production series
  o First (and still most common) use cases : heat and vealing detection (periodic monitoring => farmers buy only 1 sensor for 3 or 4 cows

Need to develop continuous use cases & concentrate more functions on each sensor
OBJECTIVES

Heat’Live® (Heat detection):

A well known sequence of typical and visible behaviours

Heat’Live® (Heat detection):

A (fairly) clear signal: classical signal processing (human expertise)

Feed’Live® (Feeding behaviour monitoring):

Feeding time

A weaker and more ambiguous signal, but still processable with human expertise

Ruminating time

Feed’Live® (Feeding behaviour monitoring):

No periodicity, weaker and more variable signal
Towards a multi-function sensor : Third Step (2019)

Vel’Live® (Calving detection) :

No typical body movement (except for the tail), may happen while the cow is up or lying down
Towards a multi-function sensor: Third Step (2019)

Vel’Live® (Calving detection):

Weak and ambiguous signal, variable patterns: deep learning required!
Provisional conclusion (autumn 2019)

• Thanks to deep learning:
  o Neck mounted accelerometer delivers all main services for livestock monitoring
    ✔ Heat detection
    ✔ Calving detection
    ✔ Feeding behaviour
  o Without any change in hardware or embedded software
  o The majority of new customers now buy a collar for each cow (instead of 1 for 3 or 4 cows) → important cost reduction

• Next steps:
  o Early disease detection
  o Redesign to cost with higher production objectives
Provisional conclusion (autumn 2019)

😊 Thanks to deep learning:
  • Science « direct from farm »

❌ Because of deep learning:
  • « Loss of control » on algorithms:
    o Uncontrolled dependence from context (race, farming techniques)
    o No real « economies of scale » when adapting to new domains
Thank you for your attention!

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