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

DATAIA Days « Life Sciences & AI »
2019 - 12 - 04

itk

Vision

Connect farmers
Improve their productions
Respect the environment

Skills

IA - Modeling

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

IT - Design

- Software conception / Platform ☐
- UI/UX ☐

IoT - Data

- ☐ Data analytics
- ☐ Machine Learning

Integration

- Coaching / Training / Platform support ☐
- Interoperability ☐

In brief

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

Main customers & partners

BAYER — Bayer CropScience · LAND O'LAKES, INC. · verizon

MARS · syngenta · SOFiPROTEOL

AGROSUD · CCPA · GROUPE Seenergi CONSULTING & INNOVATION

Main Field

2 500 000 Ha of connected crops

350 000 connected cows

Annual crops

Wheat   Soybean   Cotton   Corn   Rice

High value crops

Almonds   Grapevine   Cacao

Animal farming

Dairy cows

Animal farming

FarmLife®
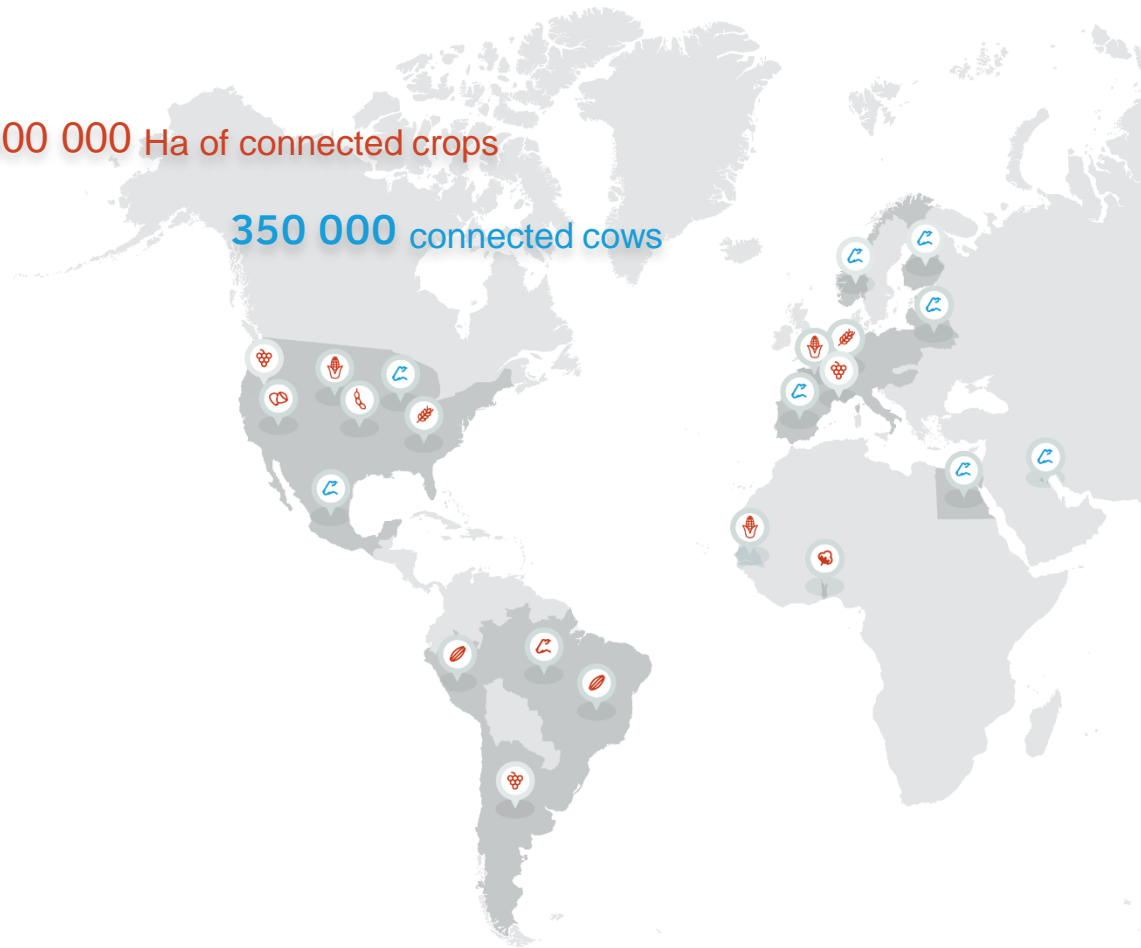
eMonitoring solutions 100% connected
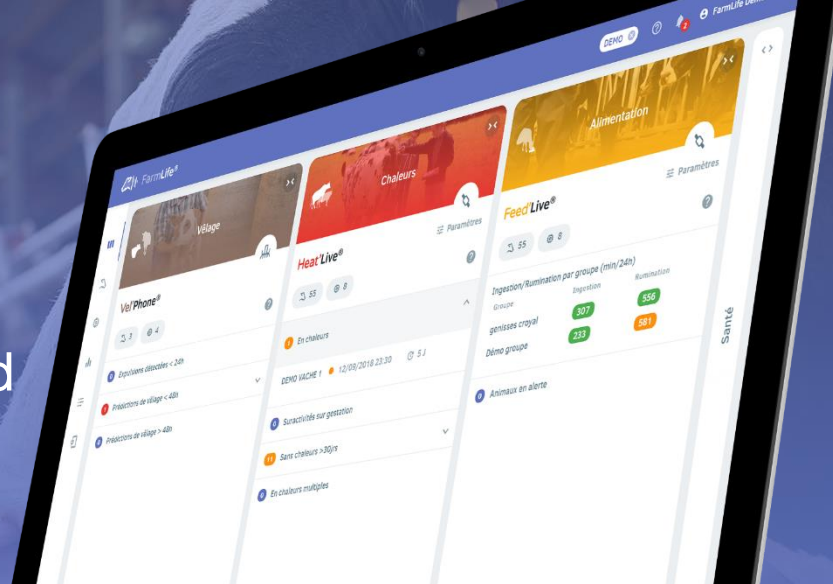
| Calving | Heat | Nutrition | Health | Well-Being |

Wearable Sensors for livestock monitoring : When cows turn to Christmas trees…

Calving detection
(Vaginal thermometer)

Heat detection
(Accelerometer)

Location

Calving detection
(Accelerometer)

Feeding Behaviour
(Accelerometer, microphone)

Rumen temperature, pH
(Bolus thermometer)

Lameness
(Podometer)
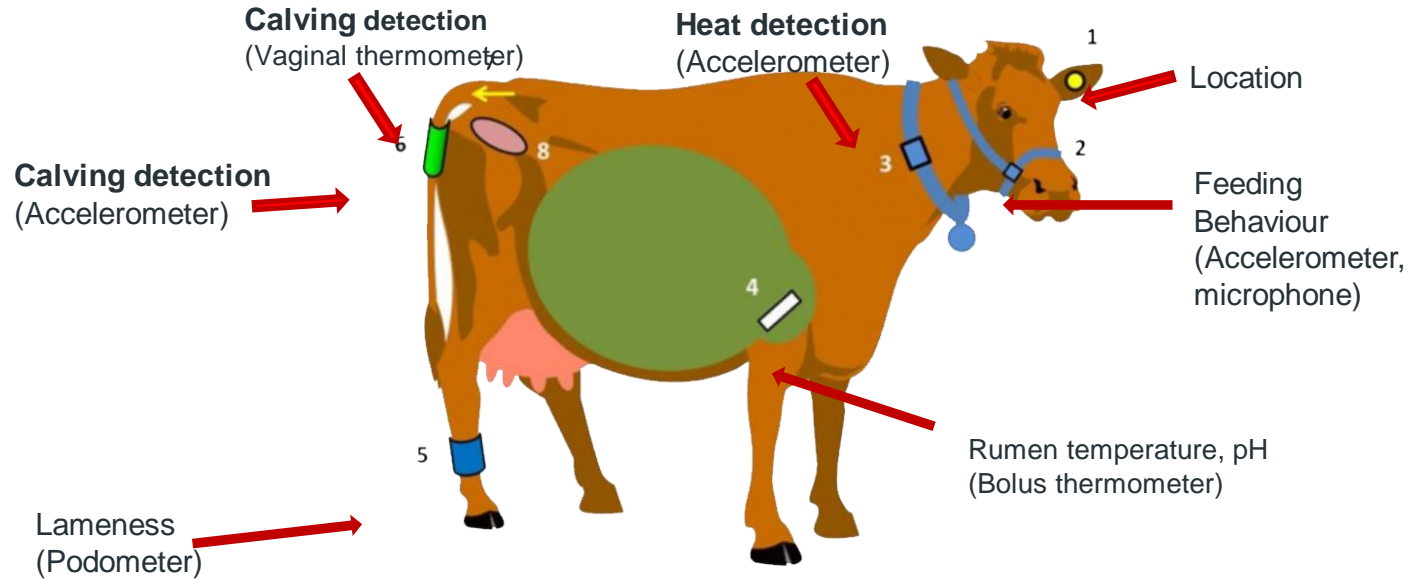
Location of engineered devices for in situ data collection in a cow : (1) ear tag, (2) halter, (3) neck collar with counterweight, (4) reticulorumen bolus (in reticulum), (5) rear leg pedometer, (6) upper tail ring, (7) tail head inject, and (8) vaginal bolus. (Caja et al, 2016)

Wearable Sensors for livestock monitoring :
When cows turn to Christmas trees…

- Many potentially interesting information for performance monitoring (feeding & reproductive)

- But economical nonsense with mono-function sensors :
  - Current cost : +- 50-100€/sensor : acceptable only for dairy cows
  - Prices may be significantly reduced only with larger production series
  - 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

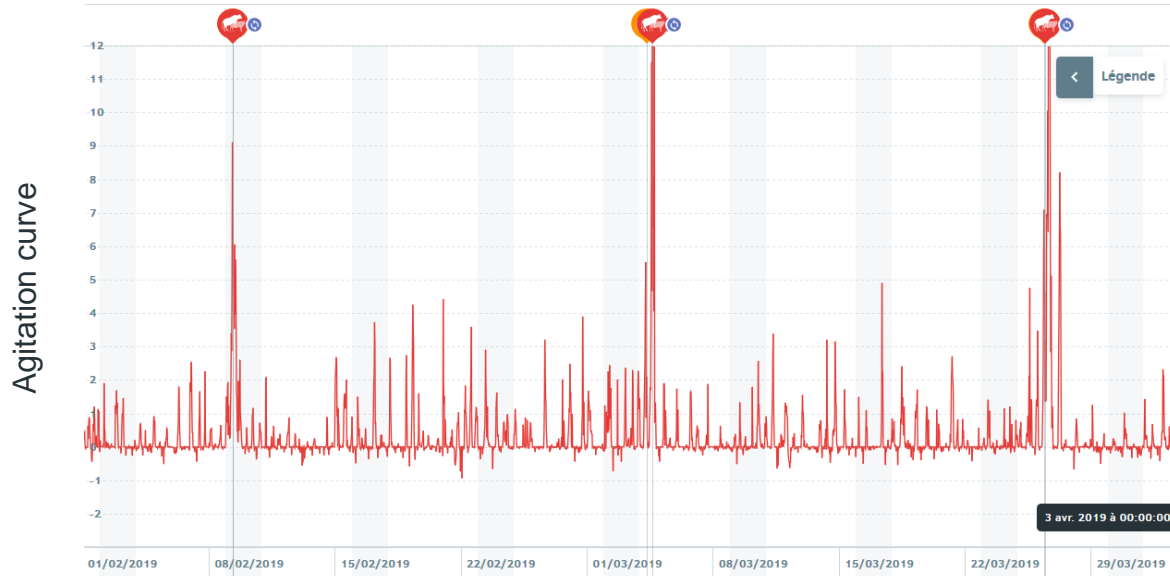# Towards a multi-function sensor : First Step (2010)

Heat'Live® (**Heat detection**) :

| BIENTÔT EN CHALEUR | OESTRUS (vraies chaleurs) | FIN DES CHALEURS |
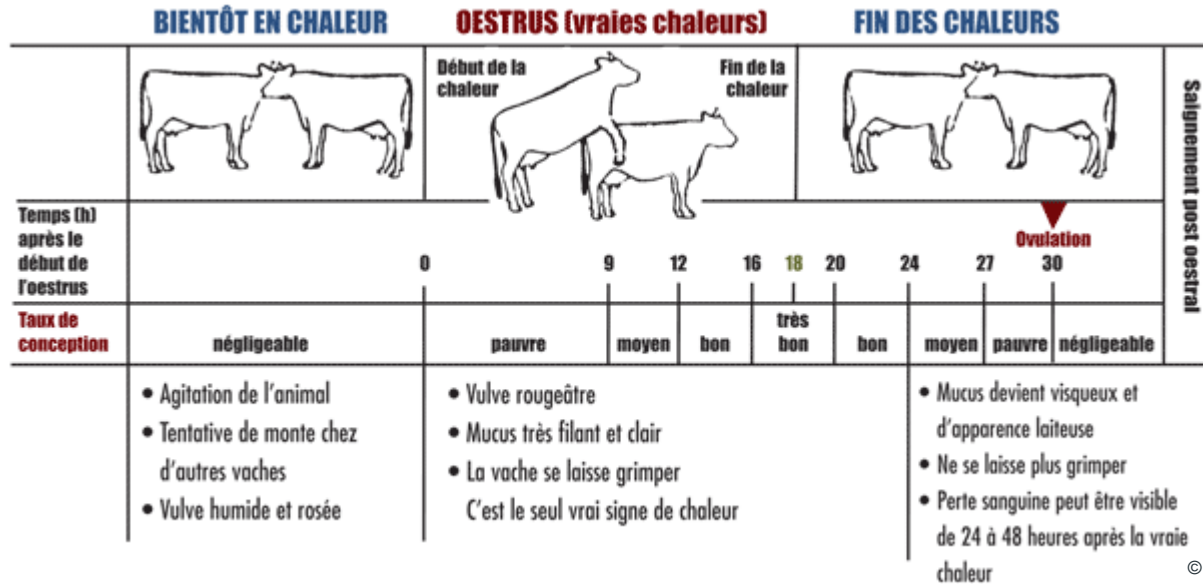
A well known sequence of typical and visible behaviours

Towards a multi-function sensor :
First Step (2010)

Heat'Live® (**Heat detection**) :

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

Towards a multi-function sensor :
Second Step (2014)

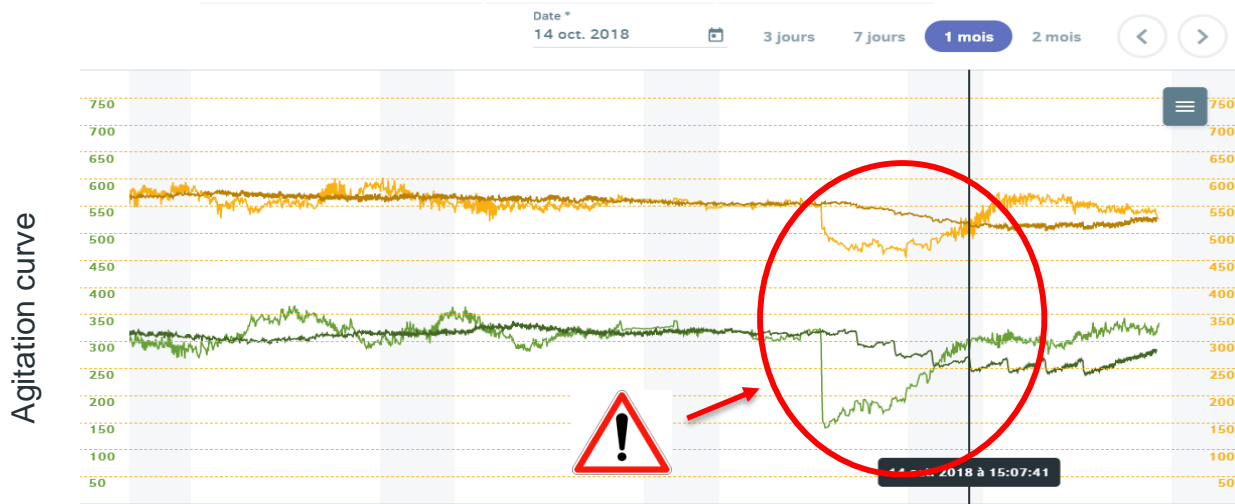**Feed'Live®** **(Feeding behaviour monitoring) :**

Feeding time

Ruminating time

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

Towards a multi-function sensor :
Second Step (2014)

Feed'Live® **(Feeding behaviour monitoring) :**

No periodicity, weaker and more variable signal

Towards a multi-function sensor :
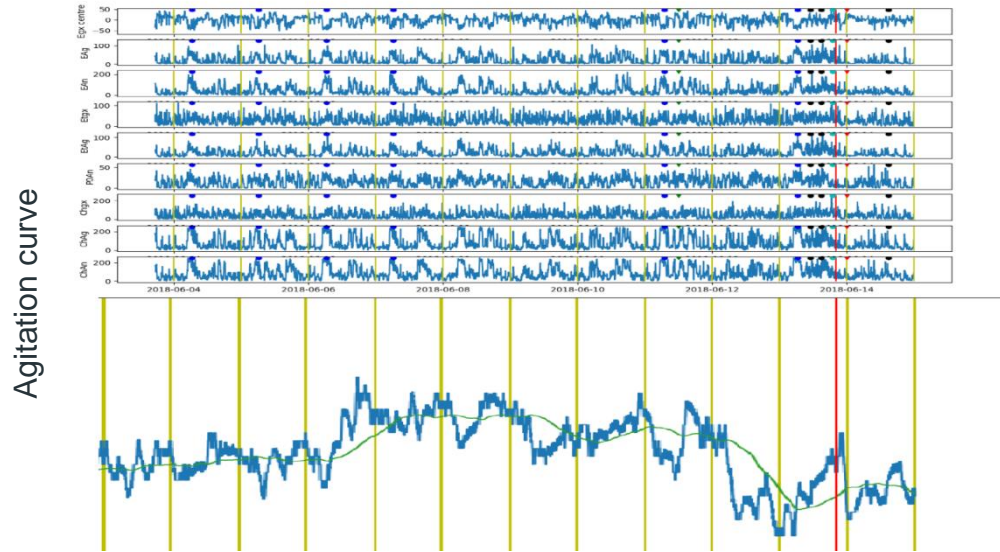# Third Step (2019)

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

- **Next steps :**
    - **Early disease detection**
    - **Redesign to cost with higher production objectives**

Provisional conclusion (autumn 2019)

☺ **Thanks to deep learning :**

➔ Science « direct from farm »

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☹ **Because of deep learning :**

➔ « Loss of control » on algorithms :

- ○ Uncontrolled dependence from context (race, farming techniques)
- ○ No real « economies of scale » when adapting to new domains

Let's keep in touch

Philippe STOOP
Directeur Recherche & Innovation
Membre correspondant
de l'Académie d'Agriculture de France

CAP ALPHA Avenue de l'Europe
34830 Clapiers – France

✉ philippe.stoop@itk.fr

📞 +33(0)6 70 02 90 17