Real-time monitoring of animals

Precision Livestock Farming (PLF)

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M3-BIORES Catholic University Leuven

(Measure, Model & Manage Bio-Responses)

Hülsenberger Gespräche 2018
June 12 – 13 Hamburg
Overview

• KU Leuven - Team
• What is Precision Livestock Farming?
• Examples
• Conclusions
Katholieke Universiteit Leuven (°1425)

Leuven
- 25 km North East of Brussels
- 100,000 inhabitants

K.U.Leuven
- > 56,000 Students
- 1,440 Professors
- 5,601 Researchers
- 2,830 Administrative and technical staff

University Hospitals
- 8,434 Clinical staff
M3-BIORES KU Leuven
Measure, Model & Manage BioResponses

310 A-Publications
389 Conference papers
48 contracts with international research partners

17 products
2 spin-off companies
15 patents

M3-BIORES
Real-time modelling of individuals

- 2 professors, 4 Post Docs
- 25 – 30 Ph d students
- 20 – 25 Mastertheses/year

2016
M3-BIORES → A2H-Health
Physiology – immunology - genetics

- 7 professors
- 60 Ph d students
- 40 mastertheses/year
Challenges for livestock production

- 65 billion animals are slaughtered every year
- Worldwide demand for animal products increases with up to 75% by 2050? (global per capital income doubles, population growth, changing diets)
- **Health:** Relationship between animal health and healthy food
- **Animal welfare** (e.g. EU)
- **Environmental Issues**
- **Social importance**
- **Economic importance** including Valorisation of knowledge
What is Precision Livestock Farming (PLF)?
Precision Livestock Farming

Tool for the **management** of livestock by continuous automated real-time monitoring of production/reproduction, health and welfare of livestock and environmental impact.
A living organism is a CITD system
A living organism:
Living organisms are ...
...individually different
A living organism:

- Complex
- Individual

N

Time

δ_Individual

δ_population

Av_population

Response variable
A living organism:

- Complex
- Individual
- Time-Varying

Example: Heat production of broiler chickens

**5 days old**

**30 days old**

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MEASURED

MODELLED (1ST ORDER)

MODELLED (2ND ORDER)
A living organism:

**Complex**  **Individual**  **Time-Varying**  **Dynamic**

Living organism = CITD - system

1. Measure
2. Model
3. Monitor & Manage

In an on-line way
In real-time

**M3-BIORES**
Trajectory M3-BIORES approach

Mussel, fish, mice

1991

Insects

1998
Farm animals: PLF

2004

2001

Horses

Humans

M3-BIORES KU Leuven
Examples of PLF Technology: What is possible today?
Example: Infection Monitoring by On-line Pig Sound Analysis

i.c.w. University of Milan, SoundTalks NV, Fancom BV
Health monitoring by on-line sound analysis:
Results  Soundtalks & Boehringer Ingelheim

Animals treated

Animals upon entering

Pigs ill again

Animals again ill
Example: Continuous automated monitoring of feed intake of broilers by sound technology
Continuous recording of sounds (top) and individual pecking sounds (bottom) as extracted by the algorithm.
The relation between number of peckings and feed intake of chickens

Number of Peckings per Minute

Feed Intake per Minute (g)

Time (minute)
Example: Real time monitoring of problems in a broiler house

i.c.w. Fancom BV
eYeNamic monitor tool

Farm manager

Farm network

Camera network

Image pre-processing

Monitoring software
• Detecting malfunctioning in broiler houses
• Produce alarms in real-time when malfunctioning happens (in feeder or drinker lines, light, climate control, etc.)
Farmer logbook and manual video observation as references
Measured vs. modelled animal distribution

Prediction window: 1 light period = 5 hours
Event detection

Feeder line

Defect Feeder line

Measured values
Smoothed values within 25% range
Smoothed values out of 25% range
Predicted values

Normal situation

Problem in feeding lines

Date (dd/mm)
Detected events in the validation experiment over 42 days

**Conclusion**: 95 % of all events were detected based upon real-time monitoring of animal behaviour.
Some other examples
Cow lameness monitor: i.c.w. Volcani, DeLaval, Wur

Scratching behaviour: Ughent, ILVO

Aggression monitor: Umil, TIHO, Fancom BV

Weight estimation: Fancom BV, Agrifirm
Real Time Stress Monitoring
Total performance = Mental performance + Physical performance
Objective measure for Performance

Under-motivation
Laid back
Anxious
Distress
Optimal Performance
Eustress

Performance
% Stress

LAP TIME (min.)
LAP STRESS (%)

KU Leuven - BioRICS
Real-time stress management

![Diagram showing the relationship between stress levels and performance, with categories for Calm, Eustress, Distress, and Distraction.](image)

- **DISTRACTION**
- **Optimal performance**
- **DISTRESS**

![Image of a race car and pit crew](image)

**Graph showing Lap Time (s) vs. Lap Stress (%)**

- **Distressed**
- **Focused**
- **Distracted**

Timeline from 13:40 to 14:10
Focus zone
Brave new world:

Mental status of animals:

Monitoring animal welfare
Real-Time Frustration Monitoring

Physical stress (bpm)

Mental stress (bpm)

Time (s)
Real-time animal welfare monitoring
(livestock, companion animals)

Existing BioRICS Stress Level Monitoring

Existing Sensixa eAr-sensor

New technology Delivers:
• Realt Time Stress Level Monitoring
• Real Time adaptive Algorithms
• Wireless connection & recharging

(Patent granted)
Conclusions

• Fully automated continuous real time detailed monitoring and management of humans and animals becomes a reality.
• PLF brings the farmer to the individual animal that needs his/her attention, active management tool.
• PLF is a tool that helps farmers and stakeholders to realise more sustainable livestock production.
• Worldwide implementation of PLF needs more collaboration between industry, researchers, farmers and stakeholders.
• Development of PLF products needs real collaboration between disciplines.
Thanks for your attention!

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Questions?