

Prediction of poor health in small ruminants and with accelerometers and machine learning

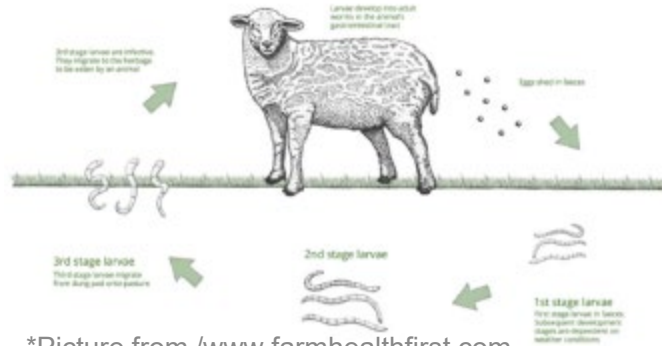
Montout et al., bioRxiv 2024

<https://www.biorxiv.org/content/10.1101/2020.08.03.234203v4...>

Environmental sustainability and net-zero



Haemonchus contortus infection and FAMACHA



*Picture from [/www.farmhealthfirst.com](http://www.farmhealthfirst.com)



*Picture from zootecniaativa.com



FAMACHA Transition

FAMACHA Evaluation A
Score 1

FAMACHA Evaluation B
Score 2

Day1 Day2 Day3 Day4 Day5 Day6 Day7 Day8 Day9 Day10 Day11 Day12

First Transition label: 1To2

FAMACHA Evaluation C
Score 2

FAMACHA Evaluation D
Score 1

Day13 Day14 Day15 Day16 Day17 Day18 Day19 Day20 Day21 Day22 Day23 Day24

Second Transition label: 2To2

Third Transition label: 2To1

Data Acquisition and Hardware



Base station:

- Range >1 Km (clear sight)



Sensor main components:

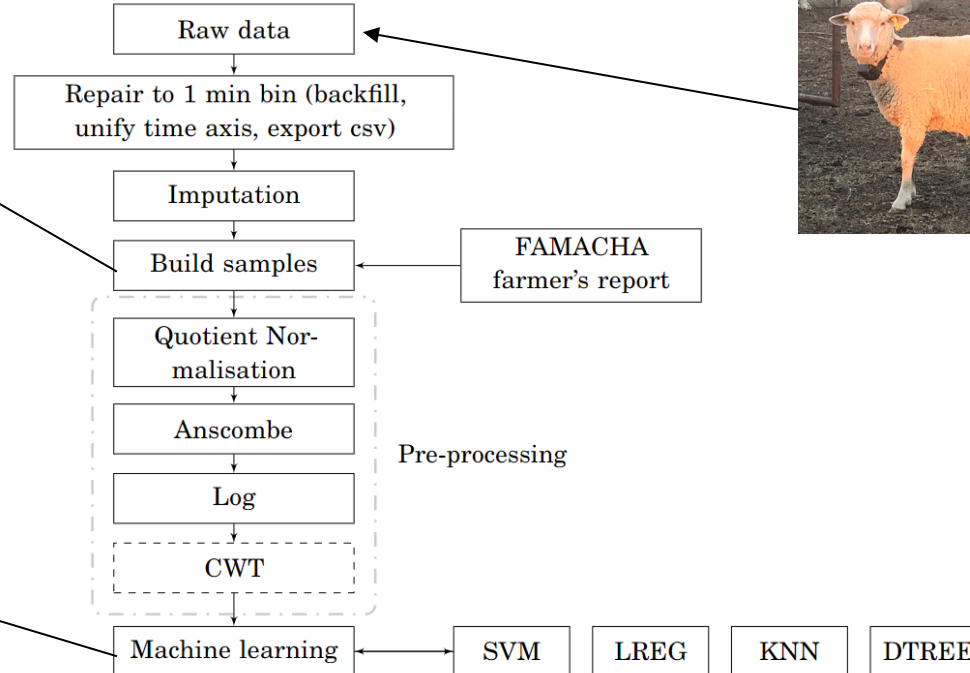
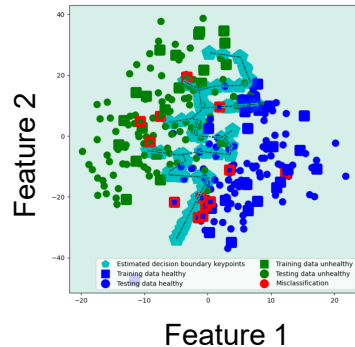
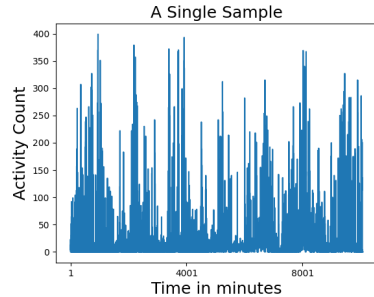
- Accelerometer.
- RFID communication chip.
- Battery.



Table 1. Characteristics of the study group

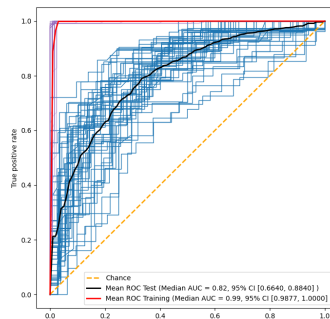
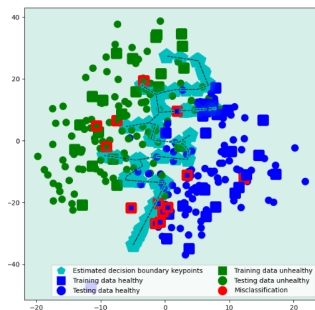
	Cedara	Delmas
Data collection period	April 2012 to July 2013	March 2015 to April 2016
Species	Goat	Sheep
Animals tagged	227	64
Tag type	Accitrack v1	Accitrack v2
Age range	2-6 years	2-6 years
Average weight	44.19 kg	72.79 kg
FAMACHA evaluation	fortnightly	weekly
Animals evaluated	64	31
FAMACHA 1 → 1	31.9%	34.9%
FAMACHA 1 → 2	12.8%	18.3%
FAMACHA 2 → 1	13.5%	18.4%
FAMACHA 2 → 2	13.9%	28.2%
FAMACHA 3+	28.8%	0.2%

Machine learning Pipeline



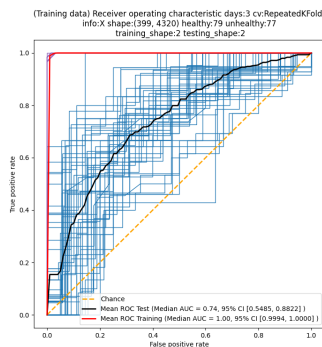
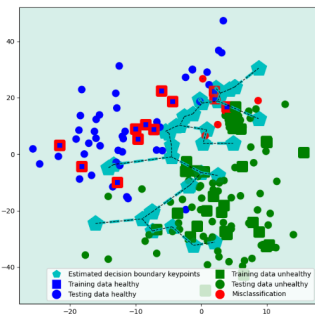
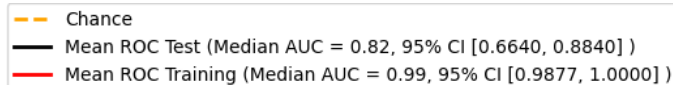
Classification of health status with SVM

Healthy class: FAMACHA 1To1
Unhealthy class: FAMACHA 2To2



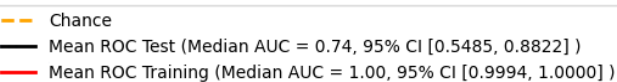
Class 1To1: 156
Class 2To2: 146

Precision class healthy: 0.75%
Precision class unhealthy: 0.73%



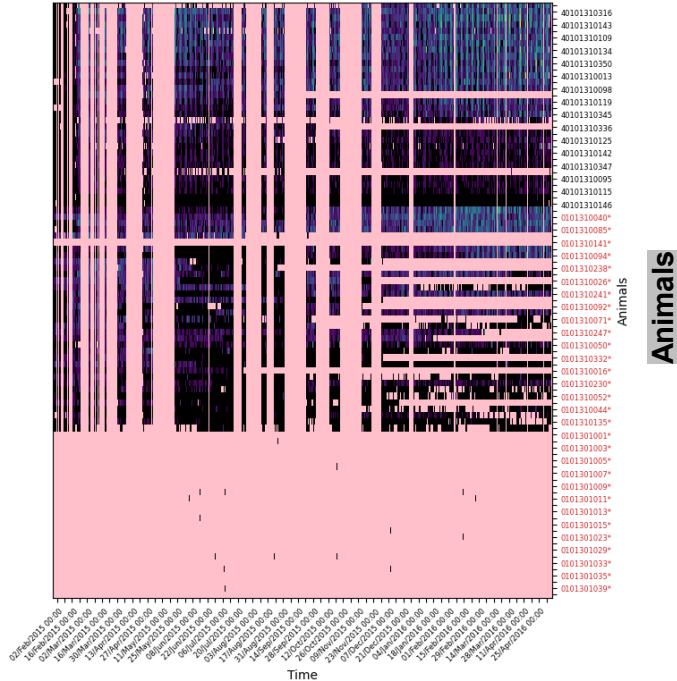
Class 1To1: 79
Class 2To2: 77

Precision class healthy: 0.66%
Precision class unhealthy: 0.66%



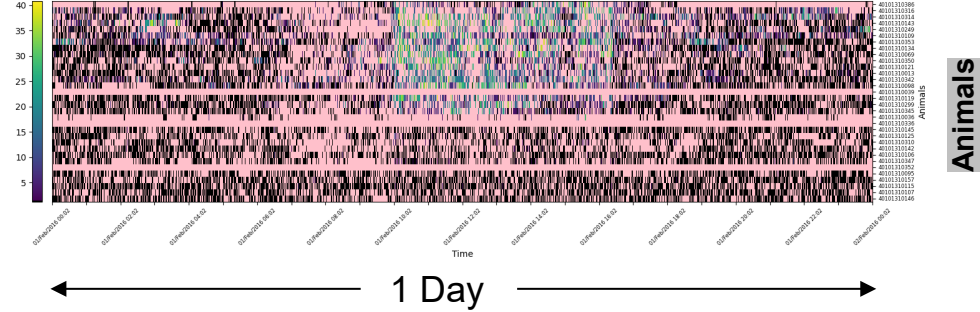
Need for Imputation

Delmas Herd First_Sensor_Value Data (T=Anscombe Bin=60T) And Samples



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Delmas Herd First_Sensor_Value Data (T=Anscombe Bin=1T) And Samples



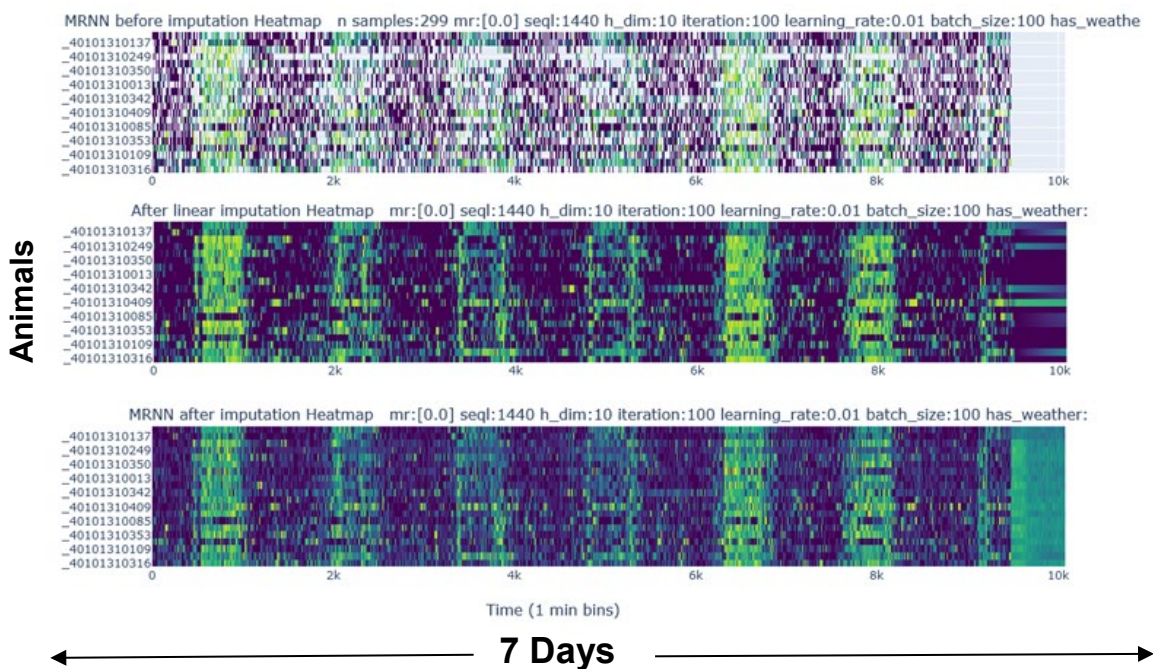
Causes of Missing Data:

- Long periods with no data due to data administrator oversight.
- Drop of information packets during transponder-base station communication.

Importance of Data Imputation:

- Data imputation is essential for optimal functioning of the ML pipeline in predicting animal health.

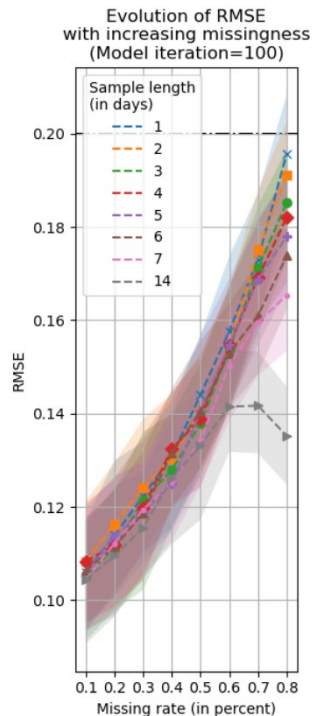
MRNN* Imputation VS Linear Interpolation



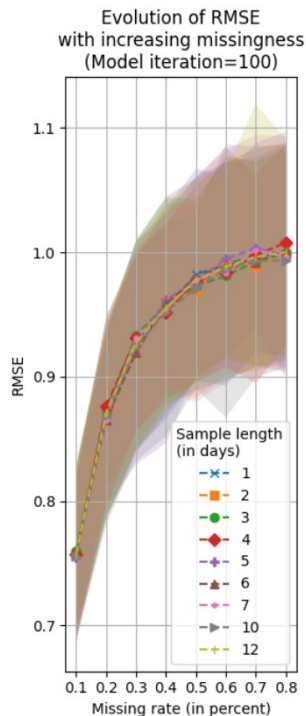
- MRNN learns what a typical day in the herd looks like

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B –MRNN

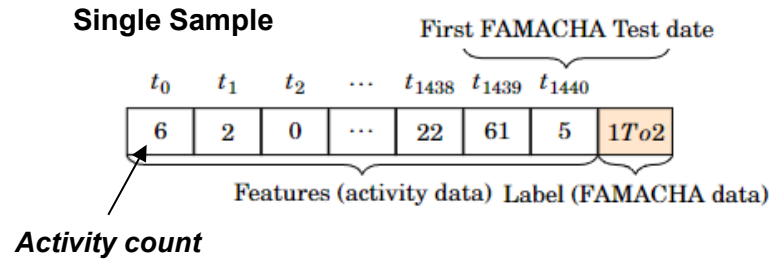


C –Linear interpolation



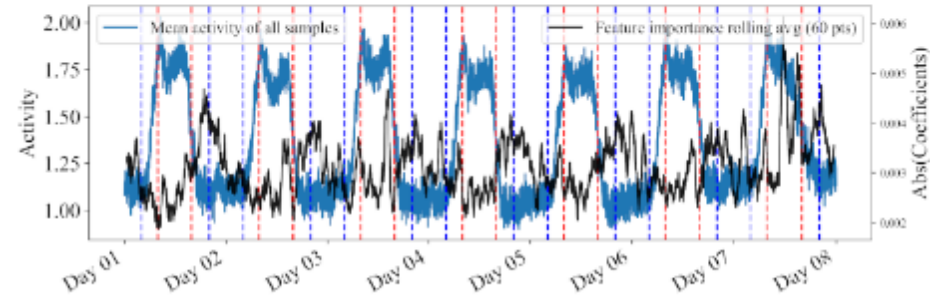
* <https://ieeexplore.ieee.org/document/8485748>

Machine Learning Sample

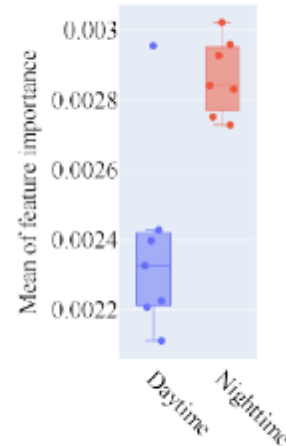


Feature Importance and Interpretation (Linear SVM)

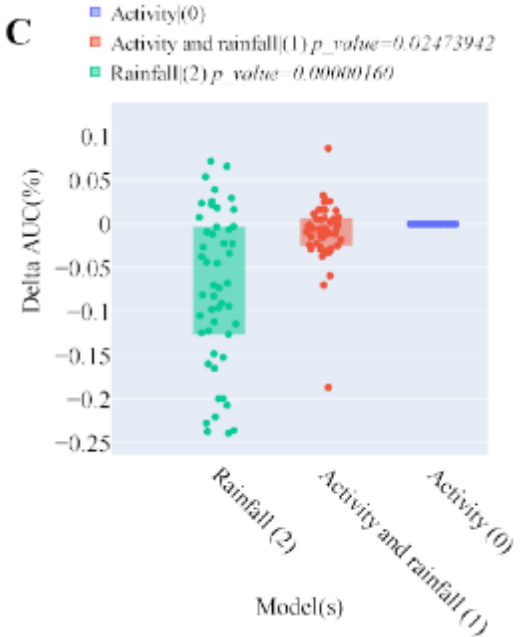
A



B



C



Sum up & on the field application

Promising results but not enough samples for generalisation.

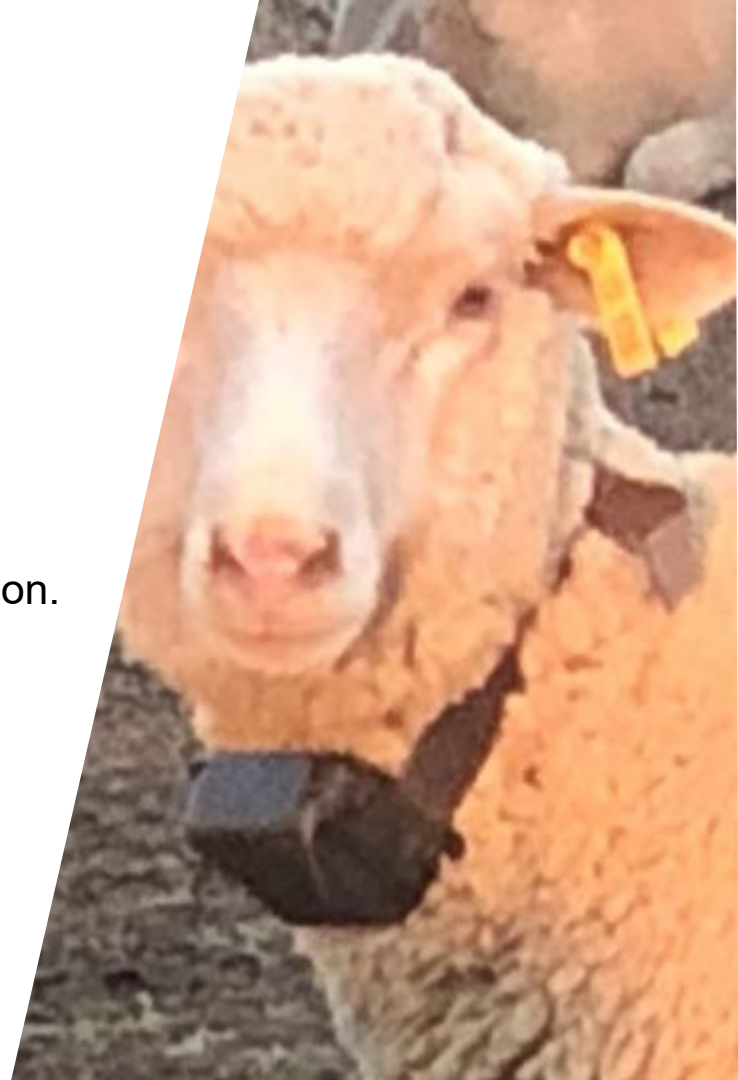
Unbalanced dataset.

On-farm Training period.

Online learning.

Data acquisition was difficult.

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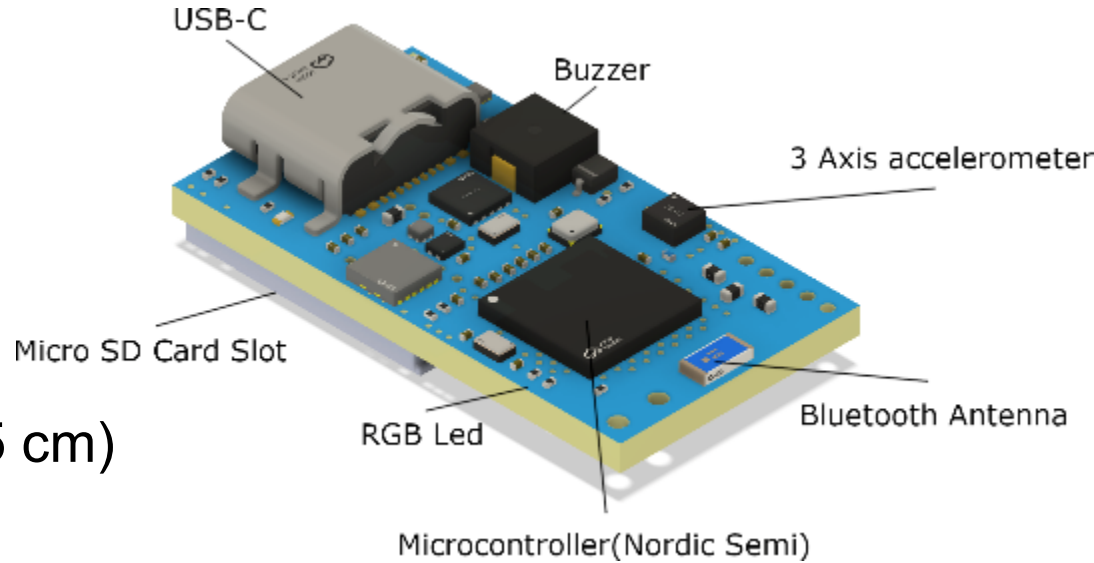


New Open-source sensor

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- Small form factor (3 cm x 1.5 cm)
- On Board Memory (SD)
- Raw data access
- Fully programable
- Bluetooth

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