

Monitoring fattening pig's behaviour by RFID registrations

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Introduction

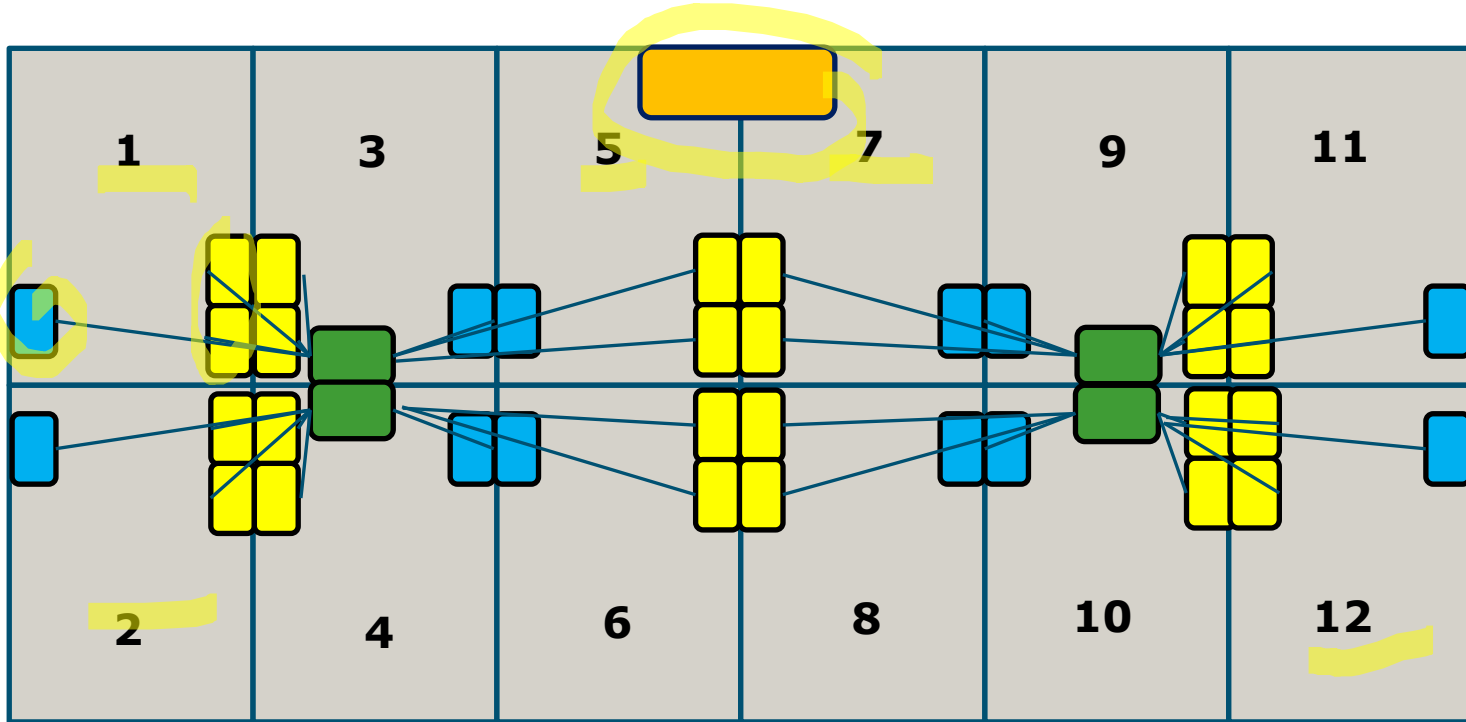
- RFID identification used to certify antibiotics-free meat production
- RFID identification can also be used for monitoring!? Added value!
- Previous research in pen with 12 weaned pigs (2 rounds):
good correspondence between tag readings and animal behaviour
- Current research 12 pens with 12 pigs
- RFID recordings at one drinker and two feeders in each pen
- Recordings can be used for individual monitoring of pigs?



Pictures of the experiment



Layout of barn



4 readers,
each with 8
antennas



feeder



drinker



reader with
antenna



weighing
platform



Setup of experiment

- Fattening pigs from start fattening till slaughter (July – Oct. 2020)
- Each pig: LF RFID (right ear)
- Weight recordings from one weighing platform (anonymously)
- Climate data (temperature, RH, CO₂, NH₃)
- Reference weight recordings (once a month)
- Video recordings for validation
- Treatments and other management data



Data processing

- Tag readings: one csv file per reader per day with each line: identification, time stamp, antenna number
- Tag readings combined in visits if interval less than 20 seconds (Maselyne et al., 2016)
- Visits combined in meals if interval less than 14 minutes (Tolkamp & Kyriazakis, 1999)



Data processing

Three types of readings/visits/meals:

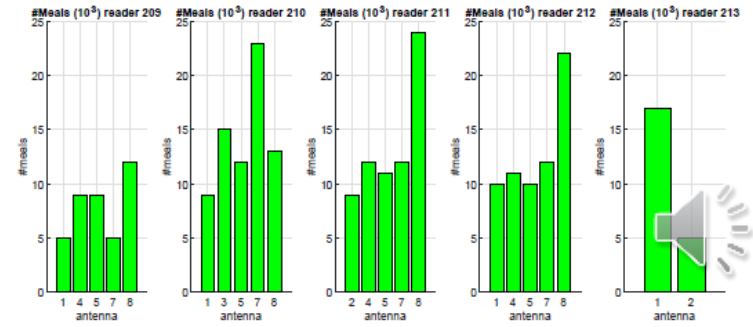
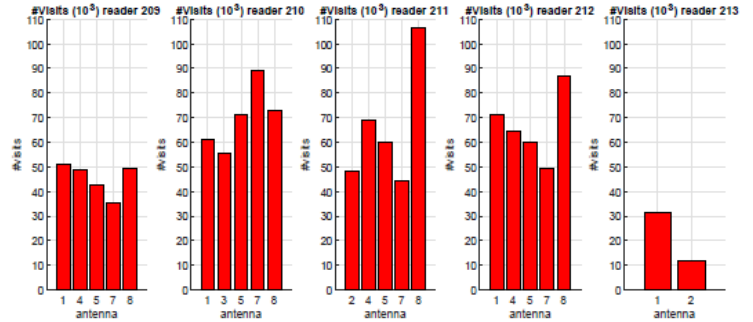
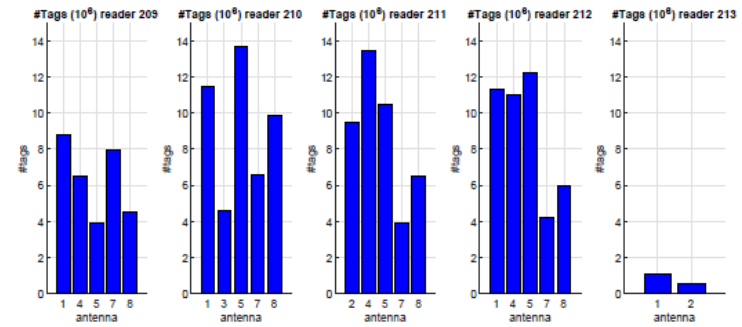
- Drinking
- Eating (2 feeders combined)
- Weighing (only in combined pen)



Readings/visits/meals

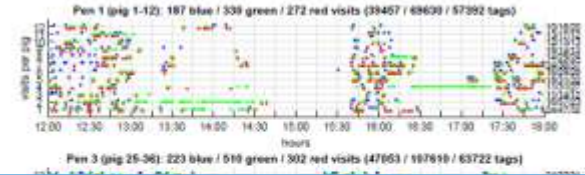
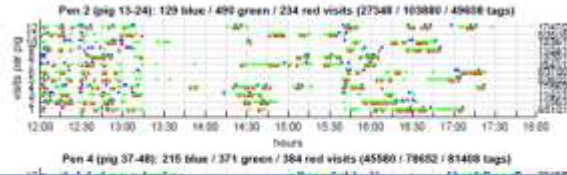
Different scale for numbers per antenna:

- 0-14 million for readings
- 0-110 thousand for visits
- 0-25 thousands for meals



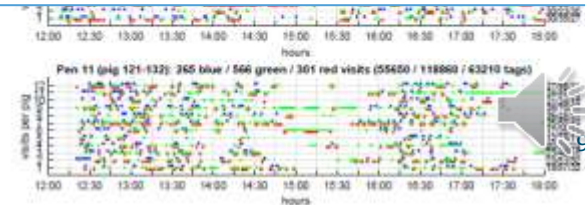
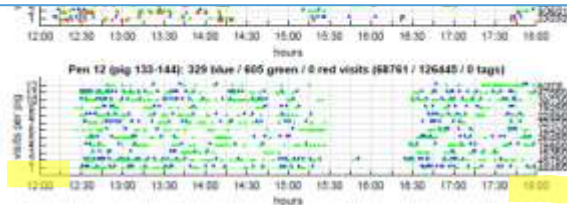
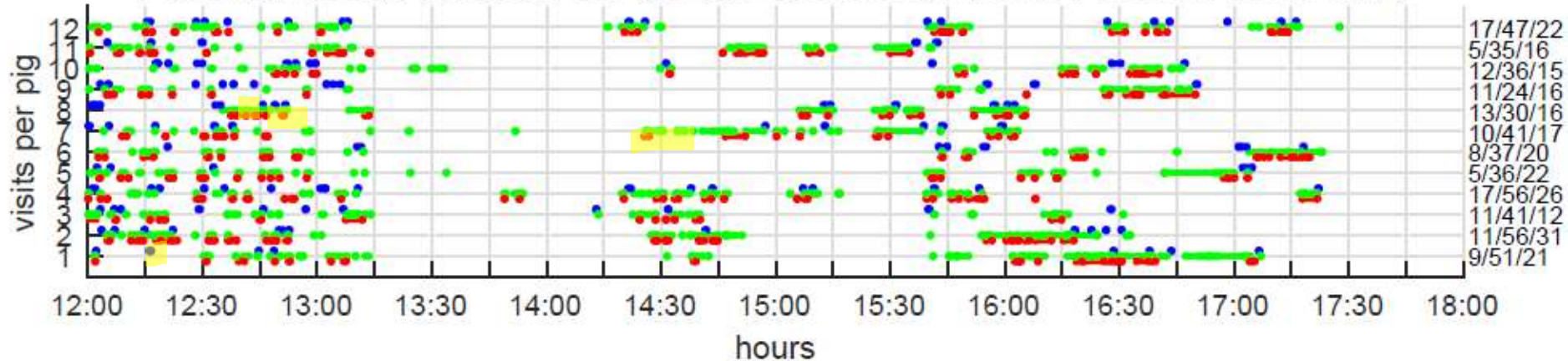
Readings combined in visits (interval ≤ 20 sec)

Cycle 1 Start/end of visits during the Afternoon on day 71: Wednesday 11 March 2020
2934 blue visits = water / 5948 green visits = feed / 3587 red visits = feed (617190 / 1251634 / 755440 tags)



Graph of all visits

Pen 2 (pig 13-24): 129 blue / 490 green / 234 red visits (27348 / 103880 / 49608 tags)



Analysis per pig

In further analysis:

- two feeders combined into one type
- visits combined in meals

Predict daily level of:

- number of meals
- average interval between meals
- maximum interval between meals

Analysis per pig

- Predict daily level with statistical model
- Alerts when difference between predicted and real level is too big
- Analysis of alerts in case of culling / treatment:
 - sensitivity = percentage of detected cases
 - specificity = percentage of healthy days without alert

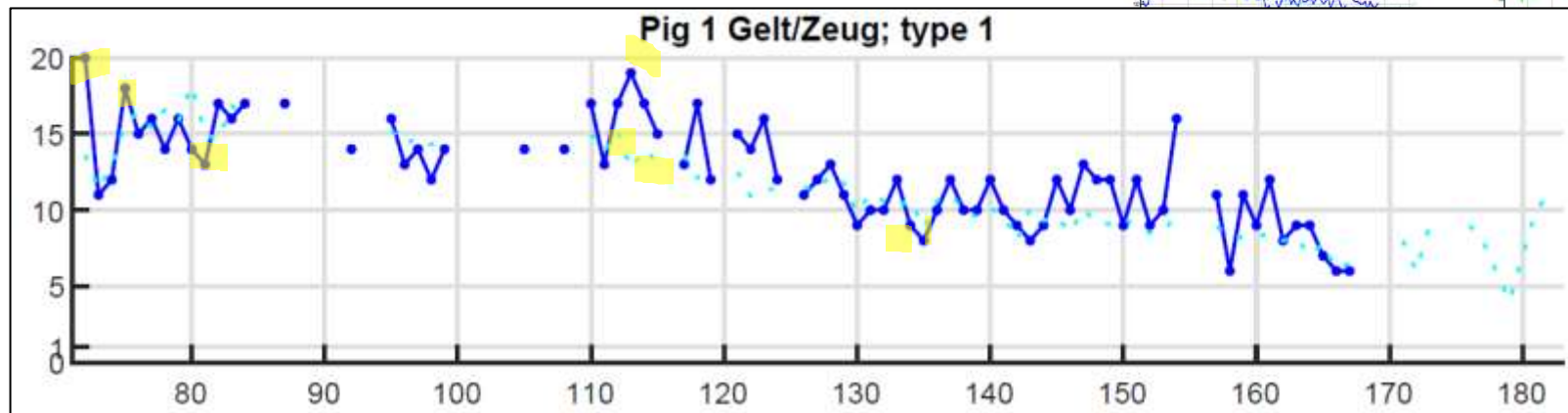
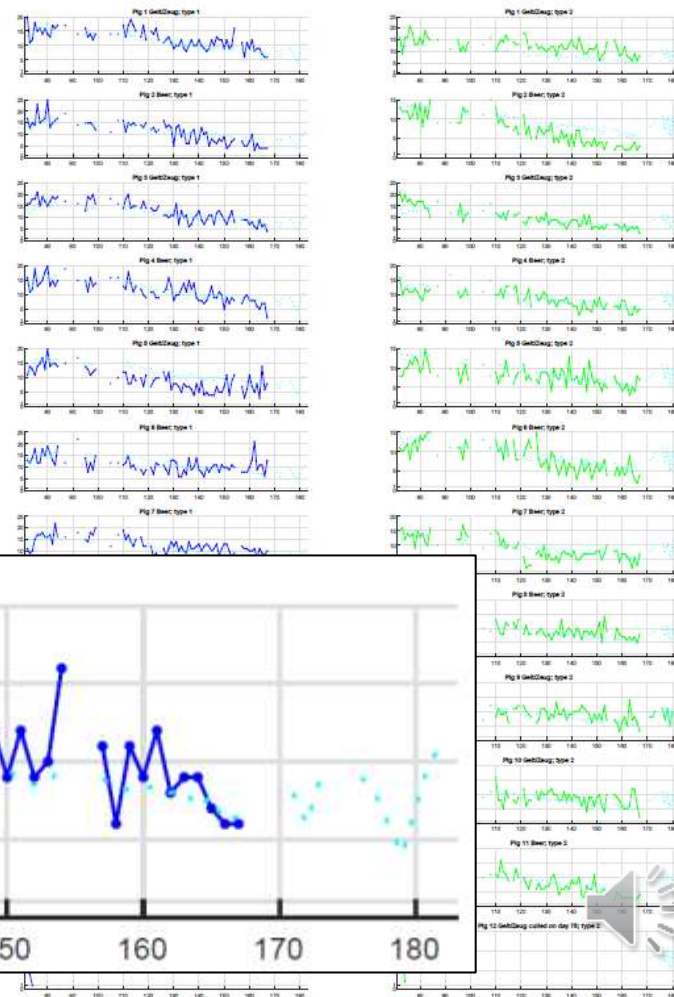
blue = water, green = feed; day = number of day in 2020

Analysis per pig

Per pen per pig:

Per day:

- left: blue = type 1 = drinking
 - right: green = type 2 = eating
- dotted line = pen average



Prediction model

- Per pig per type per day:

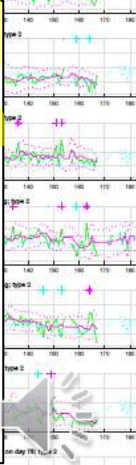
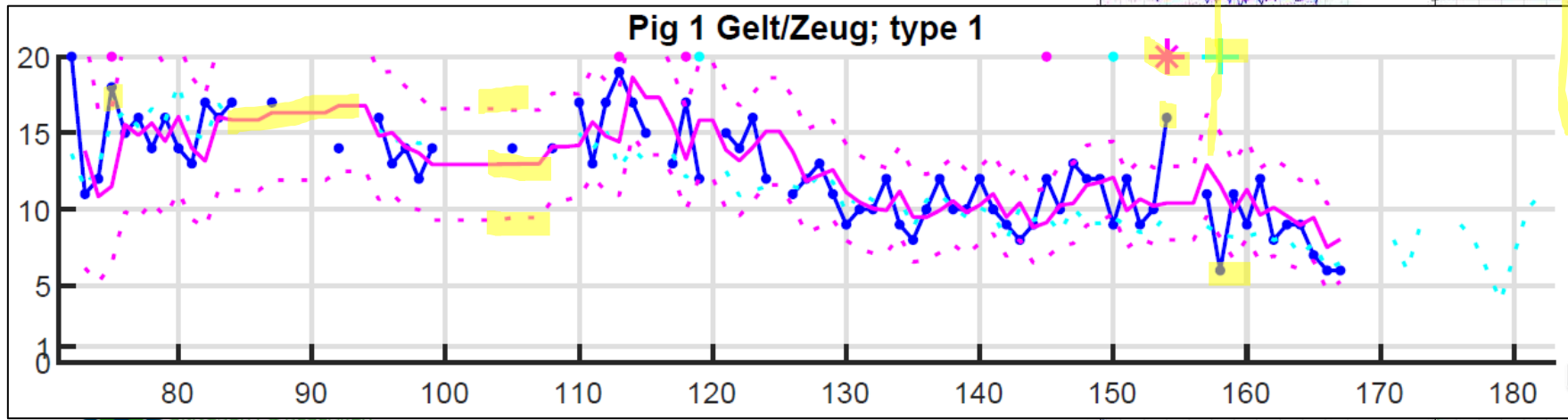
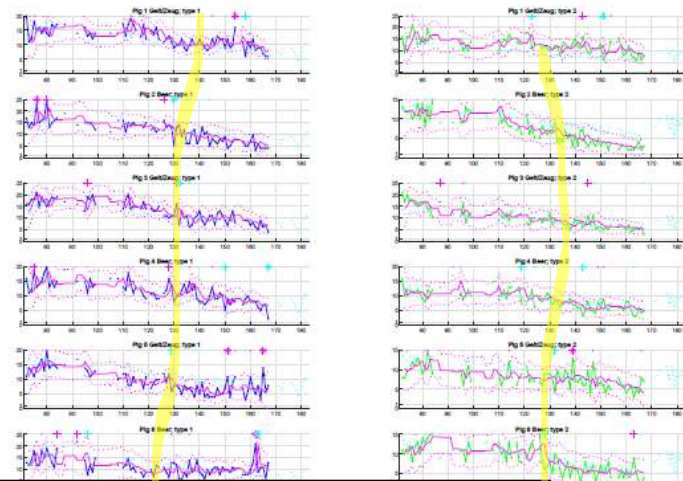
$$\text{Value}(\text{today}) = \alpha_1 + \alpha_2 \cdot \text{Value}(\text{day-1}) + \alpha_3 \cdot \text{Value}(\text{day-2}) + \alpha_4 \cdot \text{AvgValue}(\text{today})$$

Parameters α_1 , α_2 , α_3 and α_4 fitted on-line with Kalman filter:

- Fitted values
- Confidence intervals
- Alert when value outside confidence interval

Monitoring per pig

- magenta line = fitted value
- dotted line = confidence interval
- alerts: dot, cross, asterisk = outside 95%, 99%, 99.9% confidence interval



Sensitivity & specificity for number of meals

Sensitivity

* = outside 95%
 ** = outside 99%
 *** = outside 99.9%
 confidence interval

	case 1	case 2	case 3	case 4	case 5
type 1	*	**	*	***	-
type 2	**	***	*	*	**
type 3	n/a	**	**	n/a	n/a
	begin		missing	missing	missing

Specificity

		confidence interval		
	valid days	95%	99%	99.9%
type 1	9380	94.6%	98.4%	99.6%
type 2	9115	95.4%	98.8%	99.7%
type 3	2245	94.7%	97.9%	99.5%

Discussion

- Sensitivity high enough(?)
- Special circumstances: culling after a few days / missing data
- Similar sensitivity for average interval and maximum interval but lower specificity
- Specificity is high(?) but not high enough for practical application?
- Analysis of treatments:
 - to be combined with cullings
 - in most cases decreased number of visits, increased interval

Conclusions

- RFID also useful for monitoring of individual behaviour
- Visiting patterns in feeding and drinking are relevant for monitoring on individual and group level
- Individual pattern strongly influenced by group level



Thank you!

