Using a commercial precision livestock farming sensor to record dairy cows' behaviour at pasture

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Introduction

Development of PLF tools represents a new

way to acquire data for research purposes

Need to perform validation studies of these devices

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Objectives

Validate data output from a commercial precision livestock device (Axel Medria ®) to record dairy cows' behaviour at pasture, without knowledge on the algorithm used by the manufacturer.

Studied behaviours :

Ruminating

Grazing

Resting
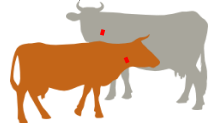
Posture (standing vs lying)

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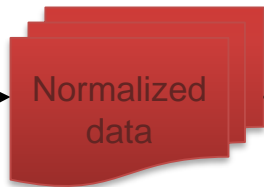
Materials and methods

Axel Medria ® :
- ❖ Tri-axial accelerometer
- ❖ Collar neck mounted

Animals :
- ❖ 3 Holstein ans 3 Montbeliardes
- ❖ Only grazing (no concentrate or roughage feed)

Data processing

Normalized data

Dataset for comparison
82k registrations

6 x 5 hours/cow
→ *180h*

Continuous focal sampling data

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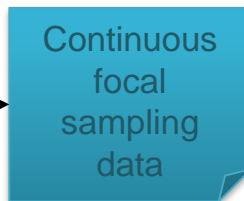
What is « normalized data » ?

A dataset that gives cow's main activity every 5 minutes :

Grazing – Ruminating – Resting – Standing - Other activity

| animal_id	device	date (UTC)	ingestion	rumination	rest	other_act	over_act	standing_up
FR1536006637	AX0042R	14/06/2019 08:30	1	0	0	0	0	1
FR1536006637	AX0042R	15/06/2019 00:05	0	0	1	0	0	0
FR1536006637	AX0042R	15/06/2019 15:10	0	1	0	0	0	0
FR1536006637	AX0042R	15/06/2019 20:15	0	0	0	1	0	1

We do not need knowledge on accelerometers nor to develop our own algorithms if the ones developed by Medria are good

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Statistical analysis

Is the device able to detect accurately the different activities ?
→ Precision, Accuracy, F-Score

| Accurate Precise | Not Accurate Precise | Accurate Not Precise | Not Accurate Not Precise |
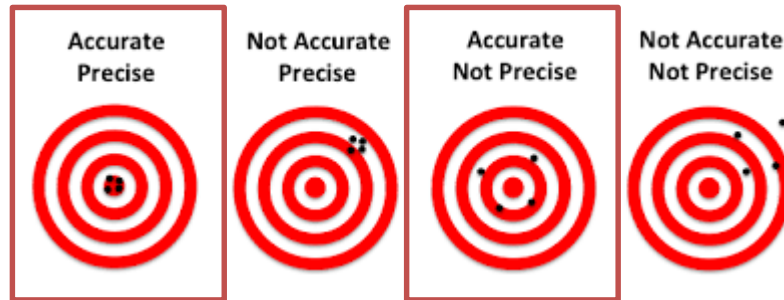
F-score is more relevant when true negative rate is high

Is the device relevant to study time-budget ?
→ Linear regressions

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Results (1)

	Grazing	Ruminating	Resting	Standing
Accuracy	85,25%	89,26%	89,81%	83,40%
Precision	96,32%	66,06%	54,29%	89,28%
F-score	0,88	0,71	0,89	0,59
	🎯	🎯	🎯	🎯

During observation period :

- cows spent most of the time grazing → TN rate is low → Accuracy

- cows spent few time resting → TN rate is high → F-score

Results (2)
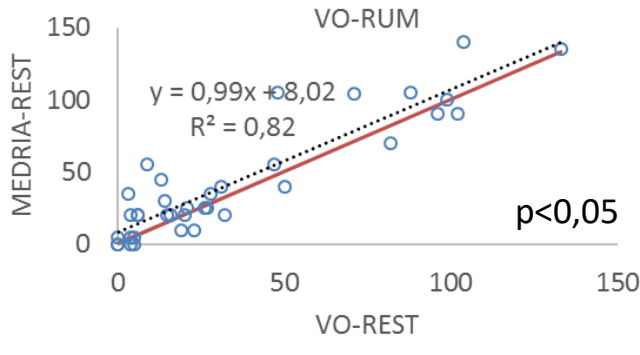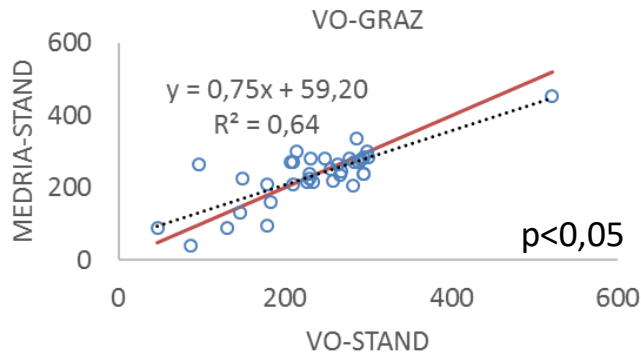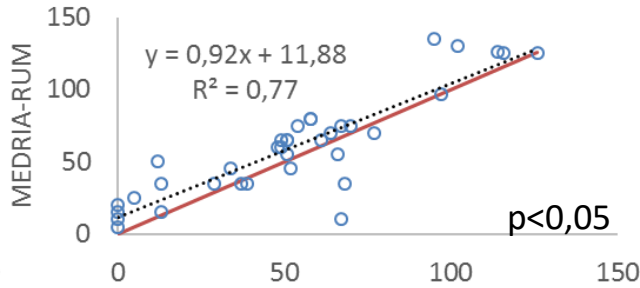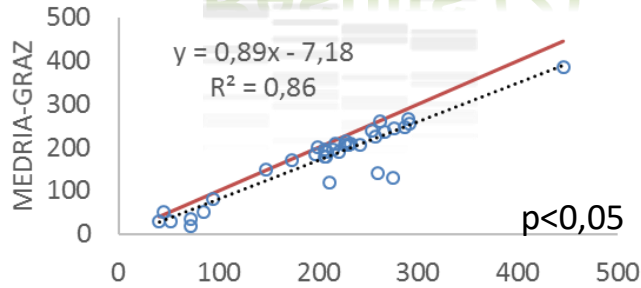
Relationship between day basis individual cow observations (VO) and Medria data (MEDRIA) durations for the 4 studied behaviours. Solid red lines represents Y=X

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Results (3)

Gathering individual time-budget data in a mean herd activity

→ improvement of the agreement between the two techniques

R^2	Individual	Herd (6 cows)
Grazing	0,86	0,92
Ruminating	0,77	0,92
Resting	0,82	0,86

Discussion

Other results found in literature are slightly better but these experiments aimed at calibrating specific models from raw data to detect a given behaviour

Author	Activity	Sens.	Spec.	Prec.	Accur.
Nilsen (2013)	Grazing	85%	82%	78%	
Martiskaïen et al. (2009)	8 ≠ activities				>80%

Author	Activity	R^2 (/cow/day)	R^2 (/day)
Rayas-Amor et al. (2017)	Grazing	0,96	0,96
	Ruminating	0,95	0,91

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Conclusion

Axel Medria ® is a simple way to acquire accurate and precise data on grazing, ruminating and resting times and posture on dairy cows'.

It allows to study easily dairy cows' behaviour over a long time, in large groups of animals, with very low constraints.

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Thank you for your attention

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Example

Massive heat wave in France in late June

→ How does temperature influence dairy cow behaviour at pasture ?

Study on 30 grazing primiparous Holstein

- 45 min rest

+ 1 hour rumination

Legend: ING (blue), RUM (red), REST (green), OTHER (purple), TEMP (line)

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