Validation of RumiWatch sensors: a confusion matrix approach

Salla Ruuska[1,2], Sara Mämmi[1], Sari Kajava[2], Mikaela Mughal[1] and Jaakko Mononen[1, 2]

[1]University of Eastern Finland, Finland

*[2] Natural Resources Institute Finland (Luke), Finland*

THE THIRD DAIRYCARE CONFERENCE, ZADAR, CROATIA OCTOBER 5TH AND 6TH 2015

UEF // University of Eastern Finland

RumiWatch is a pressure sensor based system measuring eating, ruminating and drinking time of cattle.

- RumiWatch (Itin+Hoch GmbH, Switzerland) validation against continuous behaviour recording (CR) (Experiment 1)

  – random coefficient regression model and paired t-test

    → random and systematic errors

- In addition, eating time measured by RWS was compared with the visiting time at automated feeders (Experiment 2)

Lilli Frondelius/MTT
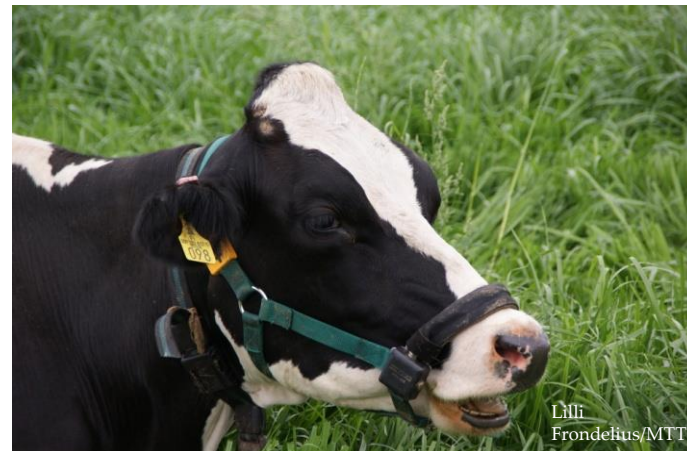
Manuscript under revision!

Our regression line approach showed that

- The RWS measurements were relatively free from random errors for rumination and eating but not for drinking.

- There was systematic error for eating and drinking.

We used confusion matrix for validation to find out what kind of erroneous classifications RWS makes.

- Sensitivity: the proportion of positives that are correctly identified as such
  - true positives / (true positives + false negatives)
- Precision: the proportion of the true positives against all the positive results
  - true positives / (true positives + false positives)

Two trained observers recorded eating, ruminating and drinking bouts by continuous recording from video-recordings and these measures were compared to RWS classifications second by second.

- Data consisted of 34 h
  - Five dairy cows in tied stalls
  - From three to nine hours per cow
- Sub data of the validation study
  - Preliminary analysis with limited data!

Sari Kajava / MTT

RWS measured eating time little more reliably than rumination time (sensitivity). On the other hand, RWS misclassified other four behaviours more to eating than to rumination (precision).

	Sensitivity	Precision
Eating	90.3 %	48.6 %
Ruminating	82.7 %	87.3 %
Drinking	3.4 %	2.4 %

Sensitivity: the proportion of positives that are correctly identified as such

Precision: the proportion of the true positives against all the positive results

The results are consistend with our previous results!

Validation of RumiWatch sensors / Ruuska et al.

A confusion matrix for eating, ruminating, drinking, "other behaviours" and "behaviour resembling eating".

Overestimation of eating

		Gold standard				
		Eating	Ruminating	Drinking	Other	Resembling eating
RWS	Eating	**20716**	3002	862	6972	11043
	Ruminating	2044	**21248**	3	860	190
	Drinking	43	0	**43**	1316	368
	Other	143	1453	354	**49226**	2514

Eating is some times classified as ruminating

Drinking is difficult to measure

LUKE
NATURAL RESOURCES
INSTITUTE FINLAND

RWS classified eating and rumination, but not drinking, reasonably well.

Overestimation of eating

		Gold standard				Resembling eating
RWS	Eating					11043
	Ruminating					190
	Drinking					368
	Other	143	1453	354	**49226**	2514

The detailed information of RWS misclassifications can be used in the further development of the system.

Eating is some times classified as ruminating

Drinking is difficult to measure

Luke
NATURAL RESOURCES
INSTITUTE FINLAND